COLORADO
Department of
Labor and Employment

Division of Workers' Compensation
633 17th Street, Suite 400
Denver, CO 80202-3660

Evidence Summary
Traumatic Brain Injury Medical Treatment Guideline
2019 Revision

This document contains a summary of the literature critique process and the resulting evidence statements for the Traumatic Brain Injury Medical Treatment Guideline.

For information about how studies were selected to be critiqued, see the search strategy and study selection document ("Search Terms and Topics" under *Traumatic Brain Injury*) on the Division of Workers' Compensation website: https://www.colorado.gov/pacific/cdle/medical-treatment-guidelines.

Articles were critiqued using the Division's literature critique criteria. The literature critique criteria documents are located on the Division website under *Assessment Criteria for Critiques* under *Traumatic Brain Injury*. Critiques for individual articles are also available on the Division website under *Critiques* for *Traumatic Brain Injury.*

Some critiques report statistical analysis that was completed by Division staff. Beginning with the Traumatic Brain Injury Medical Treatment Guideline revision of 2013, relevant RCTs that were published after a Cochrane were evaluated as to whether they would have likely met the Cochrane inclusion criteria. If so, the Cochrane RevMan software was used to update the pooled effect measure and compare it with the original Cochrane report. When Division staff completed additional statistical pooling using RevMan, the result was noted in the "Assessment by DOWC Staff" column of the critique.

Not all of the critiqued articles qualified to be used as evidence. A shortened version of the critique was completed if reasons for exclusion were identified early in the critique process.

Articles that were given a complete critique were given an assessment of "**inadequate**," "**adequate**," or "**high quality**." Note that one article may be graded at different levels for different interventions. For those studies deemed inadequate, a brief rationale was provided.

The articles that were graded as either adequate or high quality were used for evidence statements. Three levels ("**some evidence**," "**good evidence**," and "**strong evidence**") were used to describe strength of evidence for recommendations, based on the amount and quality of the supporting literature.

- "Some" means the recommendation considered at least one adequate scientific study, which reported that a treatment was effective. The Division recognizes that further research is likely to have an impact on the intervention's effect.

- "Good" means the recommendation considered the availability of multiple adequate scientific studies or at least one relevant high-quality scientific study, which reported that

a treatment was effective. The Division recognizes that further research may have an impact on the intervention's effect.

- "Strong" means the recommendation considered the availability of multiple relevant and high-quality scientific studies, which arrived at similar conclusions about the effectiveness of a treatment. The Division recognizes that further research is unlikely to have an important impact on the intervention's effect.

Because the Division synthesizes the medical evidence as much as possible, one assessment (or group of assessments) may potentially create more than one evidence statement. It is also possible that multiple assessments may be combined for a higher level of evidence (e.g., two "adequate" studies might strengthen the evidence supporting a recommendation from "some" to "good").

The following evidence table for the Traumatic Brain Injury Medical Treatment Guideline is a *summary* of evidence based on critique of scholarly articles. See full critiques, available on the Division's Website, for more details on specific studies and assessment of them.

Evidence statements for Mild Traumatic Brain Injury

Evidence statements regarding prognosis and risk factors			
Good evidence	Evidence statement	Citation	Design
	Psychosocial factors such as pre-injury general health are important determinants of recovery from acute mild head injury and may be as predictive or more predictive of recovery than such phenomena as abnormal CT findings.	(Cassidy et al., 2014)	Systematic review of observational studies
	TBI is associated with an important increase in risk of all-cause mortality six months and more after injury. This includes death from suicide, assault, and unintentional injuries. The increase in risk is approximately threefold, and it appears to be independent of sociodemographic factors such as income and marital status.	(Fazel, Wolf, Pillas, Lichtenstein, & Langstrom, 2014)	Longitudinal cohort study from a population registry database

Evidence statements regarding prognosis and risk factors			
Some evidence	Evidence statement	Citation	Design
	While neuropsychological testing scores resolve in complicated and uncomplicated mTBI patients during the year after injury, a significant level of physical, cognitive, and emotional symptoms persist for some patients 1 year after injury when compared to symptoms reported by patients who had been admitted to hospital emergency departments with non-head injuries. Based on a reanalysis of data, mTBI and complicated mTBI – whether the GCS is 15 or 13-14 – are similar with respect to the frequency of persistent concussion symptoms at one month and one year.	(Dikmen, Machamer, & Temkin, 2017)	Prospective cohort study
	Patients who have been seen in an emergency department for an uncomplicated mTBI do as well on a battery of standard neuropsychological tests as patients who have been treated in an emergency department for non-head injuries when these tests are administered one month after the date of injury.		

