

Action Collaborative on Traumatic Brain Injury Care: Adapted Clinical Practice Guideline

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ABSTRACT

Outpatient follow-up care for traumatic brain injury (TBI) is inconsistent. The Action Collaborative on TBI Care, convened under the auspices of the National Academies of Sciences, Engineering, and Medicine, aimed to standardize management with a clinical practice guideline. The guideline is intended for community-dwelling adults with TBI who are able to care for themselves at hospital discharge or who did not require acute hospital care. Guideline topics were selected and prioritized with input from individuals with lived experience and clinicians. Existing evidence-based clinical practice guidelines ($k = 18$) were identified from systematic literature reviews. Recommendations for each priority topic were extracted from existing guidelines and synthesized using the ADAPTE process. Strength of evidence ratings were assigned based on the American Academy of Family Physician's adaptation of GRADE (Grading of Recommendations, Assessment, Development, and Evaluations) through consensus voting. A draft guideline underwent external review by 20 health professional and brain injury organizations. The Action Collaborative on TBI Care guideline provides recommendations for 11 priority topics: (1) confirm the diagnosis; (2) determine whether emergency department evaluation is required; (3) request neuroimaging and neuropsychological assessment when indicated; (4) screen for social determinants of health; (5) provide guidance on return to usual activities; (6) educate the patient and family; (7) assess for risk of persistent symptoms; (8) prioritize which symptoms to target first; (9) initiate treatment for posttraumatic headache; (10) screen and initiate treatment for mental health disorders; and (11) decide if and when to refer to specialty care.

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PREAMBLE

The National Academies of Sciences, Engineering, and Medicine (NASEM), established a Forum on Traumatic Brain Injury (TBI) and an associated Action Collaborative on TBI Care in 2022 to implement recommendations from their *Traumatic Brain Injury: A Roadmap for Accelerating Progress* report.¹ The Action Collaborative on TBI Care formed Working Groups in December 2022. One of these Working Groups, the Clinical Practice Guideline (CPG) Working Group, was tasked with synthesizing a set of high priority evidence-informed clinical management strategies for outpatient TBI.

Need for a Guideline

Each year, at least 50 million people worldwide sustain a traumatic brain injury, costing the global economy \$400 billion.² Even TBI that does not require hospital admission can result in long-lasting symptoms and disability.³⁻⁵ Inadequate follow-up care is considered an important contributor to poor TBI outcomes.^{1,2} Fewer than one-half of patients with TBI see a physician after leaving the emergency department (ED)⁶⁻⁸ and those who do have highly variable care pathways.⁸⁻¹¹ NASEM's 2022 report¹ highlighted the essential role of CPGs to "reduce unwarranted variability and gaps in administrative and clinical care guidance to ensure high-quality care for TBI." They acknowledged that CPGs have been developed for pre-hospital and acute management of severe TBI,¹² including disorders of consciousness¹³ as well as for management of concussion/mild TBI in children¹⁴ and sport¹⁵ and military¹⁶ settings. However, no CPGs could be applied uniformly to adults with TBI who are discharged home from acute care without follow-up services or do not present for acute hospital care. To address variability in post-acute outpatient TBI care, NASEM's 2022 report¹ specifically recommended synthesizing existing CPGs for

this population. They further recommended a rigorous consensus-based approach where evidence was lacking.

Scope and Purpose

The objective of this guideline is to improve outpatient management of community-dwelling adults with TBI who are able to care for themselves at hospital discharge (including those discharged directly from the emergency department) or who did not require acute hospital care ([Box 1](#)). The TBI could have been of any severity, but many of these individuals will have had an initial Glasgow Coma Scale score of 13-15 and could be classified as having a “mild” TBI,¹⁷ but the Action Collaborative on TBI Care opted to follow the recommendation to de-implement the traditional tripartite (mild/moderate/severe) classification system by NASEM¹ and the National Institutes of Health TBI classification initiative.¹⁸ The rationale for an updated TBI classification system included recognition of heterogeneity within the “mild” category and patient perceptions of the term “mild” as trivializing.¹ The guideline is intended to apply to adults with TBI from any cause (eg, falls, motor vehicle crashes, assaults), occurring in any setting (eg, home, community, workplace, recreation). Considerations for special populations (older adults, survivors of intimate partner violence, athletes, military service members) are provided below. The guideline is not intended to inform the care of patients with progressive neuropsychiatric symptoms potentially associated with chronic neurotrauma exposure.

The guideline offers priority recommendations for health professionals to implement in an outpatient setting, primarily over the first 6 months following injury. Recommendations cover assessment, education, referrals, and treatment initiation in the first and subsequent few outpatient visits. Efforts are underway to prepare evidence-based guidance for long-term management of patients with persisting symptoms based on a chronic disease management approach.¹⁹ The guideline does not cover prehospital or acute hospital care but recognizes the essential role that emergency department clinicians play in directing/connecting patients to follow-up care. The Action Collaborative views the guideline as covering foundational elements of quality follow-up TBI care. Optimal post-acute TBI care includes timely delivery of all recommendations in this guideline, if appropriate for a given patient, and potentially additional interventions, as needed. Many patients with TBI not requiring hospitalization recover fully within days to weeks, such that few of the recommendations in this guideline apply.

Target Users

The guideline is intended to be used by health care professionals in primary care, as these clinicians are the most likely to assess and manage patients with TBI after they are discharged home from hospital and make referrals to specialty TBI care.^{1,6,20} Many patients with TBI do not visit an emergency department and instead present directly to primary

care.²⁰ The guideline is also intended to direct initial assessments and first-line treatments (“first steps”) by specialty care providers and TBI/concussion clinics, if not already done in primary care. The guideline does not provide comprehensive recommendations for ongoing specialty care, such as how to manage symptoms that have not responded to first-line treatments. Clinicians working in settings that exclusively treat athletes (eg, sports medicine clinics) or service members (eg, military hospitals) should consult guidelines specific to those settings.^{15,16} Certain recommendations may be outside the scope of practice for certain health care professionals. When this occurs, referral or informal support with navigating access to appropriate care is recommended.

Guideline Development Methods

The CPG Working Group followed the ADAPTE process, a systematic approach to adapting existing CPGs for a different context, described in the ADAPTE Manual and Resource Toolkit.²¹ The Group also consulted recommendations by other expert groups for CPG development best practices,^{22,23} including recommendations for achieving health equity in guideline development.^{24,25} Our methodology for each step in the ADAPTE process is described below, including details recommended in the RIGHT (Reporting Items for practice Guidelines in HealThcare)-Ad@pt Checklist.²⁶

Box 1. Summary

Who: Health care professionals treating adults with traumatic brain injury (TBI) who required only brief or no hospital care

What: Priority recommendations for clinical management including to:

1. Confirm the diagnosis
2. Determine whether emergency department evaluation is required
3. Request neuroimaging and neuropsychological assessment when indicated
4. Screen for social determinants of health
5. Provide guidance on return to usual activities
6. Educate the patient and family about TBI recovery and self-management
7. Assess for risk of persisting symptoms
8. Prioritize which symptoms to target first
9. Initiate treatment for post-traumatic headache
10. Screen and initiate treatment for mental health disorders
11. Decide if and when to refer to specialty care

Where: Community primary care settings and specialty TBI/concussion clinics

When: First 6 months following TBI

Why: To reduce care variability through the post-acute period and improve outcomes

How: Guideline topics were selected and prioritized with input from individuals with lived experience and community clinicians.² Recommendations for each priority topic were extracted from existing evidence-based clinical practice guidelines and harmonized using a systematic adaptation process.¹³

1. Creation of the Working Group

The CPG Working Group chairs (N.D.S., K.L.) were selected by the Action Collaborative on TBI Care lead (G.T.M.). Members of the Action Collaborative on TBI Care self-selected into Working Groups. The chairs then invited additional members to improve representation (career stage, geographic location, gender, race, professional discipline, and areas of expertise) and ensure target users (eg, primary care physicians) were included. Members of the finalized Working Group are listed in the [Supplemental Appendix](#), in alpha order.

CPG Working Group members were asked to report any potential conflicts of interest that may be perceived as relevant to the guideline development process, including financial interests or relationships with commercial entities whose medications, products, or services could be mentioned in the guideline. Their conflict declarations were shared with the group so that CPG Working Group members could consider others' interests in deliberations. Their declarations are available in the [Supplemental Appendix](#).

The CPG Working Group and Action Collaborative on TBI Care included people with TBI lived experience as equal members. As described below, the priority setting phase also involved a sample of 112 TBI survivors and caregivers.

2. Identification of Existing Guidelines

In line with the NASEM report,¹ the CPG Working Group made the early decision to systematically search for and synthesize existing CPGs rather than create one anew. The eligibility criteria, systematic search strategy, search results, and process for reviewing records have been reported in detail elsewhere.²⁷ In summary, the search yielded 17 eligible CPGs and 1 consensus statement¹⁵ that did not self-identify as a CPG but was considered one for the present purpose. These CPGs are listed in [Table 1](#), in publication year order.

3. Evaluation of Existing Guidelines

Eligible CPGs were independently rated by 2 CPG Working Groups members with the Appraisal of Guidelines for Research & Evaluation (AGREE II) tool²⁸ in October–November 2023. Working Group members entered their ratings (1–7 scale) for each of the 23 AGREE II items and an overall quality assessment. The 23 items map on to 6 domains. Inter-rated consistency was good, with overall quality scores falling within ± 2 points for the pair of raters for 16 of the 18 CPGs. The 2 exceptions were the “Nonpharmacological treatments for psychological and behavioural disorders following traumatic brain injury” and “Management of patients suffering from mild traumatic brain injury.” In these instances, a third rater was recruited and the scores for all 3 raters were averaged. The AGREE II overall quality ratings for eligible CPGs are included in [Table 1](#). [Figure 1](#) shows the profile of AGREE II domain scores for each CPG.

4. Priority Setting Process to Identify Topics

The CPG Working Group extracted topics from existing CPGs and identified 73 unique topics covered across the 18 eligible CPGs. They then conducted prioritization surveys with people with lived experience ($n = 112$) and clinicians in the community ($n = 99$) and integrated the survey findings into a consensus-based top priority 10 topics. These procedures and findings are described in more detail elsewhere.²⁷

5. Synthesis of Recommendations from Existing Guidelines

The CPG Working Group transformed each topic identified in the priority setting phase into a recommendation over a series of live (videoconference) meetings 1–2 times per month between June 2023 and December 2024. In preparation for each meeting, abstracted sections of each eligible CPGs relevant to the topic were assembled and shared with members, with page/section locators and strength of evidence ratings. These materials are reproduced in the [Supplemental Appendix](#). Recommendations were drafted and revised during meetings, typically with further revisions (to integrate comments raised in meetings) by the CPG Working Group chairs in between meetings. Source CPGs synthesized into each recommendation are noted with superscript letters, corresponding to the CPGs in [Table 1](#).

CPG Working Group members were instructed to synthesize recommendations from existing CPGs according to the following instructions, based on the ADAPTE manual²¹ for adapting existing clinical practice guidelines for a specific context:

- Recommendations from existing CPGs can be adopted “as is” if appropriate for the scope and intended uses of the new guideline
- Recommendations from existing CPGs can be reworded to better align with the scope and intended uses of the new guideline
- Recommendations from existing CPGs can be modified based on new evidence but supporting evidence must be cited
- Recommendations cannot be changed “to such an extent that they are no longer in keeping with the evidence upon which they should be based”²¹
- When discrepancies between existing CPGs exist, members should prioritize higher quality CPGs (higher AGREE II ratings of overall quality)

Based on desirable characteristics of guideline recommendations described in AGREE II,²⁸ CPG Working Group members were further instructed to write recommendations that:

- are concrete, precise, and concise
- have an explicit intent or purpose (eg, to improve a particular outcome or decrease the risk of an adverse event)
- clearly identify who the recommendation is appropriate for (population and setting)
- include caveats or qualifying statements where relevant (eg, patients for whom the recommendation would not apply)
- reflect uncertainty in the body of evidence

Table 1. Final Set of Eligible Clinical Practice Guidelines and Quality Ratings

	Title	Year	Organization	Country	AGREE II
a	Living Concussion Guidelines: Guideline for Concussion & Prolonged Symptoms for Adults 18 Years of Age or Older	2023*	Ontario Ministry of Health	Canada	5.5
b	Head Injury: Triage, Assessment, Investigation and Early Management of Head Injury in Children, Young People and Adults	2023	National Institute for Health and Care Excellence	United Kingdom	5.0
c	Consensus Statement on Concussion in Sport: the 6th International Conference on Concussion in Sport—Amsterdam	2023	Concussion in Sport Group	International	5.5
d	Occupational Therapy Practice Guidelines for Adults With Traumatic Brain Injury	2023	American Occupational Therapy Association (AOTA)	United States	6.0
e	Clinical Policy: Critical Issues in the Management of Adult Patients Presenting to the Emergency Department with Mild Traumatic Brain Injury	2023	American College of Emergency Physicians (ACEP)	United States	6.5
f	Management of Patients Having Mild Traumatic Brain Injury	2022	Société Française de Médecine d'Urgence and Société Française d'Anesthésie et Réanimation (SFMU/SFAR)	France	4.0
g	Nonpharmacological Treatment of Persistent Postconcussion Symptoms in Adults: A Systematic Review and Meta-analysis and Guideline Recommendation	2021	Danish Health Authority	Denmark	5.0
h	Clinical practice guideline: Management and Rehabilitation of Post-Acute Mild Traumatic Brain Injury	2021	Veterans Affairs/Department of Defense (VA/DoD)	United States	6.5
i	Transcranial Magnetic Stimulation for Pain, Headache, and Comorbid Depression: INS-NANS Expert Consensus Panel Review and Recommendation	2020	International Neuromodulation Society and North American Neuromodulation Society (INS-NANS)	United States	5.0
j	Physical Therapy Evaluation and Treatment After Concussion/Mild Traumatic Brain Injury	2020	Academy of Orthopedic Physical Therapy, American Academy of Sports Physical Therapy, Academy of Neurologic Physical Therapy, and Academy of Pediatric Physical Therapy of the American Physical Therapy Association	United States	7.0
k	Evidence-Based Cognitive Rehabilitation: Systematic Review of the Literature From 2009 Through 2014	2019	American Congress of Rehabilitation Medicine	United States	5.0
l	Nonpharmacological Treatments for Psychological and Behavioral Disorders Following Traumatic Brain Injury. A systematic literature review and expert opinion leading to recommendations	2016	SOFMER French Society of Physical Medicine and Rehabilitation	France	4.3
m	Behavioral and Affective Disorders After Brain Injury: French Guidelines for Prevention and Community Supports	2016	SOFMER French Society of Physical Medicine and Rehabilitation	France	5.0
n	The Evaluation of Behavioral Changes in Brain-Injured Patients: SOFMER Recommendations for Clinical Practice	2016	SOFMER French Society of Physical Medicine and Rehabilitation	France	5.5
o	Drugs for Behavior Disorders After Traumatic Brain Injury: Systematic Review and Expert Consensus Leading to French Recommendations for Good Practice	2016	SOFMER French Society of Physical Medicine and Rehabilitation	France	5.5
p	Development of Clinical Recommendations for Progressive Return to Activity After Military Mild Traumatic Brain Injury: Guidance for Rehabilitation Providers	2015	Office of the Army Surgeon General and Defense and Veterans Brain Injury Center	United States	6.0
q	Brain Injury Rehabilitation in Adults: A National Clinical Guideline	2013	Scottish Intercollegiate Guidelines Network (SIGN)	Scotland	5.5
r	Summary of Evidence-Based Guideline Update: Evaluation and Management of Concussion in Sports	2013	American Academy of Neurology	United States	6.5

AGREE = Appraisal of Guidelines for Research & Evaluation II²⁸ overall quality rating, from 1 = lowest possible to 7 = highest possible, averaged between independent raters.

INS-NANS = International Neuromodulation Society and the North American Neuromodulation Society; SOFMER = Société Française de Médecine Physique et Réadaptation

*"Living" guideline updated on an ongoing basis.

CPG Working Group members were asked to consider whether recommendations were implementable in primary care and outpatient TBI clinic settings whenever possible.

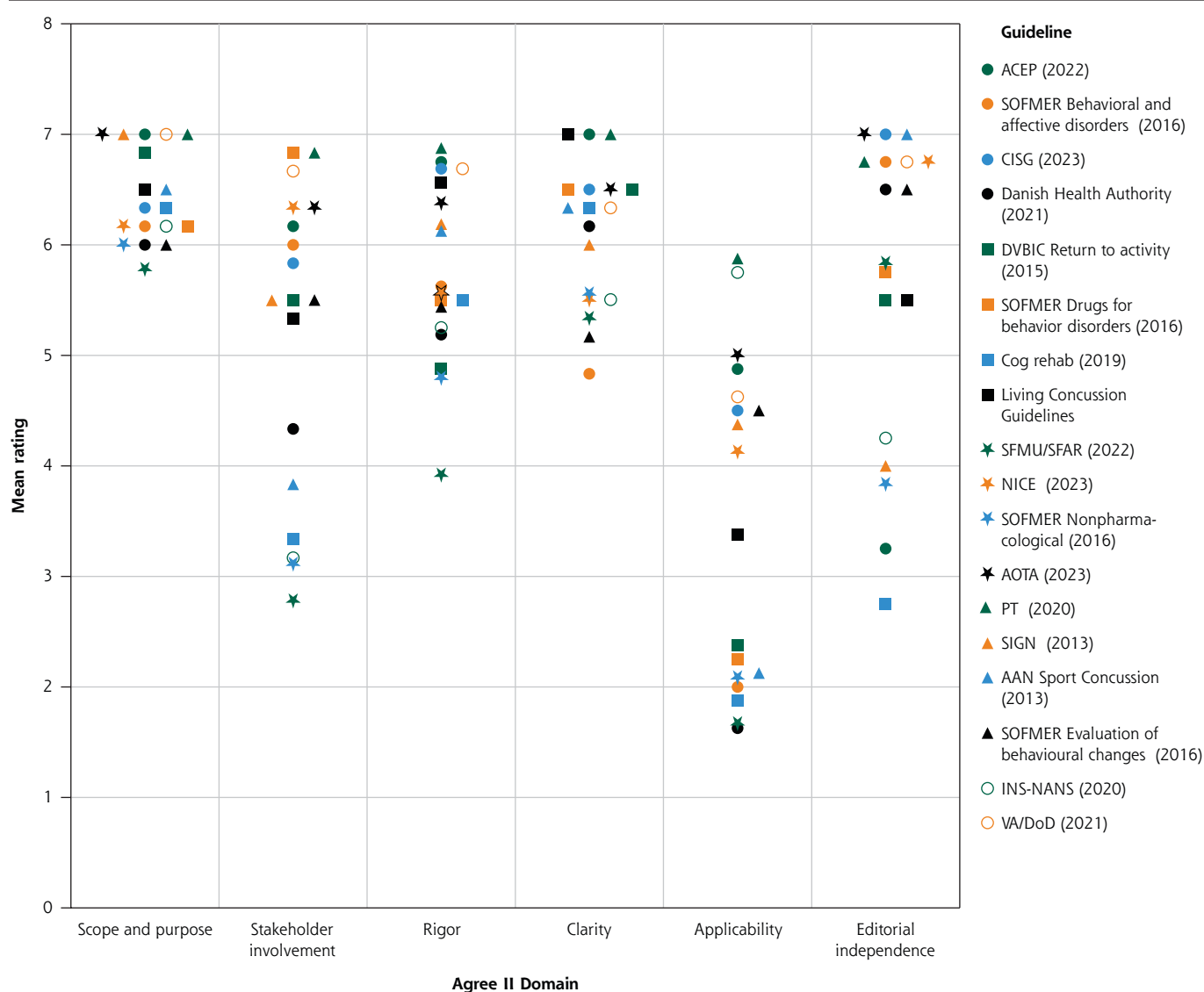
Recommendations typically integrated elements from multiple existing CPGs. When a draft recommendation was completed, the chairs called for a vote. A draft was approved when a quorum of ≥ 10 members of the CPG Working Group unanimously voted in favor during the relevant topic meeting, or by e-mail shortly after if there was no quorum at the meeting. Recommendations not achieving consensus were revised until consensus was reached (≥ 10 votes in favor, 0 opposed). Dissenting members enumerated their concerns, which were discussed by the full CPG Working Group until

there was no further dissent on the revised recommendation statement.

Because existing CPGs integrated into the current guideline used varying evidence classification systems, we reclassified the strength of recommendations according to the American Academy of Family Physician's adaptation of GRADE (Grading of Recommendations, Assessment, Development, and Evaluations).²⁹ This system has 3 levels:

- Strong for or against: Based on strong and consistent evidence. Clinicians should routinely follow this recommendation with most patients.
- Weak for or against: Based on relatively weak or inconsistent evidence. Clinicians should consider following

Figure 1. Scores for the Appraisal of Guidelines for Research & Evaluation (AGREE II) Tool



AAN = American Academy of Neurology; ACEP = American College of Emergency Physicians; AGREE = Appraisal of Guidelines for Research & Evaluation II; AOTA = American Occupational Therapy Association; CISG = Concussion in Sport Group; Cog Rehab = American Congress of Rehabilitation Medicine; DVBIC = Defense and Veterans Brain Injury Center; INS/NANS = International Neuromodulation Society/North American Neuromodulation Society; NICE = National Institute for Health and Care Excellence; PT = physical therapy; SIGN = Scottish Intercollegiate Guidelines Network; SOFMER = Société Française de Médecine Physique et Réadaptation; VA/DoD = Veterans Administration/Department of Defense

this recommendation if it aligns with the patient's preferences and values.

- Good practice: Clinical actions thought to be helpful on the basis of expert opinion, given a lack of direct evidence.

When the strength of recommendations was inconsistent across eligible CPGs, we synthesized strength ratings, giving preference to guidelines with higher AGREE II ratings. Final strength ratings were determined by consensus (>80% favoring a particular rating) in anonymous voting in a live meeting

Box 2. Questions Posed to External Reviewers

What are the strengths of the guideline?
 What are the weaknesses of the guideline?
 What modifications to the draft guideline are essential?
 How confident are you in the adaptation process (methodology) used to create the guideline? (Please respond on a scale from 1-10, where 10 means extremely confident)
 Do you agree that members of your organization should use the guideline in their clinical practice? (Please response on a scale from 1-10, where 10 means very strongly agree)
 What barriers might limit how much members of your organization use the guideline? Do you have any recommendations for reducing these barriers?
 How would the guideline impact or change current clinical practice or routines?

Box 3. Organizations Participating in the External Review Phase

American Academy of Clinical Neuropsychology (AACN)^a
 American Academy of Neurology (AAN)^{b,c}
 American Academy of Physical Medicine & Rehabilitation (AAPMR)^b
 American Academy of Family Physicians (AAFP)^b
 American College of Emergency Physicians (ACEP)^d
 American College of Surgeons (ACS)^b
 American Congress of Rehabilitation Medicine (ACRM)^b
 American Occupational Therapy Association (AOTA)^a
 American Physical Therapy Association (APTA)^b
 Association of Academic Physiatrists (AAP)^b
 Brain Injury Association of America (BIAA)^b
 Concussion in Sport Group (CISG)^b
 European Academy of Neurology (ENA) Neurotraumatology panel^b
 European Neurotrauma Organization (ENO)^b
 Headway
 International Brain Injury Association (IBIA)^a
 International Neurotrauma Society (INTS)^a
 National Association of State Head Injury Administrators (NASHIA)^a
 Neurocritical Care Society (NCS)^b
 US Department of Veterans Affairs (VA)^b

^a N/A: Not applicable. Organization does not endorse externally developed documents.

^b Organization endorsed the guideline.

^c Affirmation of quality.

^d Organization did not provide an endorsement decision.

on February 7, 2025 (see [Supplemental Appendix](#) for consensus process reporting). New recommendations on topics not covered in previous CPGs are explicitly labeled with the [^] symbol. All were rated as *Good practice* by default because our methodology did not involve a systematic search and grading of the primary evidence.

6. External Review

As recommended in the NASEM report,¹ federal agencies and professional organizations involved in guideline development were invited to review and provide feedback on a draft version of the guideline in February 2025. As recommended by ADAPTE,²¹ external reviewers were asked to provide structured feedback by responding to the questions listed in [Box 2](#).

We invited 23 organizations to participate in the external review phase. Of these, 2 did not reply and 1 (US Department of Health and Human Services) agreed to participate but could not complete their evaluation due to abrupt, unexpected staffing changes. Of the 20 organizations submitting a response ([Box 3](#)), 4 endorsed the guideline without suggesting revisions and 16 suggested revisions. Of the 20 participating organizations, 13 endorsed the guideline (indicated by "b"), either before or after revisions were made, 1 did not respond in time, and 5 did not have a mechanism for endorsement or have a general practice of not endorsing products developing by other organizations. The Working Group met twice in May 2025 to discuss the qualitative feedback. Revisions were drafted and circulated to the Working Group for approval. Thirteen organizations provided numerical ratings, with mean scores of 7.9 out of 10 (SD = 0.9) for confidence in the methodology and 7.1 (SD = 2.2) for agreement that the organization's members should use the guideline.

Recommendation 1. Confirming the Diagnosis of TBI

Recommendation: For patients seeking outpatient care following an incident that involved a plausible mechanism of TBI, qualified health care professionals should attempt to confirm or rule-out a diagnosis of traumatic brain injury based on the 2023 American Congress of Rehabilitation Medicine criteria (ACRM)¹⁷ (algorithm provided in the [Supplemental Appendix](#)) [*Strong for*]^{a,c,j,q}. The outcome of the diagnostic evaluation (and if appropriate, follow-up plans) may be clearly communicated to the patient [*Good practice*].

Context: The qualified health care professional can determine if a TBI likely occurred based on the acute care medical record and/or a clinical evaluation in the initial post-injury visit. As per the ACRM criteria, diagnosis is based on the plausibility of the injury mechanism, acute signs and symptoms, and as needed, physical examination. The diagnosis may be supported by validated objective tests of balance, cognition, and vestibular-oculomotor function and/or imaging and blood-based biomarker tests, if performed. Differential diagnosis should include consideration of potential confounding factors, including pre-existing and co-occurring health conditions that can mimic or mask TBI signs and

symptoms. If TBI is suspected but cannot be confirmed, for example, because there is missing information or prominent confounding factors, the ACRM position paper¹⁷ recommends that the patient be managed as if they had a TBI, including follow-up care as needed. If TBI is ruled out, the clinician should explain why to the patient. Patients with symptoms not attributable to TBI may still require clinical management appropriate for their condition. It is often helpful to involve a family member or care partner in the diagnostic evaluation, to provide additional information and because the patient may have difficulty remembering details of what they were told in an initial visit.

Rationale: Unless there is unequivocal evidence of TBI from a prior medical encounter (eg, emergency department assessment), diagnostic evaluation for TBI is an important first step. A TBI can be missed initially (eg, in the context of multiple trauma) or made erroneously by another provider, such as by failing to consider confounding factors for non-specific symptoms (eg, alcohol intoxication or psychological trauma). Multiple definitions of TBI are in clinical use and mentioned in existing guidelines. Based on the rigor of its development and its applicability across injury settings, the CPG Working Group favored the 2023 ACRM diagnostic criteria.¹⁷ Dropping the “mild” qualifier criterion allow the criteria to be used for TBI of any severity. These criteria require a differential diagnosis from other possible causes of observable or self-reported mental status changes. Consistent use of the ACRM definition will reduce variability in access to TBI care.

Resources: [ACRM diagnostic criteria](#)

Recommendation 2. Determining Whether Emergency Department Evaluation is Required

Recommendation: Patients should be (re)directed to an ED for urgent evaluation if they have any of the following [*Strong for*]^{a,b,c,f,h,j,q}:

- Declining or fluctuating level of consciousness
- New onset of: pupil asymmetry, focal neurologic abnormality, seizures, repeated vomiting, or marked change in behavior (eg, extreme agitation or lability)
- Severe or worsening headache
- Raccoon (panda) eyes, Battle’s sign, rhinorrhea/otorrhea, or other signs of undiagnosed skull fracture

Rationale: Delayed life-threatening complications of TBI in a patient who was discharged from hospital or did not present to hospital are rare but require vigilance. The above-listed signs and symptoms, when arising after or not documented in an ED visit, suggest that emergency medical assessments and procedures might be required (eg, correction of metabolic abnormalities or neurosurgical evacuation of an intracranial hematoma). Patients with a new onset or acute exacerbation of suicidality following TBI should be considered for ED referral, depending on the level of risk and their existing access to mental health clinicians (see also [Recommendation #10](#)). Consideration for non-urgent neuroimaging is covered in [Recommendation #3](#).