Evidence statements regarding vestibular symptoms and treatment			
Some evidence	Evidence statement	Citation	Design
	In patients with a sport-related concussion who have persistent dizziness, neck pain, and/or headache 10 days after injury and who are suspected by a physician of having vestibular involvement or cervical spine involvement, an 8 week program of combined cervical physiotherapy and vestibular rehabilitation is likely to improve the rate of medical clearance for return to sport.	(Schneider et al., 2014)	Randomized clinical trial

Evidence statements regarding psychological treatment			
Some evidence	Evidence statement	Citation	Design
	From a small study: 5 individual sessions, 1.5 hours long, of Cognitive Behavioral Therapy (CBT) initiated for patients diagnosed with acute stress disorder early after TBI are significantly more effective than supportive counseling in preventing chronic PTSD in patients who develop acute stress disorder following mTBI.	(Bryant, Moulds, Guthrie, & Nixon, 2003)	Single-blind randomized clinical trial

Evidence statements regarding fatigue			
Strong evidence	Evidence statement	Citation	Design
	Subjective fatigue is more prevalent following mTBI than in healthy controls. It is important to note that studies differ in how fatigue is defined, how it is tested for, and how results are interpreted. This leads to uncertainty in estimates of the frequency of fatigue.	(Mollayeva et al., 2014)	Systematic review of prognostic studies of TBI
Good evidence	Evidence statement	Citation	Design
	Baseline fatigue, medical comorbidity, and litigation are likely to be risk factors for fatigue in patients recovering from mTBI.	(Mollayeva et al., 2014)	Systematic review of prognostic studies of TBI
	Some post-traumatic symptoms such as fatigue are not specific to head injury but also occur with non-head injuries such as fractures, sprains, and other injuries which are not associated with TBI.	(Cassidy et al., 2014)	Systematic review of observational studies
Some evidence	Evidence statement	Citation	Design
	A blue light therapy device with a wavelength of 465 nm, used in the morning upon awakening, can alleviate the severity of fatigue associated with TBI, but the benefits do not persist after the use of the light has been discontinued.	(Sinclair, Ponsford, Taffe, Lockley, & Rajaratnam, 2014)	Randomized clinical trial

Evidence statements regarding early symptoms			
Some evidence	Evidence statement	Citation	Design
	There is little symptomatic or functional gain for patients who have persisting symptoms, such as headaches, fatigue, blurred vision, sleep disturbance, and the like 10 days after an mTBI, and are referred for an early single follow-up office visit with a specialist.	(Matuseviciene, Eriksson, & DeBoussard, 2016)	Randomized clinical trial
	Early and active individual rehabilitation treatment initiated within 2 to 8 weeks after an mTBI injury for patients with post-concussion symptoms does not significantly reduce post-concussion symptoms or improve life satisfaction one year after injury, compared with a non-intervention control group.	(Elgmark Andersson, Emanuelson, Bjorklund, & Stalhammar, 2007)	Single-blind randomized clinical trial

Evidence statements regarding return to work			
Some evidence	Evidence statement	Citation	Design
	Predictors of delayed return to work include a lower level of education, nausea or vomiting on admission to an emergency room, extracranial injuries in addition to mTBI, and severe pain early after injury. Most workers with mTBI return to work within 3 to 6 months after injury, but there is a small percentage (5% to 20%) who face persisting problems 1 to 2 years after injury.	(Cancelliere et al., 2014)	Systematic review of observational studies

Evidence statements regarding persistent mTBI symptoms			
Good evidence	Evidence statement	Citation	Design
	In the setting of mTBI, patients are likely to report their pre-injury status as more favorable than it was likely to have been since they tend to report fewer pre-injury problems with common phenomena such as misplacing car keys and forgetting where they parked than are reported by healthy uninjured volunteers.	(Cassidy et al., 2014)	Systematic review of observational studies

Evidence statements regarding chronic traumatic encephalopathy (CTE)			
Some evidence	Evidence statement	Citation	Design
	A history of repeated mTBI is a risk factor for the development of chronic traumatic encephalopathy, and among football players, the number of seasons of play may be correlated with the severity of disease.	(McKee et al., 2013)	Descriptive study of autopsy findings