Context: Neurologic deterioration following a return to normal mental status (Glasgow Coma Scale score = 15) is uncommon, especially >24 hours following TBI. Less than 0.1% of patients discharged from the ED will need to be readmitted and require neurosurgery.^{30,31} Older adults³² and patients who leave the ED against medical advice³³ are at relatively higher risk of neurologic deterioration. Chronic subdural hematoma may develop slowly after TBI, manifesting after several weeks or even months with headache, hemiparesis, speech difficulties, gait abnormalities, and/or cognitive decline, typically in older adults or younger patients with a non-operatively managed subdural hematoma.³⁴ TBI increases the risk of suicidality, beyond the acute phase.^{35,36} Screening for suicidality should be prioritized for patients with risk factors (eg, high burden of post-concussion symptoms and/or comorbid depression).³⁷ While [Recommendation #2](#) lists the most common indications for return to the ED following TBI, the list is not exhaustive and health care providers should use their clinical judgment. For example, ED evaluation may also be required for patients who are at imminent risk of harm to themselves or others.

Resources: Clinical practice guidelines are available for ED management of TBI, such as from the [American College of Emergency Physicians](#) and the [National Institute for Health and Care Excellence](#).

Recommendation 3. Role of Neuroimaging and Neuropsychological Testing to Characterize the Effects of TBI

Recommendation: Health care professionals should not order a brain MRI or CT for every patient but may consider ordering a brain MRI or CT for those with atypical clinical features (eg, strongly positional headache or focal abnormality on neurologic screen examination) or symptom course (ie, progressive/worsening symptoms) [*Good practice*]^{a,h,q}. Referral for a formal neuropsychological assessment (or cognitive assessment by another provider if neuropsychology is not accessible) may be offered to inform planning for return to sport/school/work or guide treatment in patients with persisting (>1 month) cognitive symptoms (eg, poor concentration, slowed thinking, forgetfulness) that are disabling or not improving despite treatment for priority symptoms (see [Recommendation #8](#)) [*Good practice*]^{a,c,h}. When a patient/family requests neuroimaging or neuropsychological testing that is not clinically indicated, the health care professional should explain why the investigation is unlikely to alter clinical management [*Good practice*^].

Rationale: Most clinical practice guidelines only address the need for neuroimaging in an acute hospital setting (within 8 hours of TBI), where the focus is on identifying actionable (neurosurgical) lesions. Those that address post-acute use of neuroimaging focus on “atypical” presentations,^{38,39} and are based on expert consensus. The aim is not merely to document typical TBI pathology but rather to identify complications, such as delayed subdural bleeding, infarction, or

impaired cerebrospinal fluid flow. Atypical clinical features warranting neuroimaging in the post-acute phase can usually be identified with a screening neurologic examination, and may include a strongly positional, new, and/or rapidly worsening headache, delayed mental status deterioration (see [Recommendation #2](#)); aphasia, ophthalmoplegia, nystagmus concerning for central origin, facial weakness, or extremity weakness. Advanced neuroimaging techniques (eg, diffusion tensor imaging) are not currently recommended for clinical use.¹⁵ Clinical practice guidelines generally recommend against comprehensive neuropsychological assessment when patients are still recovering.^{16,39} Cognitive recovery can take 1-3 months following TBI with an initial Glasgow Coma Scale score of 13-15.⁴⁰ Cognitive recovery tends to be slower in more severely injured patients⁴¹ and faster in athletes with sport-related concussion.⁴⁰ Neuroimaging and neuropsychological testing are not necessary, and generally not done, to rule-in or out a diagnosis of TBI in the post-acute stage.^{16,17} Neuropsychological testing may be helpful <1 months post-injury to inform return-to-sport decisions.

Context: Many patients will have not received an acute head CT because there was no specific clinical indication in the ED⁴² or they did not seek care at an ED. Patients with typical “post-concussion” symptoms can be managed without neuroimaging. This recommendation is not intended to supersede clinical judgment about other reasons for ordering neuroimaging (eg, to reassure an anxious patient or when acute neuroimaging was indicated but not done). Current areas of controversy include using neuroimaging to refine prognosis^{18,43,44} and routinely investigate patients with persisting symptoms (>3 months).^{45,46} If neuroimaging reveals possible pathology the ordering physician is unfamiliar with, they could consider a referral to neurology or neurosurgery. Some patients will advocate for neuroimaging or neuropsychological assessment with no clear clinical indications.²⁷ Health care professionals should be prepared to engage in shared decision making⁴⁷ and explain circumstances that would warrant such investigations. Investigations other than neuroimaging and neuropsychological assessment may be indicated, but only these 2 were identified as priorities by patients/caregivers and clinicians in our priority setting study.²⁷

Recommendation 4. Screening for Social Determinants of Health

Recommendation: Health professionals should screen all patients with TBI for social determinants of health (SDoH), including but not limited to food, housing, and transportation insecurity, transportation needs, financial difficulties, employment-related concerns, migration status, and interpersonal safety [*Good practice*^]. Health professionals should consider relevant SDoH in individualized treatment planning (eg, ability to attend follow-up appointments and prescription medication coverage) [*Good practice*^]. The treatment plan should link to community resources to address unmet social needs [*Good practice*^]. Health professionals should consider

the possibility of abuse (eg, domestic violence) or neglect (eg, a fall in an older adult who lives alone with insufficient care) as a cause of or contributing factor to TBI, reflect on legal reporting requirements, and take safeguarding measures to prevent re-injury and/or victimization [*Good practice*].

Rationale: Addressing SDoH is essential in TBI management, as these factors significantly impact patients' ability to access and adhere to treatment. SDoH contribute to inequities in TBI incidence, care, and outcomes.^{48,49} SDoH may also be associated with higher rates of chronic conditions after TBI⁵⁰ and difficulty engaging in self-management behaviors.⁵¹ Structural drivers include housing instability,^{52,53} institutionalized racism,⁵⁴⁻⁵⁶ perceived racism or discrimination,^{48,57,58} and immigration status.⁵⁹⁻⁶¹ Socioeconomic position, including social class, gender, race, ethnicity, education, occupation, and income, as well as built and environmental factors, and sociocultural (eg, social support) factors, influence care access and outcomes after TBI.^{48,49,62-70} Individual factors may be easier to assess and have a direct impact on the lives of people with TBI, eg, health literacy may vary by sociodemographic factors and be associated with symptom reporting and seeking care.⁷¹⁻⁷⁴ Additionally, recognizing potential abuse or neglect is crucial for preventing further harm and ensuring patient safety. TBI can occur secondary to interpersonal violence, which is often undetected, and may have a significant impact on the physical, emotional and cognitive outcomes of survivors.^{75,76} Clinicians are often reluctant to discuss interpersonal violence or safety concerns due to their lack of awareness of resources to address identified concerns.⁷⁷

Context: SDoH are unrepresented in clinical practice guidelines for TBI.⁷⁸ Screening for SDoH should be conducted by health care providers or professions trained in connecting patients to community resources (eg, community health workers, case managers, patient navigators) utilizing standardized screening tools during the initial assessment and at regular follow-up visits for patients with TBI. This approach ensures early identification of barriers to care and allows for timely community-based or psychosocial interventions, such as connecting patients with community resources, social services, and support programs. It is particularly important in marginalized populations, including those with low socioeconomic status, limited social support, and those in underserved areas.

Resources: Tools for screening social determinants include [Protocol for Responding to and Assessing Patients' Assets, Risks, and Experiences \(PRAPARE\)](#) and [Hunger Vital Sign](#).⁷⁹ Many regional or national brain injury associations (eg, Brain Injury Association of America) provide support with resource facilitation.

Recommendation 5. Guidance on Rest and When to Return to Usual Daily Activities

Recommendation: Health care professionals should (1) recommend an initial period of relative rest, which includes reduced activities of daily living and reduced screen time, for up to the first 2 days after injury and then (2) counsel the

patient to gradually resume their usual pre-injury activities as tolerated, as long as the activity does not pose a risk for TBI [*Strong for*]^{a,c,h,j,p,r}. Health care professionals may offer documentation to alleviate barriers to a gradual return to activity (eg, sick leave, light duty, school accommodations) [*Good practice*^].

Rationale: Whereas prescribed strict rest until symptom resolution was once a standard of care,^{80,81} systematic review evidence⁸²⁻⁸⁴ and contemporary clinical practice guidelines^{15,39,85,86} now support beginning a gradual return to usual activities within 48 hours of injury. Prolonged rest may slow recovery and increase risk for mental health complications. “As tolerated” means that activity does not or only mildly exacerbates symptoms (eg, increase ≤ 1 -2 points on a 0-10-point visual analog scale for less than 1 hour).^{15,87} Most clinical practice guidelines do not specifically comment on screen time. Recent evidence supports limiting screen time during the first 48 hours post-injury⁸⁸ and resuming moderate use thereafter.⁸⁹ Determining readiness to return to activities that involve a significant risk for re-injury (eg, combat/collision sports) or consequences (eg, military activities) requires distinct consideration (see [Recommendation #11](#)).

Context: When seeing a patient >2 days post-injury, only part (2) of this recommendation is applicable. For people returning to demanding roles/occupations, it may be helpful to communicate a more detailed and personalized stepwise return-to-activity plan that defines the number of steps, activities permitted at each step (with recommendations for duration, intensity, and frequency), criteria for advancing to the next step, and when to reconsult with a health professional (eg, if new symptoms emerge). These plans generally involve progressing through 4-6 steps, spending a minimum of 24 hours at each step, and progressing to the next step when the activity provokes no more than a mild and transient worsening of symptoms. Many patients are able to return to school or work with residual symptoms but may require temporary accommodations.³⁹ It is common for patients to experience transient symptom exacerbations with increased cognitive or physical activity. After the exacerbation subsides, patients can generally resume their progressive return to activity, at a slower pace.³⁹ SDoH may influence a patient’s ability to follow return to activity advice (see [Recommendation #4](#)).

Resources: The [CDC](#) has a sample return-to-work form. There are templated stepwise return-to-activity plans for return to [work](#), [school](#), [sport](#), and [military service](#).

Recommendation 6. Educating the Patient/Family

Recommendation: Health care professionals may provide written and oral information to the patient (and their accompanying family/caregiver) at the initial visit, and ongoing education at subsequent visits [*Weak for*]^{a,b,f,g,h,j,q}. Education should focus on helping patients to understand and self-manage their symptoms. Education should also include information about prognosis, tailored to the patient’s risk profile [See [Recommendation #7](#)] [*Good practice*^]. Education

materials should be culturally and linguistically appropriate [*Good practice*^].

Rationale: Patients and families emphasize the importance of education after TBI not requiring hospitalization.⁹⁰ Providing education in lay terms and using both written and spoken format facilitates information uptake.⁹¹ Lack of information about the injury and trajectory of recovery and care can lead to uncertainty, confusion and anxiety.⁹² Previous studies suggest that early education may facilitate recovery,^{91,93-95} particularly when the content is individualized.⁹² Providing reassurance about the high likelihood of good recovery may prevent or reduce catastrophizing and pessimistic expectations of recovery, which have been identified as risk factors of prolonged recovery.⁹⁶ However, telling a patient at elevated risk of persistent symptoms (per [Recommendation #7](#)) to expect a quick and complete recovery may cause distress and distrust when that prediction does not come true. Lifestyle advice (eg, on physical activity, sleep, alcohol, screen use, and diet) can promote recovery by increasing health behaviors.⁵¹

Context: Clinical practice guidelines for TBI recommend providing reassurance about recovery and improvement of symptoms to patients with TBI not requiring hospitalization. It is important to explain that most people return to their usual functioning without significant difficulties within approximately 1 month after injury. Additionally, patients should be informed when to seek urgent follow-up [[Recommendation #2](#)] and that in some cases [[Recommendation #7](#)] symptoms can be prolonged. Recommended educational materials include information about common symptoms, strategies to manage specific symptoms, available treatments, health care professionals and health services, and guidance on rest and gradual return to everyday activities as tolerated ([Recommendation #5](#)).

Resources: The patient-facing TBI education materials from the [CDC](#) are one example. Alternatives are available from many regional and national organizations (eg, [Brain Injury Association of America](#); [Model Systems Knowledge Translation Center](#)).

Recommendation 7. Assessing a Patient’s Risk for Persisting Symptoms and Providing Recommendations on When to Return for Follow-Up Medical Visits

Recommendation: Health care professionals may screen the following domains for factors that increase the risk of persisting symptoms [*Weak for*]^{a,c,e,f,h,j,q,r}:

- Demographics (eg, female sex)
- Pre-existing health conditions (eg, migraine, psychiatric disorder, prior concussions/TBIs)
- Indicators of brain injury severity (eg, Glasgow Coma Scale <15, intracranial lesions)
- High burden post-concussion symptoms on a standardized questionnaire (see Resources)
- Mental health symptoms (eg, depression, anxiety, posttraumatic stress)

- Psychosocial (eg, fearful avoidance of objectively safe activities, pessimistic expectations for recovery)
- Social determinants of health ([Recommendation #4](#)).

A patient may be considered at elevated risk for persisting symptoms if they are still symptomatic at the time of clinic visit and have ≥ 1 strong negative prognostic factor (high burden of post-concussion symptoms or mental health symptoms) or multiple other negative prognostic factors. Patients at elevated risk may benefit from (1) additional follow-up visits to monitor progress with [Recommendation #5](#) and proactively implement other interventions in primary care (eg, weekly over the first month)^a and/or (2) referral to outpatient specialty TBI care^{e,f} ([Recommendation #11](#)) [*Good practice*^].

Rationale: Recovery from TBI is variable. Identifying patients who are at lower vs higher risk for prolonged recovery can inform care coordination, as well as tailored education ([Recommendation #5](#)). There are currently no accurate and sufficiently validated prognostic models or rules for predicting clinical outcome from non-hospitalized TBI in adults. However, several pre-, peri-, and post-injury variables across the domains listed above have demonstrated prognostic value. Prior clinical practice guidelines list risk factors but do not differentiate between robust prognostic factors (highly prognostic across multiple studies) and those that are weaker or inconsistent. The best available evidence suggests that high early burden of post-concussion symptoms and mental health symptoms (depression, anxiety, and posttraumatic stress) are the strongest risk factors.^{44,97-101} Other evidence-based risk factors include those listed above.^{44,97-103} Some previous guidelines recommended against the use of blood-based and neuroimaging biomarkers for prognosis due to insufficient evidence, however, ongoing research may support these and other risk factors.¹⁸

Context: Some risk factors can be ascertained in the ED, but prognosis can be refined by assessing post-concussion symptoms, mental health symptoms, and coping at 1-3 weeks post-injury. Further guidance on assessment of SDoH is provided in [Recommendation #4](#). In addition to the risk factors listed above, inappropriate early treatment recommendations (eg, strict rest) or poor adherence to evidence-based treatment recommendations may heighten risk for persisting symptoms. Early access to outpatient specialty care may not be possible in all regions, but efforts should be made to link at-risk patients to appropriate local resources.