Evidence statements regarding initial neuropsychological testing for mTBI			
Some evidence	Evidence statement	Citation	Design
	Patients who have been seen in an emergency department for an uncomplicated mTBI do as well on a battery of standard neuropsychological tests as patients who have been treated in an emergency department for non-head injuries when these tests are administered one month after the date of injury.	(Dikmen et al., 2017)	Prospective cohort study

Evidence against use of a brain acoustic monitor as an initial diagnostic procedure for TBI			
Some evidence	Evidence statement	Citation	Design
	A Brain Acoustic Monitor cannot reliably predict the development of post-concussive symptoms.	(Dutton et al., 2011)	Diagnostic cohort study

Evidence statements regarding follow-up diagnostic procedures			
Some evidence	Evidence statement	Citation	Design
	Although it should not be used to diagnose mTBI, SPECT may provide useful information in some cases in which the prognosis is in question, particularly if structural neuroimaging is normal.	(Jacobs, Put, Ingels, Put, & Bossuyt, 1996)	Consecutive case series

Evidence statements regarding neuropsychological assessment			
Some evidence	Evidence statement	Citation	Design
	There is an association between poor effort on verbal memory tests and poor effort on computerized tests of postural stability in patients with TBI who are being evaluated for disability ratings.	(Armistead-Jehle, Lange, & Green, 2017)	Retrospective review of consecutive charts

Evidence statements regarding psychometric testing			
Good evidence	Evidence statement	Citation	Design
	Psychometric testing can predict medical treatment outcome.	(Block, Ohnmeiss, Guyer, Rashbaum, & Hochschuler, 2001)	Prospective cohort study
		(Sinikallio et al., 2009)	Observational cohort study
		(Sinikallio et al., 2010)	Observational cohort study

Evidence statements regarding acupuncture for headache			
Good evidence	Evidence statement	Citation	Design
	True acupuncture has small positive effects in reducing headache frequency in adults with episodic or chronic tension-type headache over 6 months when compared to no treatment / routine care or "sham" (placebo) acupuncture.	(K. Linde, Allais, Brinkhaus, Fei, Mehring, Shin, et al., 2016)	Systematic review and meta-analyses of randomized clinical trials
	True acupuncture has small positive effects in reducing migraine frequency over 6 months when compared to "sham" (placebo) acupuncture, small positive effects after treatment compared to prophylactic drug treatment, and moderate positive effects in reducing migraine frequency after treatment compared to no treatment / routine care in adults with episodic migraines.	(K. Linde, Allais, Brinkhaus, Fei, Mehring, Vertosick, et al., 2016)	Systematic review and meta-analyses of randomized clinical trials

Evidence statements regarding exercise, manipulation, and patient education for headache			
Good evidence	Evidence statement	Citation	Design
	Therapeutic patient education has small to moderate positive effects in improving quality of life and in reducing headache disability and the frequency of migraines in patients with migraines when compared to controls or usual care.	(Kindelan-Calvo et al., 2014)	Systematic review and meta-analyses of randomized clinical trials

Evidence statements regarding exercise, manipulation, and patient education for headache			
Some evidence	Evidence statement	Citation	Design
	6 to 8 sessions of upper cervical and upper thoracic manipulation over 4 weeks are significantly more effective in reducing headache intensity, disability, headache frequency and duration, and medication intake than mobilization combined with exercises in patients with cervicogenic headache, and the effects are maintained at 3 months.	(Dunning et al., 2016)	Single-blind randomized clinical trial
	Spinal manipulation is effective for treatment of cervicogenic headaches. Exercise is equally efficacious as manipulation and can be used in combination with manipulation. The usual course of treatment was 3–6 weeks and effects were still found at 1 year.	([Cochrane] Bronfort et al., 2004)	Systematic review of clinical trials

Evidence statements regarding pharmaceutical treatment for headache			
Strong evidence	Evidence statement	Citation	Design
	Aspirin is better than placebo for acute migraine headaches.	([Cochrane] Kirthi, Derry, Moore, & McQuay, 2010)	Meta-analysis of randomized clinical trials
	Topiramate at a dose of 100 mg/day is more effective than placebo in reducing the frequency of migraine headache.	([Cochrane] Mattias Linde, Mulleners, Chronicle, & McCrory, 2013)	Meta-analysis of clinical trials
	Sumatriptan is more effective than placebo for	(C. J. Derry, Derry, & Moore, 2014)	Meta-analyses of randomized