Resources: [The Rivermead Post-Concussion Symptoms Questionnaire \(RPQ\)](#), [Neurobehavioral Symptom Inventory \(NSI\)](#), and symptom scale embedded in the [Sport Concussion Assessment Tool 6](#) are widely used self-report measures of post-concussion symptom severity.

Recommendation 8. Prioritizing Which Symptoms to Treat First

Recommendation: Health care professionals should prioritize symptoms that (1) are most bothersome to the patient, (2) if treated successfully, are most likely to bring about improvement in other symptoms, and/or (3) impede participation

in active rehabilitation [*Weak for*]^{a,c,h,j,l}. Headaches, poor sleep, and depression/anxiety are the most common priority symptoms.

Rationale: Certain symptoms often perpetuate or exacerbate others, leading to a cascade of secondary effects.¹⁰⁴⁻¹⁰⁷ For instance, poor sleep can contribute to low mood, fatigue, and difficulty concentrating. Addressing symptoms at the root, or the “top of the cascade,” may alleviate these secondary issues. For example, improving sleep may lead to a reduction in other symptoms.¹⁰⁸⁻¹¹⁰ Additionally, encouraging proactive management of headaches, poor sleep, and mood disorders in primary care might improve overall symptom burden.¹¹¹

Context: People with TBI experience variable constellations of symptoms, which may include headaches, sleep disturbance/fatigue, cognitive, emotional, and/or visual-vestibular symptoms. A detailed assessment of symptoms and their attributes (frequency/severity, course, functional impact, factors that exacerbate or alleviate) and co-occurrence can inform a personalized treatment plan that prioritizes and sequences interventions. Bodily pain associated with soft tissue and orthopedic injuries should also be considered. When available, collateral input from patient caregivers, family members, or friends can provide additional details about which symptoms tend to precede (and therefore possibly cause) others or have a different perspective about which symptoms are most functionally impairing. It is helpful to ask the collateral source(s) questions to understand the patient's experience fully. Symptom patterns can also evolve over time, so periodic reassessment is important to guide any treatment plan adjustments. When symptoms listed in [Recommendation #2](#) are present, they require medical attention before headaches, poor sleep, and depression/anxiety.

Recommendation 9. First-Line Treatments for Posttraumatic Headache

Recommendation: Health care professionals should characterize the headache history and presentation(s) to determine if the patient has posttraumatic headache with features similar to migraine, tension-type, cervicogenic, and/or other headache type(s) [*Good practice*]^{a,h,j}. Management of recurrent posttraumatic headache generally parallels primary headache disorders. General management starts with (1) lifestyle strategies, including emphasis on a regular sleep schedule, minimizing alcohol use, no skipped or delayed meals, good hydration, regular low-intensity cardiovascular exercise (if no contraindications), and use of relaxation strategies, and (2) over-the-counter analgesics (eg, acetaminophen/paracetamol, ibuprofen, naproxen) to abort headache exacerbations; triptans should be considered for attacks with migraine-like features if over-the-counter medications alone are not effective [*Weak for*]^{a,h}. When headache frequency exceeds 10 days per month or they are disabling, daily prophylactic pharmacotherapy may additionally be considered [*Weak for*]^{a,h}. Cervicogenic headache may further benefit from manual therapy of

the neck [Good practice[^]]. Specialty care can assist with identifying and treating other common posttraumatic headache presentations (eg, vestibular migraine, occipital neuralgia, headache exacerbated by vision-related disturbances, etc) or managing refractory headache (see [Recommendation #11](#)) [Good practice[^]].

Rationale: When posttraumatic headaches interfere with daily functioning (assessed with patient-reported measures such as the [Headache Impact Test-6](#)) they should be a priority management target. Much evidence for treating posttraumatic headache is extrapolated from clinical trials in primary headache disorders with similar features. There is strong evidence for certain treatments in certain primary headache disorders (eg, angiotensin receptor blockers for migraine prophylaxis¹¹²) but our Working Group downgraded the strength of recommendations given the scarcity of trials and therefore uncertainty in posttraumatic headache specifically. Some patients may have a history of pre-injury primary headache disorder(s); post-injury headache features may be similar or different from pre-injury headache features. The above assessment and treatment framework can still be applied.

Context: Clinical practice guidelines for TBI emphasize that treatment for recurrent posttraumatic headache should be aligned with the predominant headache type (eg, tension-type, migraine, other). Medication adaptation (medication-overuse or rebound) headache should be considered, especially in patients who use analgesics with caffeine or narcotics >10 days per month. Abortive medications, including over-the-counter and triptans, are most effective when administered early in the onset of headaches with migraine-like features. The specific choice of prophylactic should be tailored to patient preference and side effect profile. Prophylactic therapy can minimize risk of excessive reliance on abortive strategies and related risk of medication overuse headache. Examples of prophylactic medications include tricyclic antidepressants (eg, amitriptyline), serotonin and norepinephrine reuptake inhibitors (eg, venlafaxine), angiotensin receptor blockers (eg, candesartan), and calcitonin gene-related peptide (CGRP) pathway inhibitors.¹¹² Prescribing a symptom diary during medication titration can help identify patterns (eg, triggers, alleviating factors, frequency, duration, severity) to refine the headache treatment plan and monitor response, and expediate second-line headache management in specialty care. Education about avoiding contact with headache triggers (eg, specific foods or alcohol) may be helpful but should include guidance about how to manage headache triggers that are ubiquitous in daily life (eg, lights, stress). Selection of a prophylactic medication regimen should account for comorbid conditions which may benefit from a specific agent and/or its side effect profile; for example, some headache prophylactic agents are antidepressants which may be useful for patients who are also experiencing depression ([Recommendation #10](#)). Headaches consistently triggered by mental exertion/fatigue may benefit from

non-pharmacological strategies. Vision-related disturbances may exacerbate headache symptoms and may serve as additional treatment targets for headache prevention.

Resources: The [Department of Defense Clinical Recommendation](#) on management of posttraumatic headache offers detailed guidance on interventions, stratified by predominant headache type. Clinical practice guidelines for primary headache disorders (eg, [American Headache Society](#)) are also relevant.

Recommendation 10. Screening for Mental Health Disorders and Providing First-Line Intervention for Mental Health Disorders

Recommendation: Qualified health care professionals should screen for new onset mental health conditions and worsening of pre-existing mental health conditions after TBI [*Strong for*]^{a,c,f,h,j,q}. When screening reveals imminent suicidal ideation, urgent protective action may be required ([Recommendation #2](#)). When clinically appropriate, primary care clinicians should initiate first line therapy, using clinical practice guidelines for mental health disorders in the general population [*Weak for*]^{a,h,q}. First line therapeutics include either psychotherapy, pharmacotherapy, or both [*Weak for*]^{a,d,g,h,i,o,q}. Primary care clinicians could refer to mental health specialists when first-line psychopharmacological treatment is not effective and/or to access psychotherapy, considering low-barrier options (eg, community clinics with sliding scale fees or evidence-based self-management programs) when access is a concern [Good practice[^]].

Rationale: TBI increases the risk of mental health disorders, including Major Depressive Disorder, anxiety disorders, and PTSD.¹¹³⁻¹¹⁷ Mental health disorders are associated with higher symptom burden and disability, and lower quality of life, following TBI.¹¹⁸⁻¹²⁰ Psychological distress may not only be a consequence, but also a contributor to persisting symptoms and disability.^{121,122} Screening measures originally developed for primary care appear to have similar diagnostic accuracy (sensitivity and specificity) in people with TBI, and do not require modified content or cut-off scores.¹²³⁻¹²⁶ Existing TBI guidelines extrapolate evidence on treatment effectiveness from mental health disorders in the general population, as relatively few studies have specifically studied mental health treatments in TBI samples. For this reason, the Working Group downgraded the strength of recommendations that were primarily not based on studies with TBI patients. Disparities in access to psychotherapy may be especially prominent because health insurance often does not adequately cover this service and because acceptable clinicians (eg, from the same cultural background as the patient) may not be available locally. Self-management interventions, such as workbooks, websites, and smartphone apps, may be more effective than no mental health treatment.^{127,128}

Context: Worsening or recurrence of a pre-existing disorders may occur, as well as new onset disorders. The elevated risk for mental health disorders after TBI may start

within weeks and persist for years, but there is a peak in onset between 2- and 6-months post-injury.¹²⁹⁻¹³² Screening for mental health disorders early (~1 month post-injury) and again later in patients who remain symptomatic is therefore advisable. Psychotherapy is generally considered first line for mental health disorders of any severity and pharmacotherapy (alone or in combination with psychotherapy) for moderate to severe mental health disorders.³⁹ Cognitive behavioral therapy and other evidence-based psychotherapies can be delivered either in person or virtually. First-line pharmacotherapeutics may include selective serotonin reuptake inhibitors (SSRI) or serotonin and norepinephrine reuptake inhibitors (SNRI) for depression and anxiety disorders. Sleep disorders (eg, nightmares and insomnia) may contribute substantially to mental health conditions and may be treated concomitantly (eg, with prazosin for nightmares, and cognitive behavioral therapy for insomnia), or prioritized based on severity. SSRIs/SNRIs can also reduce headache frequency ([Recommendation #9](#)), so may be a good option for patients experiencing both headaches and mental health symptoms.

Resources: Validated tools should be used to screen for depression (eg, [PHQ2](#), [PHQ9](#)), anxiety (eg, [GAD2](#), [GAD7](#)), posttraumatic stress disorder (PTSD) (eg, [PCL-5](#)), and drug/alcohol abuse (eg, [AUDIT-C](#)). Evidence-based guidelines for managing mental health disorders in people without TBI include the [VA/DoD](#) and [CANMAT](#) guidelines.

Recommendation 11. Referral to a Specialist Provider or Interdisciplinary Clinic That Specializes in Brain Injury

Recommendation: Referral to specialty care should be considered for patients who are at high risk for persisting symptoms ([Recommendation #7](#)), continue to have disabling symptoms beyond 30 days post-injury, and/or are not responding to first-line interventions in primary care [*Weak for*]^{a,b,c,e,g,h,j,q}.

Rationale: The majority of patients with TBI not requiring hospitalization can be managed in primary care.^{16,20,39} However, up to 1 in 3 will have persisting symptoms beyond 30 days that could interfere with their return to usual activities.³ Specialty interventions for TBI may include, for patients with specific indications, vestibular rehabilitation for dizziness, imbalance, and/or related symptoms, clinician-directed cognitive rehabilitation for memory/concentration problems, advanced headache treatments such as botulinum toxin injections, cognitive behavioral therapy for insomnia, and graded physical exercise for overall symptom improvement, which have been recommended in recent clinical practice guidelines.^{16,39,85,133,134} Given the evolving evidence supporting treatments for persisting symptoms, training in TBI care and familiarity with the empirical literature are both important for specialty clinic staff. In addition to the criteria above, referral to specialty care for expert medical clearance may be prudent for patients who are returning to activities (eg, occupation or sport) with an elevated risk of re-injury or high consequences.

Context: Early access to outpatient specialty care may not be possible in all regions, but efforts should be made to link at-risk patients to appropriate local resources. For people who are recovering well or experiencing symptoms primarily attributable to comorbid conditions (eg, depression) rather than to TBI, referral to an interdisciplinary TBI clinic—especially one that does not follow quality standards^{135,136}—could lead to iatrogenesis.²⁰ Patients with multiple symptoms are usually best served by an interdisciplinary TBI clinic that can provide both symptom-focused and general therapies (eg, monitored aerobic exercise), personalized by an initial multimodal assessment. When access to a TBI clinic is limited or a patient has only 1-2 prominent symptoms, referral to a single clinician who has experience with TBI (eg, neurologist, physical therapist, rehabilitation medicine physician) may be appropriate. Interventions for persisting symptoms can typically be completed in less than 4 months.¹³⁴ Some patients will under-report symptoms, so involving a caregiver in the primary care assessment can help clarify their rehabilitation needs.

Considerations for Special Populations

Older Adults

Older adults have a relatively high incidence of TBI, most commonly due to falls.¹³⁷ Diagnosis of TBI without an observed loss of consciousness may be challenging when there is pre-existing cognitive decline. Older adults with TBI, especially TBI with loss of consciousness, are at increased risk of stroke, posttraumatic epilepsy, and neurodegenerative processes.^{138,139} Compared with young adults, older adults are also more likely to have frailty, disabilities, and medical co-morbidities that contribute to their clinical presentation and recovery.¹³⁸ Nevertheless, many older adults are able to return home and achieve a complete neuropsychological and functional recovery following TBI with Glasgow Coma Scale score of 13-15, warranting optimism.¹⁴⁰⁻¹⁴³ Older adults' experience with managing health problems¹⁴⁴ may allow them to maintain patience during their recovery. As with young adults, a higher burden of initial post-concussion symptoms predicts poor outcome.¹⁴⁵ Frailty is an additional negative prognostic indicator, independent of age.^{145,146} Having a primary care clinician plays a role in older adults successfully returning home after injury and in monitoring patients at high risk of hospital readmission.^{142,143} Fall prevention should be a focus in return to activity and assessment for safety (including the need for supervision) in the home.¹⁴⁷ Health care professionals can address existing disparities in access to care by facilitating conversations about informal caregiver support, home health care, and the adequacy of primary care services.¹⁴⁴

Survivors of Intimate Partner Violence

Clinicians should be prepared to encounter patients with TBI caused by intimate partner violence (IPV).^{75,148} Survivors of IPV frequently have a history of multiple TBIs, which may

have gone unaddressed. These patients may present with a known TBI or with symptoms that, upon further investigation, reveal a TBI and/or strangulation-induced hypoxic event. Co-occurring mental health conditions such as post-traumatic stress disorder (PTSD) are common and can complicate retrospective diagnosis.¹⁴⁹ Intimate partner violence survivors often have risk factors associated with prolonged recovery (**Recommendation #7**). An approach that is dually trauma-informed and SDoH-sensitive is essential. Recommendations that rely on caregiver involvement, such as support from family members or social networks, may be particularly difficult for survivors who experience social isolation. This necessitates additional efforts by clinicians to ensure that care plans are feasible. Financial barriers further complicate recovery, as survivors may struggle with the costs of taking time off work or arranging childcare.

Athletes

Athletes who sustain a TBI in sport activity ("sport-related concussion") are typically younger and healthier at the time of injury and tend to have milder injuries and faster recovery compared with people injured in other settings.¹⁵⁰⁻¹⁵² Because sport-related concussions are associated with an elevated risk of re-injury, including both subsequent concussions and musculoskeletal injuries,¹⁵³⁻¹⁵⁵ a major focus of clinical management is supporting prompt removal from and safe return to sport.^{15,155-157} Consistent with the 2023 ACRM diagnostic criteria¹⁷ (**Recommendation #1**), athletes with symptoms but no signs can be diagnosed with concussion and managed accordingly. The international Concussion in Sport Group recommends a medically supervised, stepwise progression for return to play, from light aerobic activity to full contact practice and finally, competition.¹⁵ The combined period of clinical recovery and progression through these steps takes about 2-4 weeks, on average.^{158,159} More frequent follow-up visits during this period may be helpful. Motivated by various incentives (eg, identity preservation, pressure from teammates, collegiate scholarships), athletes may minimize symptom reporting so they can return to competitive play more rapidly. Objective evaluation, such as with neuropsychological testing, can help confirm concussion recovery. Contemporary approaches emphasize the benefits of active rehabilitation over passive rest to promote and accelerate recovery.^{82,87} This may include prescribed aerobic exercise, which appears safe and effective for athletes with sport-related concussion.^{82,85,87,160,161} Many regions have legislation that require documented medical clearance for return to play.¹⁶² Medical clearance is generally defined as symptom-free at rest and with physical exertion, but may include other factors depending on clinical judgment (eg, normalized cognitive testing). Elite athletes will likely benefit from involvement of sports medicine clinicians,¹⁵⁵ if they do not already have access through their team or league. For further guidance specific to managing athletes with sport-related concussion, see the Concussion in Sport Group consensus statement.¹⁵

Military Service Members

Like athletes, many military service members with TBI are younger, healthier, and have more lifetime neurotrauma exposure than civilians with TBI. Return to duty often requires a higher standard than typical return to work or return to school, considering the consequences of an error or accident.¹⁶³ The health care professional's role includes understanding the occupational requirements, and advise commanding officers on the risks. A special consideration is that clinicians are advisors to the commanding officers; the commanding officers make final return to duty decisions based on military mission requirements. If available, assessments to inform return to duty should include collateral source information about the military service member's pre-injury baseline because service members may minimize symptom reporting or functional impacts so they can return to duty more rapidly. In the context of combat and deployment-related injuries, concomitant effects of post-traumatic stress, depression, multiple trauma, and chronic pain are common, requiring multidisciplinary care.^{16,164} Despite potential neuropathological differences, TBI caused by blast has a similar clinical presentation¹⁶⁵ and is clinically managed like non-blast TBI. However, hearing loss, middle ear injury, burns, and chemical exposures accompanying blast-related TBI may require specialty referrals and multiple-trauma care.¹⁶⁶ Health care professionals should become aware of local military-specific resources and consider referring challenging cases to the Defense Intrepid Network for TBI and Brain Health or VA Multiple-trauma System. For further guidance specific to managing military service members with TBI, see the Veterans Affairs/Department of Defense guideline.¹⁶

Knowledge Translation

The CPG Working Group will use multiple methods for dissemination. National and international organizations involved in the external review process will be asked to promote awareness of the guideline among their members. Participants in the Action Collaborative on TBI Care are also involved in establishing a network of TBI clinics as demonstration sites to create a learning health system. The guideline will be integrated into these demonstration sites and adherence to the guideline will be monitored with performance metrics.¹⁶⁷ Members of the Action Collaborative on TBI Care will also serve as community champions, helping to promote awareness of the guideline through local presentations to health care professionals. A link to download the guidelines will be made available on the website of endorsing organizations that maintain a CPG repository and the National Academies' TBI Forum website. To further support use by primary care physicians, the guideline will be accessible through the American Academy of Family Physicians app. Finally, the guideline will also be promoted directly to a wider audience of potential users through co-publication in family medicine, brain injury, and rehabilitation journals. Barriers and facilitators to implementation will be identified through surveys and/or

focus groups with users. This will inform the development of implementation tools (eg, accredited continuing medical education materials).

Limitations and Directions for Future Research

First, the guideline included a disproportionately high number of recommendations based on expert opinion (*Good practice*) or limited/mixed evidence. This was expected because (1) the overall body of primary evidence is immature, and consequently, *Strong* recommendations are rare in existing CPGs,^{16,133} and (2) topics for the present guideline were prioritized considering perceived importance by people with lived experience and clinicians rather than solely based on the quantity and quality of available evidence, and these included topics recently identified as research gaps.⁹⁰ Research is needed to further evaluate and refine *Good practice* and *Weak* for recommendations. The learning health system comprised of TBI clinics in the Action Collaborative network will facilitate this. Second, the CPG Working Group included members from Europe and several international organizations contributed to the external phase, but nevertheless, the guideline may have limited applicability outside of North America. Third, the CPG Working Group considered the potential for recommendations to maintain or widen inequities (eg, by discussing barriers in disadvantaged groups) but monitoring will be necessary to assess whether these efforts were sufficient. Fourth, the guideline is intended for adults. Pediatric-specific guidelines are available elsewhere.^{14,168}

Plans for Updating the Guideline

The CPG Working Group plans to reconvene within 5 years of the publication date of this guideline to prepare an update.

 [Read or post commentaries in response to this article.](#)

Key words: clinical practice guideline; concussion; traumatic brain injury

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 [Supplemental materials](#)

References

1. National Academies of Sciences, Engineering, and Medicine. *Traumatic Brain Injury: A Roadmap for Accelerating Progress*. National Academies Press; 2022.
2. Maas AIR, Menon DK, Manley GT, et al; InTBI Participants and Investigators. Traumatic brain injury: progress and challenges in prevention, clinical care, and research. *Lancet Neurol*. 2022;21(11):1004-1060. doi:[10.1016/s1474-4422\(22\)00309-x](#)
3. Cancelliere C, Verville L, Stubbs JL, et al. Post-Concussion symptoms and disability in adults with mild traumatic brain injury: a systematic review and meta-analysis. *J Neurotrauma*. 2023;40(11-12):1045-1059. doi:[10.1089/neu.2022.0185](#)
4. Gaudette É, Seabury SA, Temkin N, et al; TRACK-TBI Investigators. Employment and economic outcomes of participants with mild traumatic brain injury in the TRACK-TBI study. *JAMA Netw Open*. 2022;5(6):e2219444-e44. doi:[10.1001/jamanetworkopen.2022.19444](#)
5. Bloom B, Thomas S, Ahrensberg JM, et al. A systematic review and meta-analysis of return to work after mild traumatic brain injury. *Brain Inj*. 2018;32(13-14):1623-1636. doi:[10.1080/02699052.2018.1532111](#)
6. Seabury SA, Gaudette É, Goldman DP, et al; TRACK-TBI Investigators. Assessment of follow-up care after emergency department presentation for mild traumatic brain injury and concussion: results from the TRACK-TBI study. *JAMA Netw Open*. 2018;1(1):e180210-e10. doi:[10.1001/JAMANETWORKOPEN.2018.0210](#)
7. Ramsay S, Dahinten VS, Ranger M, et al. Follow-up visits after pediatric concussion and the factors associated with early follow-up: a population-based study in British Columbia. *Brain Inj*. 2025;39(1):10-16. doi:[10.1080/02699052.2024.2395382](#)
8. de Koning ME, Scheenen ME, van der Horn HJ, et al. Outpatient follow-up after mild traumatic brain injury: results of the UPFRONT-study. *Brain Inj*. 2017;31(8):1102-1108. doi:[10.1080/02699052.2017.1296193](#)
9. Bastos Gottgroy R, Hume PA, Theadom A. Describing the patient journey through healthcare pathways following mild traumatic brain injury in New Zealand using novel Graph analysis. *Brain Inj*. 2023;37(11):1294-1304. doi:[10.1080/02699052.2023.2230878](#)
10. Karvandi E, Helmy A, Kolias AG, et al. Specialist healthcare services for concussion/mild traumatic brain injury in England: a consensus statement using modified Delphi methodology. *BMJ Open*. 2023;13(12):e077022. doi:[10.1136/bmjopen-2023-077022](#)

11. Foks KA, Cnossen MC, Dippel DWJ, et al. Management of mild traumatic brain injury at the emergency department and hospital admission in Europe: a survey of 71 neurotrauma centers participating in the CENTER-TBI study. *J Neurotrauma*. 2017;34(17):2529-2535. doi:[10.1089/neu.2016.4919](https://doi.org/10.1089/neu.2016.4919)
12. Carney N, Totten AM, O'Reilly C, et al. Guidelines for the management of severe traumatic brain injury, fourth edition. *Neurosurgery*. 2017; 80(1):6-15. doi:[10.1227/NEU.0000000000001432](https://doi.org/10.1227/NEU.0000000000001432)
13. Giacino JT, Katz DI, Schiff ND, et al. Practice guideline update recommendations summary: disorders of consciousness: report of the Guideline Development, Dissemination, and Implementation Subcommittee of the American Academy of Neurology; the American Congress of Rehabilitation Medicine; and the National Institute on Disability, Independent Living, and Rehabilitation Research. *Neurology*. 2018;91(10):450-460. doi:[10.1212/WNL.0000000000005926](https://doi.org/10.1212/WNL.0000000000005926)
14. Lumba-Brown A, Yeates KO, Sarmiento K, et al. Centers for Disease Control and Prevention Guideline on the Diagnosis and Management of Mild Traumatic Brain Injury Among Children. *JAMA Pediatr*. 2018;172(11):e182853. doi:[10.1001/jamapediatrics.2018.2853](https://doi.org/10.1001/jamapediatrics.2018.2853)
15. Patrícios JS, Schneider KJ, Dvorak J, et al. Consensus statement on concussion in sport: the 6th International Conference on Concussion in Sport-Amsterdam, October 2022. *Br J Sports Med*. 2023;57(11):695-711. doi:[10.1136/bjsports-2023-106898](https://doi.org/10.1136/bjsports-2023-106898)
16. Department of Veterans Affairs, Department of Defense. The management and rehabilitation of post-acute mild traumatic. *Brain Inj*. 2022;36(5):693-702. doi:[10.1080/02699052.2022.2033848](https://doi.org/10.1080/02699052.2022.2033848)
17. Silverberg ND, Iverson GL, Cogan A, et al; ACRM Brain Injury Special Interest Group Mild TBI Task Force members; ACRM Mild TBI Diagnostic Criteria Expert Consensus Group. The American Congress of Rehabilitation Medicine diagnostic criteria for mild traumatic brain injury. *Arch Phys Med Rehabil*. 2023;104(8):1343-1355. doi:[10.1016/j.apmr.2023.03.036](https://doi.org/10.1016/j.apmr.2023.03.036)
18. Manley GT, Dams-O'Connor K, Alosco ML, et al; NIH-NINDS TBI Classification and Nomenclature Initiative. A new characterisation of acute traumatic brain injury: the NIH-NINDS TBI Classification and Nomenclature Initiative. *Lancet Neurol*. 2025;24(6):512-523. doi:[10.1016/S1474-4422\(25\)00154-1](https://doi.org/10.1016/S1474-4422(25)00154-1)
19. Corrigan JD, Hammond FM, Sander AM, et al. Model of care for chronic brain injury. *Arch Phys Med Rehabil*. 2025;106(1):145-149. doi:[10.1016/j.apmr.2024.08.001](https://doi.org/10.1016/j.apmr.2024.08.001)
20. Silverberg ND, Iaccarino MA, Panenka WJ, et al; American Congress of Rehabilitation Medicine Brain Injury Interdisciplinary Special Interest Group Mild TBI Task Force. Management of concussion and mild traumatic brain injury: a synthesis of practice guidelines. *Arch Phys Med Rehabil*. 2020;101(2):382-393. doi:[10.1016/j.apmr.2019.10.179](https://doi.org/10.1016/j.apmr.2019.10.179)
21. The ADAPTE Collaboration. The ADAPTE Process: Resource Toolkit for Guideline Adaptation (Version 2.0). Guideline International Network. Published 2009. <https://g-i-n.net/wp-content/uploads/2021/03/ADAPTE-Resource-toolkit-March-2010.pdf>
22. Schünemann HJ, Wiercioch W, Etzeandía I, et al. Guidelines 2.0: systematic development of a comprehensive checklist for a successful guideline enterprise. *CMAJ*. 2014;186(3):E123-E142. doi:[10.1503/cmaj.131237](https://doi.org/10.1503/cmaj.131237)
23. Qaseem A, Forland F, Macbeth F, Ollenschläger G, Phillips S, van der Wees P; Board of Trustees of the Guidelines International Network. Guidelines International Network: toward international standards for clinical practice guidelines. *Ann Intern Med*. 2012;156(7):525-531. doi:[10.7326/0003-4819-156-7-201204030-00009](https://doi.org/10.7326/0003-4819-156-7-201204030-00009)
24. Shaver N, Bennett A, Beck A, et al. Health equity considerations in guideline development: a rapid scoping review. *BMJ Open*. 2023;11(2):E357-E371. doi:[10.9778/cmajo.20220130](https://doi.org/10.9778/cmajo.20220130)
25. Welch VA, Akl EA, Guyatt G, et al. GRADE equity guidelines 1: considering health equity in GRADE guideline development: introduction and rationale. *J Clin Epidemiol*. 2017;90:59-67. doi:[10.1016/j.jclinepi.2017.01.014](https://doi.org/10.1016/j.jclinepi.2017.01.014)
26. Song Y, Alonso-Coello P, Ballesteros M, et al; RIGHT-Ad@pt Working Group. A reporting tool for adapted guidelines in health care: the RIGHT-Ad@pt Checklist. *Ann Intern Med*. 2022;175(5):710-719. doi:[10.7326/m21-4352](https://doi.org/10.7326/m21-4352)
27. Silverberg ND, Lee K, Mikolic A, et al; Action Collaborative on TBI Care. Priority clinical actions for outpatient management of nonhospitalized traumatic brain injury. *J Neurotrauma*. 2025; doi:[10.1089/neu.2024.0414](https://doi.org/10.1089/neu.2024.0414)
28. Brouwers MC, Kho ME, Browman GP, et al; AGREE Next Steps Consortium. AGREE II: advancing guideline development, reporting and evaluation in health care. *CMAJ*. 2010;182(18):E839-E842. doi:[10.1503/cmaj.090449](https://doi.org/10.1503/cmaj.090449)
29. American Academy of Family Physicians. *Clinical Practice Guideline Manual*. 2017. <https://www.aafp.org/family-physician/patient-care/clinical-recommendations/cpg-manual.html>
30. de Bousard CN, Bellocco R, af Geijerstam JL, Borg J, Adami J. Delayed intracranial complications after concussion. *J Trauma*. 2006;61(3):577-581. doi:[10.1097/01.ta.0000224901.67930.ce](https://doi.org/10.1097/01.ta.0000224901.67930.ce)
31. Borg J, Holm L, Cassidy JD, et al; WHO Collaborating Centre Task Force on Mild Traumatic Brain Injury. Diagnostic procedures in mild traumatic brain injury: results of the WHO Collaborating Centre Task Force on Mild Traumatic Brain Injury. *J Rehabil Med*. 2004;43(Suppl):61-75. doi:[10.1080/16501960410023822](https://doi.org/10.1080/16501960410023822)
32. Yue JK, Krishnan N, Kanter JH, et al; TRACK-TBI Investigators. Neuroworsening in the emergency department is a predictor of traumatic brain injury intervention and outcome: a TRACK-TBI Pilot Study. *J Clin Med*. 2023;12(5):2024. doi:[10.3390/jcm12052024](https://doi.org/10.3390/jcm12052024)
33. Jumah F, Chotai S, Hilden P, et al. Characteristics and outcomes of discharge against medical advice and 30-day readmissions after concussion: analysis of the nationwide readmissions database. *Neurosurgery*. 2022;91(3):373-380. doi:[10.1227/neu.0000000000002040](https://doi.org/10.1227/neu.0000000000002040)
34. Mehta V, Harward SC, Sankey EW, Nayar G, Codd PJ. Evidence based diagnosis and management of chronic subdural hematoma: a review of the literature. *J Clin Neurosci*. 2018;50:7-15. doi:[10.1016/j.jocn.2018.01.050](https://doi.org/10.1016/j.jocn.2018.01.050)
35. Bahraini NH, Simpson GK, Brenner LA, et al. Suicidal ideation and behaviours after traumatic brain injury: a systematic review. *Brain Impair*. 2013;14(1):92-112. doi:[10.1017/Brlmp.2013.11](https://doi.org/10.1017/Brlmp.2013.11)
36. Madsen T, Erlangsen A, Orlovskaa S, Mofaddi R, Nordentoft M, Benros ME. Association between traumatic brain injury and risk of suicide. *JAMA*. 2018;320(6):580-588. doi:[10.1001/jama.2018.10211](https://doi.org/10.1001/jama.2018.10211)
37. Campbell-Sills L, Jain S, Sun X, et al; TRACK-TBI Investigators. Risk factors for suicidal ideation following mild traumatic brain injury: a TRACK-TBI Study. *J Head Trauma Rehabil*. 2021;36(1):E30-E39. doi:[10.1097/HTR.0000000000000602](https://doi.org/10.1097/HTR.0000000000000602)
38. Scottish Intercollegiate Guidelines Network. Brain Injury Rehabilitation for Adults: A National Clinical Guideline, 2013. <https://www.sign.ac.uk/media/1068/sign130.pdf>
39. Lithopoulos A, Dawson J, Reed N, Zemek R, Marshall S. Living guidelines for the diagnosis and management of adult and pediatric concussion. [published Online First: 20211208]. *J Neurotrauma*. 2022;39(1-2):243-244. doi:[10.1089/neu.2021.0395](https://doi.org/10.1089/neu.2021.0395)
40. Karr JE, Areshenkoff CN, Garcia-Barrera MA. The neuropsychological outcomes of concussion: a systematic review of meta-analyses on the cognitive sequelae of mild traumatic brain injury. *Neuropsychology*. 2014;28(3):321-336. doi:[10.1037/neu0000037](https://doi.org/10.1037/neu0000037)
41. Schretlen DJ, Shapiro AM. A quantitative review of the effects of traumatic brain injury on cognitive functioning. *Int Rev Psychiatry*. 2003;15(4):341-349. doi:[10.1080/09540260310001606728](https://doi.org/10.1080/09540260310001606728)
42. Harnan SE, Pickering A, Pandor A, Goodacre SW. Clinical decision rules for adults with minor head injury: a systematic review. *J Trauma*. 2011;71(1):245-251. doi:[10.1097/TA.0b013e31820d090f](https://doi.org/10.1097/TA.0b013e31820d090f)
43. Yuh EL, Jain S, Sun X, et al; TRACK-TBI Investigators for the CENTER-TBI Investigators. Pathological computed tomography features associated with adverse outcomes after mild traumatic brain injury: a TRACK-TBI study with external validation in CENTER-TBI. *JAMA Neurol*. 2021;78(9):1137-1148. doi:[10.1001/jamaneurol.2021.2120](https://doi.org/10.1001/jamaneurol.2021.2120)
44. Mikolic A, Steyerberg EW, Polinder S, et al. Prognostic models for global functional outcome and post-concussion symptoms following mild traumatic brain injury: a collaborative European NeuroTrauma Effectiveness Research in Traumatic Brain Injury (CENTER-TBI) study. *J Neurotrauma*. 2023;40(15-16):1651-1670. doi:[10.1089/neu.2022.0320](https://doi.org/10.1089/neu.2022.0320)
45. Panwar J, Hsu CCT, Tator CH, Mikulis D. Magnetic resonance imaging criteria for post-concussion syndrome: a study of 127 post-concussion syndrome patients. *J Neurotrauma*. 2020;37(10):1190-1196. doi:[10.1089/neu.2019.6809](https://doi.org/10.1089/neu.2019.6809)
46. Yeates KO, Räisänen AM, Premji Z, et al. What tests and measures accurately diagnose persisting post-concussive symptoms in children, adolescents and adults following sport-related concussion? A systematic review. *Br J Sports Med*. 2023;57(12):780-788. doi:[10.1136/bjsports-2022-106657](https://doi.org/10.1136/bjsports-2022-106657)
47. Rowe BH, Yang E, Corrick S, Hussain MW. Reducing computed tomography (CT) imaging for adults with minor traumatic brain injuries in the emergency department. *BMJ*. 2024;386:e074867. doi:[10.1136/bmj-2023-074867](https://doi.org/10.1136/bmj-2023-074867)
48. Griffith DM, Towfighi A, Manson SM, Littlejohn EL, Skolarus LE. Determinants of inequities in neurologic disease, health, and well-being: the ninds social determinants of health framework. *Neurology*. 2023;101(7)(Suppl 1):S75-S81. doi:[10.1212/WNL.0000000000207566](https://doi.org/10.1212/WNL.0000000000207566)