Evidence statements regarding pharmaceutical treatment for headache			
Strong evidence continued	rapid relief of acute migraine headache in adults. The subcutaneous route of administration at a dose of 4 mg or 6 mg is likely to be more effective than the oral route of either 50 or 100 mg. There is insufficient evidence to support the oral dose of 25 mg, although it may be effective as well. The intranasal route of 20 mg is supported by the evidence, but there is insufficient support for the 10 mg route. There is insufficient evidence regarding the rectal route of 25 mg due to limited data, but it is also a reasonable option under appropriate circumstances.		clinical trials
	Propranolol is superior to placebo for migraine prophylaxis.	([Cochrane] K. Linde & Rossnagel, 2004)	Meta-analysis of clinical trials
Good evidence	Evidence statement	Citation	Design
	Amitriptyline is beneficial for chronic tension headaches.	(Bendtsen, Jensen, & Olesen, 1996)	Randomized crossover trial
	Acetaminophen at a dose of 1000 mg/day is effective for acute migraines.	(S. Derry, Moore, & McQuay, 2010)	Meta-analysis of randomized clinical trials
	A single dose of 200-400 mg of ibuprofen is effective for acute migraines.	([Cochrane] Rabbie, Derry, Moore, & McQuay, 2010)	Meta-analysis of randomized clinical trials
	Valproate is more effective than placebo in reducing the frequency of migraine headache.	([Cochrane] Mattias Linde et al., 2013)	Meta-analysis of clinical trials

Evidence statements regarding pharmaceutical treatment for headache			
Good evidence continued	Adding an antiemetic to aspirin makes it more effective for headache and associated symptoms.	([Cochrane] Kirthi et al., 2010)	Meta-analysis of randomized clinical trials

Evidence statements regarding botulinum toxin injections for migraine			
Some evidence	Evidence statement	Citation	Design
	Botulinum toxin is more effective than placebo in the prophylaxis of chronic migraine with headache frequency of 15 or more days per month.	(Aurora et al., 2011)	Randomized clinical trial followed by open-label study

Evidence against botulinum toxin injections for cervical pain and cervicogenic headache			
Good evidence	Evidence statement	Citation	Design
	Botulinum toxin is not different from placebo for cervical pain and is not likely to be clinically more effective than placebo for cervicogenic headache.	(Langevin et al., 2011)	Meta-analysis of randomized clinical trials
		(M. Linde et al., 2011)	Crossover randomized clinical trial

Evidence statements regarding vestibular rehabilitation			
Good evidence	Evidence statement	Citation	Design
	Vestibular rehabilitation incorporating visual motion performed by the patient alone with brief instruction from a health care provider reduces dizziness and improves function.	([Cochrane] McDonnell & Hillier, 2015)	Meta-analysis of randomized clinical trials

Evidence statements regarding vestibular rehabilitation			
Some evidence	Evidence statement	Citation	Design
	2 to 6 sessions of Mulligan sustained natural apophyseal glides (SNAGs) or Maitland mobilizations over 6 weeks are significantly more effective in reducing the intensity and frequency of cervicogenic dizziness than a placebo intervention in patients with chronic cervicogenic dizziness. The effects are maintained at 12 weeks post treatment.	(Reid, Rivett, Katekar, & Callister, 2014)	Double-blind randomized clinical trial
	An 8-week program of combined cervical physiotherapy and vestibular rehabilitation is likely to improve the rate of medical clearance for return to sport for patients with a sport-related concussion who have persistent dizziness, neck pain, and/or headache 10 days after injury and who are suspected by a physician of having vestibular involvement or cervical spine involvement.	(Schneider et al., 2014)	Randomized clinical trial

Evidence statements regarding mTBI sleep disturbance			
Good evidence	Evidence statement	Citation	Design
	Online cognitive behavioral treatment (CBT) programs are comparable to both face-to-face CBT programs as well as pharmacologic therapy in reducing insomnia severity and sleep efficiency.	(Zachariae, Lyby, Ritterband, & O'Toole, 2016)	Meta-analysis of randomized clinical trials

Evidence statements regarding mTBI sleep disturbance			
Some evidence	Evidence statement	Citation	Design
	Blue light therapy significantly reduces self-reported fatigue and daytime sleepiness symptoms and may be helpful in some patients with TBI.	(Sinclair et al., 2014)	Randomized clinical trial