49. Johnson LW, Diaz I. Exploring the social determinants of health and health disparities in traumatic brain injury: a scoping review. [published Online First: 20230423]. *Brain Sci.* 2023;13(5):707. doi:[10.3390/brainsci13050707](https://doi.org/10.3390/brainsci13050707)
50. Izzy S, Chen PM, Tahir Z, et al. Association of traumatic brain injury with the risk of developing chronic cardiovascular, endocrine, neurological, and psychiatric disorders. *JAMA Netw Open.* 2022;5(4):e229478. doi:[10.1001/jamanetworkopen.2022.9478](https://doi.org/10.1001/jamanetworkopen.2022.9478)
51. Driver S, Juengst S, Reynolds M, et al. Healthy lifestyle after traumatic brain injury: a brief narrative. *Brain Inj.* 2019;33(10):1299-1307. doi:[10.1080/02699052.2019.1641623](https://doi.org/10.1080/02699052.2019.1641623)
52. Stubbs JL, Thornton AE, Sevvick JM, et al. Traumatic brain injury in homeless and marginally housed individuals: a systematic review and meta-analysis. *Lancet Public Health.* 2020;5(1):e19-e32. doi:[10.1016/S2468-2667\(19\)30188-4](https://doi.org/10.1016/S2468-2667(19)30188-4)
53. Chan V, Estrella MJ, Baddeliyanage R, Shah R, Babineau J, Colantonio A. Rehabilitation among individuals experiencing homelessness and traumatic brain injury: a scoping review. *Front Med (Lausanne).* 2022;9:916602. doi:[10.3389/fmed.2022.916602](https://doi.org/10.3389/fmed.2022.916602)
54. Omar S, Williams CC, Bugg LB, et al. Mapping the institutionalization of racism in the research about race and traumatic brain injury rehabilitation: implications for Black populations. *Disabil Rehabil.* 2024;1-16. doi:[10.1080/09638288.2024.2361803](https://doi.org/10.1080/09638288.2024.2361803)
55. Omar S, Williams CC, Bugg LB, Colantonio A. "Somewhere along the line, your mask isn't going to be fitting right": institutional racism in Black narratives of traumatic brain injury rehabilitation across the practice continuum. *BMC Health Serv Res.* 2024;24(1):834. doi:[10.1186/s12913-024-10986-1](https://doi.org/10.1186/s12913-024-10986-1)
56. Omar S, Nixon S, Colantonio A. Integrated care pathways for black persons with traumatic brain injury: a critical transdisciplinary scoping review of the clinical care journey. *Trauma Violence Abuse.* 2023;24(3):1254-1281. doi:[10.1177/15248380211062221](https://doi.org/10.1177/15248380211062221)
57. Venkatesan UM, Rabinowitz AR, Bernier RA, Soto JA, Hillary FG. Effects of perceived discrimination on behavioral health outcomes in people aging with traumatic brain injury. *J Head Trauma Rehabil.* 2023;38(2):191-200. doi:[10.1097/htr.0000000000000815](https://doi.org/10.1097/htr.0000000000000815)
58. Bernier RA, Venkatesan UM, Soto JA, Rabinowitz AR, Hong JS, Hillary FG. Perceived discrimination and blood pressure in individuals aging with traumatic brain injury. *Rehabil Psychol.* 2021;66(2):148-159. doi:[10.1037/rep0000379](https://doi.org/10.1037/rep0000379)
59. Pappadis MR, Sander AM, Struchen MA, Kurtz DM. *Soy diferente*: a qualitative study on the perceptions of recovery following traumatic brain injury among Spanish-speaking U.S. immigrants. *Disabil Rehabil.* 2022;44(11):2400-2409. doi:[10.1080/09638288.2020.1836045](https://doi.org/10.1080/09638288.2020.1836045)
60. Ohayagha C, Merced K, Perrin PB, Arango-Lasprilla JC, Klyce DW, Jones SCT. U.S. vs. foreign nativity and 10-year trajectories of mental health after traumatic brain injury: a model systems study. *J Clin Med.* 2023;12(3):867. doi:[10.3390/jcm12030867](https://doi.org/10.3390/jcm12030867)
61. Keatley E, d'Alfonso A, Abeare C, Keller A, Bertelsen NS. Health outcomes of traumatic brain injury among refugee survivors of torture. *J Head Trauma Rehabil.* 2015;30(6):E1-E8. doi:[10.1097/htr.000000000000103](https://doi.org/10.1097/htr.000000000000103)
62. Taylor S, Brayan K, Storch B, et al. Association between social determinants of health and traumatic brain injury: a scoping review. *J Neurotrauma.* 2024;41(13-14):1494-1508. doi:[10.1089/neu.2023.0517](https://doi.org/10.1089/neu.2023.0517)
63. Parsons K, Mulugeta MG, Bailey G, et al. Association between social determinants of health and pediatric traumatic brain injury outcomes. [published Online First: 20240314]. *Front Neurol.* 2024;15:1339255. doi:[10.3389/fneur.2024.1339255](https://doi.org/10.3389/fneur.2024.1339255)
64. Gary KW, Arango-Lasprilla JC, Stevens LF. Do racial/ethnic differences exist in post-injury outcomes after TBI? A comprehensive review of the literature. *Brain Inj.* 2009;23(10):775-789. doi:[10.1080/02699050903200563](https://doi.org/10.1080/02699050903200563)
65. Fuentes A, Schoen C, Kulzer RR, Long C, Bushnik T, Rath JF. Impact of racial-ethnic minority status and systemic vulnerabilities on time to acute TBI rehabilitation admission in an urban public hospital setting. *Rehabil Psychol.* 2019;64(2):229-236. doi:[10.1037/rep0000260](https://doi.org/10.1037/rep0000260)
66. Richie EA, Nugent JG, Raslan AM. Racial and ethnic inequities in mortality during hospitalization for traumatic brain injury: a call to action. *Front Surg.* 2021;8:690971. doi:[10.3389/fsurg.2021.690971](https://doi.org/10.3389/fsurg.2021.690971)
67. Pappadis MR, Talley KG, Garcia P, et al. Racial and ethnic differences in traumatic brain injury outcomes from 2009 to 2023: protocol for a systematic review. *JMIR Res Protoc.* 2024;13:e58763. doi:[10.2196/58763](https://doi.org/10.2196/58763)
68. Miller T, Kallenbach MD, Huber DL, Brett BL, Nelson LD. Relationship between neighborhood disadvantage and mild traumatic brain injury symptoms. *J Head Trauma Rehabil.* 2023;38(2):165-174. doi:[10.1097/htr.0000000000000809](https://doi.org/10.1097/htr.0000000000000809)
69. McCauley SR, Boake C, Levin HS, Contant CF, Song JX. Postconcussional disorder following mild to moderate traumatic brain injury: anxiety, depression, and social support as risk factors and comorbidities. *J Clin Exp Neuropsychol.* 2001;23(6):792-808. doi:[10.1076/jcen.23.6.792.1016](https://doi.org/10.1076/jcen.23.6.792.1016)
70. Yue JK, Upadhyayula PS, Avalos LN, Phelps RRL, Suen CG, Cage TA. Concussion and mild-traumatic brain injury in rural settings: epidemiology and specific health care considerations. *J Neurosci Rural Pract.* 2020;11(1):23-33. doi:[10.1055/s-0039-3402581](https://doi.org/10.1055/s-0039-3402581)
71. Sander AM, Pappadis MR, Juengst SB, et al. Characterizing health literacy and its correlates among individuals with traumatic brain injury (TBI): a TBI Model Systems study. *J Head Trauma Rehabil.* 2024;39(2):95-102. doi:[10.1097/htr.0000000000000913](https://doi.org/10.1097/htr.0000000000000913)
72. Moore M, Kiatchai T, Ayyagari RC, Vavilala MS. Targeted areas for improving health literacy after traumatic brain injury. *Brain Inj.* 2017;31(13-14):1876-1881. doi:[10.1080/02699052.2017.1346291](https://doi.org/10.1080/02699052.2017.1346291)
73. Hahn EA, Boileau NR, Hanks RA, Sander AM, Miner JA, Carlozzi NE. Health literacy, health outcomes, and the caregiver role in traumatic brain injury. *Rehabil Psychol.* 2020;65(4):401-408. doi:[10.1037/rep0000330](https://doi.org/10.1037/rep0000330)
74. Pappadis MR, Sander AM, Juengst SB, et al. The relationship of health literacy to health outcomes among individuals with traumatic brain injury: a traumatic brain injury model systems study. *J Head Trauma Rehabil.* 2024;39(2):103-114. doi:[10.1097/htr.0000000000000912](https://doi.org/10.1097/htr.0000000000000912)
75. Costello K, Greenwald BD. Update on domestic violence and traumatic brain injury: a narrative review. *Brain Sci.* 2022;12(1):122. doi:[10.1136/bjsports-2022-106676](https://doi.org/10.1136/bjsports-2022-106676)
76. Haag HL, Jones D, Joseph T, Colantonio A. Battered and brain injured: traumatic brain injury among women survivors of intimate partner violence—a scoping review. *Trauma Violence Abuse.* 2022;23(4):1270-1287. doi:[10.1177/1524838019850623](https://doi.org/10.1177/1524838019850623)
77. Beynon CE, Gutmanis IA, Tutty LM, Wathen CN, MacMillan HL. Why physicians and nurses ask (or don't) about partner violence: a qualitative analysis. *BMC Public Health.* 2012;12:473. doi:[10.1186/1471-2458-12-473](https://doi.org/10.1186/1471-2458-12-473)
78. Maas AIR, Roozenbeek B, Manley GT. Clinical trials in traumatic brain injury: past experience and current developments. *Neurotherapeutics.* 2010;7(1):115-126. doi:[10.1016/j.nurt.2009.10.022](https://doi.org/10.1016/j.nurt.2009.10.022)
79. Gundersen C, Engelhard EE, Crumbaugh AS, Seligman HK. Brief assessment of food insecurity accurately identifies high-risk US adults. *Public Health Nutr.* 2017;20(8):1367-1371. doi:[10.1017/S1368980017000180](https://doi.org/10.1017/S1368980017000180)
80. Giza CC, Choe MC, Barlow KM. Determining if rest is best after concussion. *JAMA Neurol.* 2018;75(4):399-400. doi:[10.1001/jamaneurol.2018.0006](https://doi.org/10.1001/jamaneurol.2018.0006)
81. Silverberg ND, Iverson GL. Is rest after concussion "the best medicine?": recommendations for activity resumption following concussion in athletes, civilians, and military service members. *J Head Trauma Rehabil.* 2013;28(4):250-259. doi:[10.1097/HTR.0b013e31825ad658](https://doi.org/10.1097/HTR.0b013e31825ad658)
82. Leddy JJ, Burma JS, Toomey CM, et al. Rest and exercise early after sport-related concussion: a systematic review and meta-analysis. *Br J Sports Med.* 2023;57(12):762-770. doi:[10.1136/bjsports-2022-106676](https://doi.org/10.1136/bjsports-2022-106676)
83. Kontos AP, Eagle SR, Braithwaite R, et al. The effects of rest on concussion symptom resolution and recovery time: a meta-analytic review and subgroup analysis of 4329 patients. *Am J Sports Med.* 2023;51(14):3893-3903. doi:[10.1177/03635465221150214](https://doi.org/10.1177/03635465221150214)
84. De Luigi AJ, Bell KR, Bramhall JP, et al. Consensus statement: An evidence-based review of exercise, rehabilitation, rest, and return to activity protocols for the treatment of concussion and mild traumatic brain injury. *PM R.* 2023;15(12):1605-1642. doi:[10.1002/pmrj.13070](https://doi.org/10.1002/pmrj.13070)
85. Quatman-Yates CC, Hunter-Giordano A, Shimamura KK, et al. Physical therapy evaluation and treatment after concussion/mild traumatic brain injury. *J Orthop Sports Phys Ther.* 2020;50(4):CPG1-CPG73. doi:[10.2519/jospt.2020.0301](https://doi.org/10.2519/jospt.2020.0301)
86. McCulloch KL, Goldman S, Lowe L, et al. Development of clinical recommendations for progressive return to activity after military mild traumatic brain injury: guidance for rehabilitation providers. *J Head Trauma Rehabil.* 2015;30(1):56-67. doi:[10.1097/HTR.000000000000104](https://doi.org/10.1097/HTR.000000000000104)
87. Leddy JJ. Sport-Related Concussion. *N Engl J Med.* 2025;392(5):483-493. doi:[10.1056/NEJMc2400691](https://doi.org/10.1056/NEJMc2400691)
88. Macnow T, Curran T, Tolliday C, et al. Effect of screen time on recovery from concussion: a randomized clinical trial. *JAMA Pediatr.* 2021;175(11):1124-1131. doi:[10.1001/jamapediatrics.2021.2782](https://doi.org/10.1001/jamapediatrics.2021.2782)
89. Cairncross M, Yeates KO, Tang K, et al. Early postinjury screen time and concussion recovery. *Pediatrics.* 2022;150(5):e2022056835. doi:[10.1542/peds.2022-056835](https://doi.org/10.1542/peds.2022-056835)

90. Osmond MH, Legace E, Gill PJ, et al; Canadian Traumatic Brain Injury Research Consortium. Partnering with patients, caregivers, and clinicians to determine research priorities for concussion. *JAMA Netw Open*. 2023;6(6): e2316383-e83. doi:[10.1001/jamanetworkopen.2023.16383](https://doi.org/10.1001/jamanetworkopen.2023.16383)
91. Hart T, Driver S, Sander A, et al. Traumatic brain injury education for adult patients and families: a scoping review. *Brain Inj*. 2018;32(11):1295-1306. doi:[10.1080/02699052.2018.1493226](https://doi.org/10.1080/02699052.2018.1493226)
92. Snell DL, Martin R, Surgenor LJ, et al. Wrestling with uncertainty after mild traumatic brain injury: a mixed methods study. *Disabil Rehabil*. 2020;42(14): 1942-1953. doi:[10.1080/09638288.2018.1542461](https://doi.org/10.1080/09638288.2018.1542461)
93. Remigio-Baker RA, Gregory E, Cole WR, et al. Beliefs about the influence of rest during concussion recovery may predict activity and symptom progression within an active duty military population. *Arch Phys Med Rehabil*. 2020; 101(7):1204-1211. doi:[10.1016/j.apmr.2020.02.015](https://doi.org/10.1016/j.apmr.2020.02.015)
94. Eliyahu L, Kirkland S, Campbell S, Rowe BH. The effectiveness of early educational interventions in the emergency department to reduce incidence or severity of postconcussion syndrome following a concussion: a systematic review. *Acad Emerg Med*. 2016;23(5):531-542. doi:[10.1111/acem.12924](https://doi.org/10.1111/acem.12924)
95. Nygren-de Boussard C, Holm LW, Cancelliere C, et al. Nonsurgical interventions after mild traumatic brain injury: a systematic review. Results of the International Collaboration on Mild Traumatic Brain Injury Prognosis. *Arch Phys Med Rehabil*. 2014;95(3)(Suppl):S257-S264. doi:[10.1016/j.apmr.2013.10.009](https://doi.org/10.1016/j.apmr.2013.10.009)
96. Silverberg ND, Mikolic A. Management of psychological complications following mild traumatic brain injury. *Curr Neurol Neurosci Rep*. 2023;23(3): 49-58. doi:[10.1007/s11910-023-01251-9](https://doi.org/10.1007/s11910-023-01251-9)
97. Cnossen MC, van der Naalt J, Spikman JM, et al. Prediction of persistent post-concussion symptoms after mild traumatic brain injury. *J Neurotrauma*. 2018;35(22):2691-2698. doi:[10.1089/neu.2017.5486](https://doi.org/10.1089/neu.2017.5486)
98. Iverson GL, Gardner AJ, Terry DP, et al. Predictors of clinical recovery from concussion: a systematic review. *Br J Sports Med*. 2017;51(12):941-948. doi:[10.1136/bjsports-2017-097729](https://doi.org/10.1136/bjsports-2017-097729)
99. Ponsford J, Cameron P, Fitzgerald M, Grant M, Mikocka-Walus A, Schönberger M. Predictors of postconcussive symptoms 3 months after mild traumatic brain injury. *Neuropsychology*. 2012;26(3):304-313. doi:[10.1037/a0027888](https://doi.org/10.1037/a0027888)
100. Temkin N, Machamer J, Dikmen S, et al; TRACK-TBI Investigators. Risk factors for high symptom burden three months after traumatic brain injury and implications for clinical trial design: a transforming research and clinical knowledge in traumatic brain injury study. *J Neurotrauma*. 2022;39(21-22): 1524-1532. doi:[10.1089/neu.2022.0113](https://doi.org/10.1089/neu.2022.0113)
101. van der Naalt J, Timmerman ME, de Koning ME, et al. Early predictors of outcome after mild traumatic brain injury (UPFRONT): an observational cohort study. *Lancet Neurol*. 2017;16(7):532-540. doi:[10.1016/S1474-4422\(17\)30117-5](https://doi.org/10.1016/S1474-4422(17)30117-5)
102. Silverberg ND, Gardner AJ, Brubacher JR, Panenka WJ, Li JJ, Iverson GL. Systematic review of multivariable prognostic models for mild traumatic brain injury. *J Neurotrauma*. 2015;32(8):517-526. doi:[10.1089/neu.2014.3600](https://doi.org/10.1089/neu.2014.3600)
103. Lubbers VF, van den Hoven DJ, van der Naalt J, Jellema K, van den Brand C, Backus B. Emergency department risk factors for post-concussion syndrome after mild traumatic brain injury: a systematic review. *J Neurotrauma*. 2024; 41(11-12):1253-1270. doi:[10.1089/neu.2023.0302](https://doi.org/10.1089/neu.2023.0302)
104. Iverson GL. Network analysis and precision rehabilitation for the post-concussion syndrome. *Front Neurol*. 2019;10:489. doi:[10.3389/fneur.2019.00489](https://doi.org/10.3389/fneur.2019.00489)
105. Eagle SR, Jain S, Sun X, et al.; TRACK-TBI Investigators. Network analysis and relationship of symptom factors to functional outcomes and quality of life following mild traumatic brain injury: a TRACK-TBI study. *Front Neurol*. 2023; 14:1308540. doi:[10.3389/fneur.2023.1308540](https://doi.org/10.3389/fneur.2023.1308540)
106. Preszler J, Manderino L, Fazio-Sumrok V, et al. Multidomain concussion symptoms in adolescents: a network analysis. *Appl Neuropsychol Child*. 2023; 12(4):294-303. doi:[10.1080/21622965.2022.2099742](https://doi.org/10.1080/21622965.2022.2099742)
107. Faulkner JW, Theadom A, Snell DL, Williams MN. Network analysis applied to post-concussion symptoms in two mild traumatic brain injury samples. *Front Neurol*. 2023;14:1226367. doi:[10.3389/fneur.2023.1226367](https://doi.org/10.3389/fneur.2023.1226367)
108. Malarkey ME, Fu AJ, Mannan N, et al. Internet-guided cognitive behavioral therapy for insomnia among patients with traumatic brain injury: a randomized clinical trial. *JAMA Netw Open*. 2024;7(7):e2420090. doi:[10.1001/jamanetworkopen.2024.20090](https://doi.org/10.1001/jamanetworkopen.2024.20090)
109. Barlow KM, Kirk V, Brooks B, et al. Efficacy of melatonin for sleep disturbance in children with persistent post-concussion symptoms: secondary analysis of a randomized controlled trial. *J Neurotrauma*. 2021;38(8):950-959. doi:[10.1089/neu.2020.7154](https://doi.org/10.1089/neu.2020.7154)
110. Tomfohr-Madsen L, Madsen JW, Bonneville D, et al. A pilot randomized controlled trial of cognitive-behavioral therapy for insomnia in adolescents with persistent postconcussion symptoms. *J Head Trauma Rehabil*. 2020;35(2): E103-E112. doi:[10.1097/HTR.0000000000000504](https://doi.org/10.1097/HTR.0000000000000504)
111. Silverberg ND, Panenka WJ, Lizotte PP, Bayley MT, Dance D, Li LC. Promoting early treatment for mild traumatic brain injury in primary care with a guideline implementation tool: a pilot cluster randomised trial. *BMJ Open*. 2020; 10(10):e035527. doi:[10.1136/bmjopen-2019-035527](https://doi.org/10.1136/bmjopen-2019-035527)
112. US Department of Veterans Affairs and the Department of Defense. *VA/DoD Clinical Practice Guidelines: Management of Headache*, 2.0 ed. US Department of Veterans Affairs; 2023.
113. Ledoux A-A, Webster RJ, Clarke AE, et al. Risk of Mental Health Problems in children and youths following concussion. *JAMA Netw Open*. 2022;5(3): e221235-e35. doi:[10.1001/jamanetworkopen.2022.1235](https://doi.org/10.1001/jamanetworkopen.2022.1235)
114. Hellewell SC, Beaton CS, Welton T, Grieve SM. Characterizing the risk of depression following mild traumatic brain injury: a meta-analysis of the literature comparing chronic mTBI to non-mTBI populations. *Front Neurol*. 2020; 11:350. doi:[10.3389/fneur.2020.00350](https://doi.org/10.3389/fneur.2020.00350)
115. Scholten AC, Haagsma JA, Cnossen MC, Olf M, van Beeck EF, Polinder S. Prevalence of and risk factors for anxiety and depressive disorders after traumatic brain injury: a systematic review. *J Neurotrauma*. 2016;33(22):1969-1994. doi:[10.1089/neu.2015.4252](https://doi.org/10.1089/neu.2015.4252)
116. Van Praag DLG, Cnossen MC, Polinder S, Wilson L, Maas AIR. Post-traumatic stress disorder after civilian traumatic brain injury: a systematic review and meta-analysis of prevalence rates. *J Neurotrauma*. 2019;36(23):3220-3232. doi:[10.1089/neu.2018.5759](https://doi.org/10.1089/neu.2018.5759)
117. Delmonico RL, Theodore BR, Sandel ME, Armstrong MA, Camicia M. Prevalence of depression and anxiety disorders following mild traumatic brain injury. *PM R*. 2022;14(7):753-763. doi:[10.1002/pmrj.12657](https://doi.org/10.1002/pmrj.12657)
118. Bryant RA, O'Donnell ML, Creamer M, McFarlane AC, Clark CR, Silove D. The psychiatric sequelae of traumatic injury. *Am J Psychiatry*. 2010;167(3):312-320. doi:[10.1176/appi.ajp.2009.09050617](https://doi.org/10.1176/appi.ajp.2009.09050617)
119. Lange RT, Iverson GL, Rose A. Depression strongly influences postconcussion symptom reporting following mild traumatic brain injury. *J Head Trauma Rehabil*. 2011;26(2):127-137. doi:[10.1097/HTR.0b013e3181e4622a](https://doi.org/10.1097/HTR.0b013e3181e4622a)
120. van der Vlegel M, Polinder S, Mikolic A, et al; The Center-Tbi Participants and Investigators. The association of post-concussion and post-traumatic stress disorder symptoms with health-related quality of life, health care use and return-to-work after mild traumatic brain injury. *J Clin Med*. 2021;10(11): 2473. doi:[10.3390/jcm10112473](https://doi.org/10.3390/jcm10112473)
121. Zahner E, Nelson LD, Dikmen SS, et al. The temporal relationship of mental health problems and functional limitations following mTBI: a TRACK-TBI and TED study. *Journal of Neurotrauma* 2019;36:1786-93-86-93. doi:[10.1089/neu.2018.6172](https://doi.org/10.1089/neu.2018.6172)
122. Silverberg ND, Rioux M, Mikolic A, Perez DL, Burke MJ, Howard A. Somatic symptom disorder after mild traumatic brain injury. *J Head Trauma Rehabil*. 2025. doi:[10.1097/htr.0000000000001068](https://doi.org/10.1097/htr.0000000000001068)
123. Gitaari M, Mikolic A, Panenka WJ, Silverberg ND. Diagnostic accuracy of mental health screening tools after mild traumatic brain injury. *AMA Netw Open*. 2024;7(7):e2424076. doi:[10.1001/jamanetworkopen.2024.24076](https://doi.org/10.1001/jamanetworkopen.2024.24076)
124. Fann JR, Bombardier CH, Dikmen S, et al. Validity of the Patient Health Questionnaire-9 in assessing depression following traumatic brain injury. *J Head Trauma Rehabil*. 2005;20(6):501-511. doi:[10.1097/00001199-200511000-00003](https://doi.org/10.1097/00001199-200511000-00003)
125. Dyer JR, Williams R, Bombardier CH, Vannoy S, Fann JR. Evaluating the psychometric properties of 3 depression measures in a sample of persons with traumatic brain injury and major depressive disorder. *J Head Trauma Rehabil*. 2016;31(3):225-232. doi:[10.1097/HTR.0000000000000177](https://doi.org/10.1097/HTR.0000000000000177)
126. Cook KF, Bombardier CH, Bamer AM, Choi SW, Kroenke K, Fann JR. Do somatic and cognitive symptoms of traumatic brain injury confound depression screening? *Arch Phys Med Rehabil*. 2011;92(5):818-823. doi:[10.1016/j.apmr.2010.12.008](https://doi.org/10.1016/j.apmr.2010.12.008)
127. Lean M, Fornells-Ambrojo M, Milton A, et al. Self-management interventions for people with severe mental illness: systematic review and meta-analysis. *Br J Psychiatry*. 2019;214(5):260-268. doi:[10.1192/bjp.2019.54](https://doi.org/10.1192/bjp.2019.54)
128. Sander AM, Pappadis MR, Bushnik T, et al. An umbrella review of self-management interventions for health conditions with symptom overlap with traumatic brain injury. *J Head Trauma Rehabil*. 2024;39(2):140-151. doi:[10.1097/htr.0000000000000863](https://doi.org/10.1097/htr.0000000000000863)
129. Stein MB, Jain S, Giacino JT, et al.; TRACK-TBI Investigators. Risk of posttraumatic stress disorder and major depression in civilian patients after mild traumatic brain injury: a TRACK-TBI study. *JAMA Psychiatry*. 2019;76(3):249-258. doi:[10.1001/jamapsychiatry.2018.4288](https://doi.org/10.1001/jamapsychiatry.2018.4288)