Evidence statements regarding mTBI and cognitive treatment			
Good evidence	Evidence statement	Citation	Design
	Cognitive training has small to moderate positive effects in improving cognitive and functional outcomes in patients with mild to severe TBI who are at least 1-year post-acute TBI when compared to waiting list controls or standard rehabilitation.	(Hallock et al., 2016)	Systematic review and meta-analyses of randomized clinical trials
	mTBI without post-traumatic amnesia does not require routine rehabilitation.	(Turner-Stokes, Disler, Nair, & Wade, 2005)	Systematic review of randomized trials, quasi-randomized trials, and quasi-experimental studies
Some evidence	Evidence statement	Citation	Design
	Routine scheduling for cognitive rehabilitation for uncomplicated mTBI is not likely to improve outcomes, and mTBI cases with a psychiatric history are more likely to benefit from routine assessment for cognitive rehabilitation treatment.	(Ghaffar, McCullagh, Ouchterlony, & Feinstein, 2006)	Randomized clinical trial

Evidence statements regarding mTBI psychological/educational interventions			
Some evidence	Evidence statement	Citation	Design
	5 individual sessions, 1.5 hours long, of Cognitive Behavioral Therapy (CBT) initiated for patients diagnosed with acute stress disorder early after TBI are significantly more effective than supportive counseling in preventing chronic PTSD in patients who develop acute stress disorder following mTBI.	(Bryant et al., 2003)	Single-blind randomized clinical trial
	For patients with complicated mTBI and moderate TBI who have completed initial therapy, 12 weeks of telephone-based and in-person Cognitive Behavioral Therapy (CBT) interventions are no more effective than usual care for treating Major Depressive Disorder (MDD). Due to the differences noted between groups in this study, it is not possible to determine if telephone CBT is preferable to in-person CBT after initial treatment has been completed. However, telephone CBT allowed more participation by support persons, and this may be important to patients with mTBI. It is interesting that secondary data showed high satisfaction with CBT, 84%, and only 26% with usual care.	(Fann et al., 2015)	Single-blind randomized clinical trial

Evidence statements regarding nonsteroidal anti-inflammatory drugs (NSAIDs)			
Good evidence	Evidence statement	Citation	Design
	Celecoxib in a dose of 200 mg per day, administered over a long period, does not have a worse cardiovascular risk profile than naproxen at a dose of up to 1000 mg per day or ibuprofen at a dose of up to 2400 mg per day.	(Nissen et al., 2016)	Randomized noninferiority trial
	Celecoxib has a more favorable safety profile than ibuprofen or naproxen with respect to serious GI adverse events, and it has a more favorable safety profile than ibuprofen with respect to renal adverse events.		
	Topical NSAIDs are associated with fewer systemic adverse events than oral NSAIDs, e.g., reduced risk of gastrointestinal adverse effects by approximately one third.	([Cochrane] S. Derry, Moore, Gaskell, McIntyre, & Wiffen, 2016)	Meta-analysis of randomized clinical trials

Evidence statements regarding hyperbaric oxygen			
Good evidence	Evidence statement	Citation	Design
	HBO2 is unlikely to be beneficial in the setting of mTBI.	(Crawford, Teo, Yang, Isbister, & Berry, 2017)	Systematic review of randomized and nonrandomized studies of HBO2

Evidence statements regarding mTBI interdisciplinary rehabilitation programs			
Good evidence	Evidence statement	Citation	Design
	mTBI without post-traumatic amnesia does not require routine rehabilitation.	([Cochrane] Turner-Stokes et al., 2005)	Systematic review of randomized trials, quasi-randomized trials, and quasi-experimental studies

Evidence statements regarding return to work			
Strong evidence	Evidence statement	Citation	Design
	In the setting of TBI, there is a negative association between psychiatric comorbidity (anxiety, depression, PTSD) and return to work; however, the magnitude of this effect has not been clearly established.	(Garrelfs, Donker-Cools, Wind, & Frings-Dresen, 2015)	Systematic review of observational studies

Evidence statements for Moderate/Severe Traumatic Brain Injury

Evidence statements regarding course of recovery			
Good evidence	Evidence statement	Citation	Design
	TBI is associated with an important increase in risk of all-cause mortality six months and more after injury. This includes death from suicide, assault, and unintentional injuries. The increase in risk is approximately threefold, and it appears to be independent of sociodemographic factors such as income and marital status.	(Fazel et al., 2014)	Longitudinal cohort study from a population registry database