130. Ouellet M-C, Beaulieu-Bonneau S, Sirois M-J, et al. Depression in the first year after traumatic brain injury. *Journal of Neurotrauma*. 2018;10:neu.2017.5379-neu.2017.5379. doi:[10.1089/neu.2017.5379](https://doi.org/10.1089/neu.2017.5379)
131. Rao V, Bertrand M, Rosenberg P, et al. Predictors of new-onset depression after mild traumatic brain injury. *J Neuropsychiatry Clin Neurosci*. 2010;22(1):100-104. doi:[10.1176/jnp.2010.22.1.100](https://doi.org/10.1176/jnp.2010.22.1.100)
132. Jorge RE, Robinson RG, Moser D, Tateno A, Crespo-Facorro B, Arndt S. Major depression following traumatic brain injury. *Arch Gen Psychiatry*. 2004;61(1):42-50. doi:[10.1001/archpsyc.61.1.42](https://doi.org/10.1001/archpsyc.61.1.42)
133. Rytter HM, Graff HJ, Henriksen HK, et al. Nonpharmacological treatment of persistent postconcussion symptoms in adults: a systematic review and meta-analysis and guideline recommendation. *JAMA Netw Open*. 2021;4(11):e2132221. doi:[10.1001/jamanetworkopen.2021.32221](https://doi.org/10.1001/jamanetworkopen.2021.32221)
134. Wheeler S, Acord-Vira A. Occupational therapy practice guidelines for adults with traumatic brain injury. *Am J Occup Ther*. 2023;77(4):7704397010. doi:[10.5014/ajot.2023.077401](https://doi.org/10.5014/ajot.2023.077401)
135. CARF International. *Medical Rehabilitation Standards Manual*. CARF International; 2024.
136. The Concussion Advisory Subcommittee of the Ontario Neurotrauma Foundation. Standards for post-concussion care. Jun 8, 2017. <https://pedsconcussion.com/wp-content/uploads/2021/07/Standards-for-Post-Concussion-Care-2017-en.pdf>
137. Centers for Disease Control and Prevention. Surveillance report of traumatic brain injury-related hospitalizations and deaths by age group, sex, and mechanism of injury—United States, 2016 and 2017, 2021.
138. Gardner RC, Dams-O'Connor K, Morrissey MR, Manley GT. Geriatric traumatic brain injury: epidemiology, outcomes, knowledge gaps, and future directions. *J Neurotrauma*. 2018;35(7):889-906. doi:[10.1089/neu.2017.5371](https://doi.org/10.1089/neu.2017.5371)
139. Albrecht JS, Liu X, Smith GS, et al. Stroke incidence following traumatic brain injury in older adults. *J Head Trauma Rehabil*. 2015;30(2):E62-E67. doi:[10.1097/HTR.0000000000000035](https://doi.org/10.1097/HTR.0000000000000035)
140. van der Vlegel M, Mikolić A, Lee Hee Q, et al; CENTER-TBI Participants and Investigators. Health care utilization and outcomes in older adults after traumatic brain injury: a CENTER-TBI study. *Injury*. 2022;53(8):2774-2782. doi:[10.1016/j.injury.2022.05.009](https://doi.org/10.1016/j.injury.2022.05.009)
141. Hume CH, Wright BJ, Kinsella GJ. Systematic review and meta-analysis of outcome after mild traumatic brain injury in older people. *J Int Neuropsychol Soc*. 2022;28(7):736-755. doi:[10.1017/S1556617721000795](https://doi.org/10.1017/S1556617721000795)
142. Mosenthal AC, Livingston DH, Lavery RF, et al. The effect of age on functional outcome in mild traumatic brain injury: 6-month report of a prospective multicenter trial. *J Trauma*. 2004;56(5):1042-1048. doi:[10.1097/01.ta.0000127767.83267.33](https://doi.org/10.1097/01.ta.0000127767.83267.33)
143. Pappadis MR, Malagaris I, Kuo YF, Leland N, Freburger J, Goodwin JS. Care patterns and predictors of community residence among older patients after hospital discharge for traumatic brain injury. *J Am Geriatr Soc*. 2023;71(6):1806-1818. doi:[10.1111/jgs.18308](https://doi.org/10.1111/jgs.18308)
144. Thompson HJ, Weir S, Rivara FP, et al. Utilization and costs of health care after geriatric traumatic brain injury. *J Neurotrauma*. 2012;29(10):1864-1871. doi:[10.1089/neu.2011.2284](https://doi.org/10.1089/neu.2011.2284)
145. Abdulle AE, de Koning ME, van der Horn HJ, et al. Early predictors for long-term functional outcome after mild traumatic brain injury in frail elderly patients. *J Head Trauma Rehabil*. 2018;33(6):E59-E67. doi:[10.1097/HTR.0000000000000368](https://doi.org/10.1097/HTR.0000000000000368)
146. Galimberti S, Graziano F, Maas AIR, et al; CENTER-TBI and TRACK-TBI participants and investigators. Effect of frailty on 6-month outcome after traumatic brain injury: a multicentre cohort study with external validation. *Lancet Neurol*. 2022;21(2):153-162. doi:[10.1016/S1474-4422\(21\)00374-4](https://doi.org/10.1016/S1474-4422(21)00374-4)
147. Coulter JS, Randazzo J, Kary EE, Samar H. Falls in older adults: approach and prevention. *Am Fam Physician*. 2024;109(5):447-456.
148. St Ivany A, Schminkey D. Intimate partner violence and traumatic brain injury: state of the science and next steps. *Fam Community Health*. 2016;39(2):129-137. doi:[10.1097/fch.0000000000000094](https://doi.org/10.1097/fch.0000000000000094)
149. Tocalino D, Moore A, Cripps E, et al. Exploring the intersection of brain injury and mental health in survivors of intimate partner violence: a scoping review. *Front Public Health*. 2023;11:1100549. doi:[10.3389/fpubh.2023.1100549](https://doi.org/10.3389/fpubh.2023.1100549)
150. Roby PR, Mozel AE, Arbogast KB, et al; CARE Consortium Investigators. Postinjury outcomes after non-sport-related concussion: a CARE Consortium study. *J Athl Train*. 2024;59(3):289-296. doi:[10.4085/1062-6050-0181.23](https://doi.org/10.4085/1062-6050-0181.23)
151. Beauchamp F, Boucher V, Neveu X, et al. Post-concussion symptoms in sports-related mild traumatic brain injury compared to non-sports-related mild traumatic brain injury. *CJEM*. 2021;23(2):223-231. doi:[10.1007/s43678-020-00060-0](https://doi.org/10.1007/s43678-020-00060-0)
152. Ntikas M, Stewart W, Ietswaart M, et al; CENTER-TBI participants and investigators. Contrasting characteristics and outcomes of sports-related and non-sports-related traumatic brain injury. *JAMA Netw Open*. 2024;7(1):e2353318. doi:[10.1001/jamanetworkopen.2023.53318](https://doi.org/10.1001/jamanetworkopen.2023.53318)
153. McPherson AL, Nagai T, Webster KE, Hewett TE. Musculoskeletal injury risk after sport-related concussion: a systematic review and meta-analysis. *Am J Sports Med*. 2019;47(7):1754-1762. doi:[10.1177/0363546518785901](https://doi.org/10.1177/0363546518785901)
154. Reneker JC, Babl R, Flowers MM. History of concussion and risk of subsequent injury in athletes and service members: a systematic review and meta-analysis. *Musculoskelet Sci Pract*. 2019;42:173-185. doi:[10.1016/j.msksp.2019.04.004](https://doi.org/10.1016/j.msksp.2019.04.004)
155. Harmon KG, Clugston JR, Dec K, et al. American Medical Society for Sports Medicine position statement on concussion in sport. *Br J Sports Med*. 2019;53(4):213-225. doi:[10.1136/bjsports-2018-100338](https://doi.org/10.1136/bjsports-2018-100338)
156. Giza CC, Kutcher JS, Ashwal S, et al. Summary of evidence-based guideline update: evaluation and management of concussion in sports [RETIRED]: report of the Guideline Development Subcommittee of the American Academy of Neurology. *Neurology*. 2013;80(24):2250-2257. doi:[10.1212/WNL.0b013e31828d57dd](https://doi.org/10.1212/WNL.0b013e31828d57dd)
157. Parachute. *Canadian Guideline on Concussion in Sport (2nd Ed)*. Parachute; 2024. <https://parachute.ca/wp-content/uploads/2019/06/Concussion-Guideline-2024.pdf>
158. Broglio SP, McAllister T, Katz BP, LaPradd M, Zhou W, McCrea MA; CARE Consortium Investigators. The natural history of sport-related concussion in collegiate athletes: findings from the NCAA-DoD CARE consortium. *Sports Med*. 2022;52(2):403-415. doi:[10.1007/s40279-021-01541-7](https://doi.org/10.1007/s40279-021-01541-7)
159. Putukian M, Purcell L, Schneider KJ, et al. Clinical recovery from concussion—return to school and sport: a systematic review and meta-analysis. *Br J Sports Med*. 2023;57(12):798-809. doi:[10.1136/bjsports-2022-106682](https://doi.org/10.1136/bjsports-2022-106682)
160. Lal A, Kolakowsky-Hayner SA, Ghajar J, Balamane M. The effect of physical exercise after a concussion: a systematic review and meta-analysis. *Am J Sports Med*. 2018;46(3):743-752. doi:[10.1177/0363546517706137](https://doi.org/10.1177/0363546517706137)
161. Langevin P, Frémont P, Fait P, Dubé MO, Bertrand-Charette M, Roy JS. Aerobic exercise for sport-related concussion: a systematic review and meta-analysis. *Med Sci Sports Exerc*. 2020;52(12):2491-2499. doi:[10.1249/MSS.0000000000002402](https://doi.org/10.1249/MSS.0000000000002402)
162. Albano AW Jr, Senter C, Adler RH, Herring SA, Asif IM. The legal landscape of concussion: implications for sports medicine providers. *Sports Health*. 2016;8(5):465-468. doi:[10.1177/1941738116662025](https://doi.org/10.1177/1941738116662025)
163. Department of Defense. Progressive return to activity: primary care for acute concussion management. Published 2024. <https://health.mil/Reference-Center/Publications/2024/02/23/Progressive-Return-to-Activity-Primary-Care-for-Acute-Concussion-Management>
164. Military Health System. Traumatic Brain Injury Center of Excellence. Research review on pain and traumatic brain injury. Published 2024. <https://health.mil/Reference-Center/Publications/2024/08/29/TBICoE-Research-Review-Pain-and-TBI>
165. Mac Donald CL, Johnson AM, Wierzechowski L, et al. Prospectively assessed clinical outcomes in concussive blast vs nonblast traumatic brain injury among evacuated US military personnel. *JAMA Neurol*. 2014;71(8):994-1002. doi:[10.1001/jamaneurol.2014.1114](https://doi.org/10.1001/jamaneurol.2014.1114)
166. Military Health System. Low-level blast exposure and TBI. Accessed Dec 10, 2024. <https://health.mil/Military-Health-Topics/Centers-of-Excellence/Traumatic-Brain-Injury-Center-of-Excellence/Low-Level-Blast-Exposure-and-TBI>
167. Kötter T, Blozik E, Scherer M. Methods for the guideline-based development of quality indicators—a systematic review. *Implement Sci*. 2012;7:21. doi:[10.1186/1748-5908-7-21](https://doi.org/10.1186/1748-5908-7-21)
168. Reed N, Zemek R, Dawson J, Ledoux AA. *Living Guideline for Pediatric Concussion*. Published 2022. <https://pedsconcussion.com/>. doi:[10.17605/OSF.IO/3VWN9](https://doi.org/10.17605/OSF.IO/3VWN9)