Evidence against use of a brain acoustic monitor as an initial diagnostic procedure for TBI			
Some evidence	Evidence statement	Citation	Design
	A Brain Acoustic Monitor cannot reliably predict the development of post-concussive symptoms.	(Dutton et al., 2011)	Diagnostic cohort study

Evidence statements regarding neuropsychological assessment			
Some evidence	Evidence statement	Citation	Design
	There is an association between poor effort on verbal memory tests and poor effort on computerized tests of postural stability in patients with TBI who are being evaluated for disability ratings.	(Armistead-Jehle et al., 2017)	Retrospective review of consecutive charts

Evidence statements regarding psychometric testing			
Good evidence	Evidence statement	Citation	Design
	Psychometric testing can predict medical treatment outcome.	(Block et al., 2001)	Prospective cohort study
		(Sinikallio et al., 2009)	Observational cohort study
		(Sinikallio et al., 2010)	Observational cohort study

Evidence statements regarding medications: glucocorticoids			
Good evidence	Evidence statement	Citation	Design
	Glucocorticoids do not decrease mortality.	(CRASH trial collaborators, 2004)	Randomized clinical trial
Some evidence	Evidence statement	Citation	Design
	Glucocorticoids may even increase the mortality rate in individuals with TBIs.	(CRASH trial collaborators, 2004)	Randomized clinical trial

Evidence statements regarding medications: anti-epileptics			
Good evidence	Evidence statement	Citation	Design
	In the setting of M/S TBI, treatment within 24 hours from the time of trauma with an antiepileptic drug reduces the risk of seizures in the first 7 days after trauma.	(Thompson, Pohlmann-Eden, Campbell, & Abel, 2015)	Meta-analysis of randomized clinical trials

Evidence statements regarding medications: erythropoietin			
Good evidence	Evidence statement	Citation	Design
	In the setting of acute M/S TBI, erythropoietin reduces mortality.	(Liu, 2016)	Meta-analysis of randomized clinical trials

Evidence statements regarding medications: tranexamic acid (TXA)			
Some evidence	Evidence statement	Citation	Design
	When there is a risk of intracranial bleeding in the setting of TBI, TXA is more effective than placebo in reducing the risk of in-hospital mortality and unfavorable neurologic outcomes.	(Zehtabchi, Abdel Baki, Falzon, & Nishijima, 2014)	Meta-analysis of randomized clinical trials

Evidence statements regarding therapeutic hypothermia			
Good evidence	Evidence statement	Citation	Design
	In the setting of severe TBI with intracranial pressure greater than 20 mmHg for at least 5 minutes despite stage 1 treatment such as mechanical ventilation, sedation, elevation of the head of the bed, IV fluids with or without inotropes, analgesia, surgical removal of space-occupying lesions, and ventriculostomy with or without CSF removal, the addition of therapeutic hypothermia lowering core temperature to 32 to 35° C does not improve outcomes at 6 months and may be harmful by increasing	(Andrews et al., 2015)	Randomized clinical trial

Good evidence continued	mortality and the risk of unfavorable neurological outcome.		

Evidence statements regarding decompressive craniectomy			
Good evidence	Evidence statement	Citation	Design
	In patients with severe TBI and raised ICP, a decompressive craniectomy procedure initiated when the ICP rises above 20 mmHg for 15 minutes out of 60 minutes despite use of first tier treatments does not improve the frequency of death or severe disability compared to continuation of nonsurgical treatment.	(Cooper et al., 2011, DECRA trial)	Randomized clinical trial
	Decompressive craniectomy leads to improved mortality when utilized as a last tier approach for severe and refractory intracranial hypertension in patients with severe TBI. However, while operative treatment with craniectomy appears to reduce mortality, it does appear to be associated with slightly increased rates of vegetative state as well as complications. Additionally, the study found no difference in favorable functional	(Hutchinson et al., 2016, RESCUEicp trial)	Parallel group randomized clinical trial

Evidence statements regarding decompressive craniectomy			
Good evidence continued	neurologic outcomes between surgery versus medical management, although the high cross-over rate may have affected these findings.		

Evidence statements regarding activities of daily living			
Good evidence	Evidence statement	Citation	Design
	In the stroke population, occupational therapy provides a modest reduction in disability and risk of death.	([Cochrane] Legg, Drummond, & Langhorne, 2006)	Meta-analysis of randomized clinical trials

Evidence statements regarding M/S TBI cognitive therapy			
Good evidence	Evidence statement	Citation	Design
	Cognitive training has small to moderate positive effects in improving cognitive and functional outcomes in patients with mild to severe TBI who are at least 1-year post-acute TBI when compared to waiting list controls or standard rehabilitation.	(Hallock et al., 2016)	Systematic review and meta-analyses of randomized clinical trials

Evidence statements regarding M/S TBI cognitive therapy			
Good evidence continued	Structured, goal-oriented, individualized multidisciplinary cognitive rehabilitation for patients requiring hospitalization improves mobility, personal care, and independence in ADLs for individuals with TBI. This type of multi-disciplinary rehabilitation of patients with M/S TBI is likely to provide functional and symptomatic benefit once the patient is able to participate.	(Turner-Stokes et al., 2005)	Systematic review of randomized trials, quasi-randomized trials, and quasi-experimental studies
Some evidence	Evidence statement	Citation	Design
	Intensive therapy - 15 hours/week for 16 weeks - in a group setting emphasizing integration of cognitive, interpersonal, and functional gains is superior to the same amount of therapy from multiple individual providers for severe TBI.	(Cicerone et al., 2008)	Randomized clinical trial

Evidence statements regarding M/S TBI cognitive therapy			
Some evidence continued	From an older study of young military patients with M/S TBI who could safely live at home without continual supervision: Psychological treatment in a supported home environment had similar results to inpatient multidisciplinary treatment. Note: This program is not recommended for patients with work related injury as the population in this study differs from the work related injury population.	(Salazar et al., 2000)	Randomized Clinical Trial
	Automated, audiovisual prompts and reminders delivered on home television were more effective in increasing the number of tasks completed than using self-selected or typical reminder strategies for persons with moderate to severe acquired brain injury needing to compensate for memory failures.	(Lemoncello, Sohlberg, Fickas, & Prideaux, 2011)	Randomized controlled crossover trial
	A cognitive program aimed at high order reasoning instruction is likely to improve some aspects of executive function (e.g., working memory, inhibition, switching tasks) for	(Vas, Chapman, Cook, Elliott, & Keebler, 2011)	Randomized clinical trial

Evidence statements regarding M/S TBI cognitive therapy			
	individuals with chronic TBI.		
Some evidence continued	A multi-faceted cognitive rehabilitative intervention focused on aspects of executive function can lead to lasting improvement. In this study, group treatment sessions occurred twice per week for 1 hour over a period of 3 months and were focused on self-awareness, self-initiation, goal setting, planning, flexibility, strategic behavior, self-monitoring, and self-inhibition.	(Spikman, Boelen, Lamberts, Brouwer, & Fasotti, 2010)	Randomized clinical trial
	Video feedback training in addition to verbal feedback significantly improved intellectual self-awareness in M/S TBI participants compared with verbal feedback alone and with no feedback after 4 training sessions.	(Schmidt, Fleming, Ownsworth, & Lannin, 2012)	Double-blind randomized clinical trial

Evidence statements regarding M/S TBI cognitive therapy			
Some evidence continued	8 weeks of occupational therapy training in the use of a personal digital assistant provided significant improvements in patients' daily memory function and decreased functional memory failures compared with standard memory training that uses non-electronic memory aids in participants with moderate to severe acquired brain injury.	(Lannin, 2014)	Randomized clinical trial
	Up to 8 telephone counseling calls focused on independent problem solving over 1 year was no more effective than usual care on improving function, health/emotional status, community/work activities, and well-being at 1 and 2 years after moderate TBI.	(Bell et al., 2011)	Single-blind randomized clinical trial

Evidence statements regarding M/S TBI cognitive therapy			
Some evidence continued	Patients with a history of a severe TBI (characterized by 24 hours or more of post-traumatic amnesia) are better equipped to plan a complex task such as organizing a vacation when they are asked in a structured way to recall a time in their personal history when they successfully planned a complex task, such as organizing a move to a new place to live (i.e., autobiographical cueing).	(Cicerone et al., 2011)	Systematic review of clinical trials and observational studies

Evidence statements regarding speech-language disorders and treatment			
Strong evidence	Evidence statement	Citation	Design
	Patients who have had a TBI are likely to have deficits with respect to processing and expressing the social aspects of verbal communication, such as recognizing the emotional content of utterances on the basis of voice tone and other variables.	(Ilie, Cusimano, & Li, 2017)	Systematic review of observational studies
Good evidence	Evidence statement	Citation	Design
	Many patients with TBI may have difficulty with respect to the recognition and expression of emotional markers of verbal	(Ilie et al., 2017)	Systematic review of observational studies

Evidence statements regarding speech-language disorders and treatment			
Good evidence continued	communication even though they score within normal limits on standardized tests of verbal comprehension.		
Some evidence	Evidence statement	Citation	Design
	Group instruction, 90 minutes weekly over 12 weeks, by a skilled leader, results in improved communication skills for patients with M/S TBI.	(Dahlberg et al., 2007)	Randomized clinical trial

Evidence statements regarding cognitive enhancers			
Good evidence	Evidence statement	Citation	Design
	Citicoline: Citicoline does not improve functional scores in patients with M/S TBI or mild complicated TBI.	(Zafonte et al., 2012)	Phase 3 randomized clinical trial
	Methylphenidate: Methylphenidate has a short-term effect on improving test performance on standardized measures of attention in patients with M/S TBI.	(Whyte et al., 2004; Willmott & Ponsford, 2009)	Randomized crossover trials.
Some evidence	Evidence statement	Citation	Design
	Amantadine: Short-term use of amantadine at daily doses in the setting of severe TBI improves disability more than placebo during the first four weeks of treatment, but effects beyond this	(Giacino et al., 2012)	Randomized clinical trial

Evidence statements regarding cognitive enhancers			
	timeframe are not known.		
Some evidence continued	Donepezil: From a small study of sub-acute patients with M/S TBI: there is improvement in working memory, retrieval of declarative information, sustained attention, and the rate of cognitive recovery with use of donepezil. The effect was evident at ten weeks and may persist after stopping the medication.	(Zhang, Plotkin, Wang, Sandel, & Lee, 2004)	Randomized crossover trial

Evidence statements regarding hypnotics and sedatives			
Some evidence	Evidence statement	Citation	Design
	Zolpidem does not appreciably enhance the effectiveness of Cognitive Behavioral Therapy.	(Morin, 2009)	Randomized clinical trial

Evidence statements regarding nonsteroidal anti-inflammatory drugs (NSAIDs)			
Good evidence	Evidence statement	Citation	Design
	Celecoxib in a dose of 200 mg per day, administered over a long period, does not have a worse cardiovascular risk profile than naproxen at a dose of up to 1000 mg per day or ibuprofen at a dose of up to 2400 mg per day.	(Nissen et al., 2016)	Randomized noninferiority trial

Evidence statements regarding nonsteroidal anti-inflammatory drugs (NSAIDs)			
Good evidence continued	Celecoxib has a more favorable safety profile than ibuprofen or naproxen with respect to serious GI adverse events, and it has a more favorable safety profile than ibuprofen with respect to renal adverse events.		
	Topical NSAIDs are associated with fewer systemic adverse events than oral NSAIDs, e.g., reduced risk of gastrointestinal adverse effects by approximately one third.	([Cochrane] S. Derry et al., 2016)	Meta-analysis of randomized clinical trials

Evidence statements regarding mobility treatment			
Good evidence	Evidence statement	Citation	Design
	Rhythmic auditory stimulation music interventions significantly improve gait velocity and stride length in people with moderate to severe acquired brain injury compared with standard treatment or controls.	([Cochrane] Magee, Clark, Tamplin, & Bradt, 2017)	Systematic review and meta-analyses of randomized clinical trials
	Music interventions for gait may be enhanced when a trained music therapist delivers the intervention.		

Evidence statements regarding muscle tone and joint restriction management			
Strong evidence	Evidence statement	Citation	Design
	Botulinum toxin A has objective and symptomatic benefits over placebo for cervical dystonia.	([Cochrane] Costa et al., 2005)	Meta-analysis of randomized clinical trials
	Botulinum toxin A injection is effective in reducing muscle tone in the setting of symptomatic spasticity when patients have had a stroke. The effects of botulinum toxin on functional ability are less certain, in part because motor weakness is an important component of the functional limitations imposed by upper motor neuron lesions. The optimum dose of botulinum toxin is not certain. Note: It is likely, although unproved, that botulinum toxin would have similar effects on patients with TBI and severe muscle spasm.	(Dong, Wu, Hu, & Wang, 2017)	Systematic review and meta-analyses of randomized clinical trials

Evidence statements regarding muscle tone and joint restriction management			
Good evidence	Evidence statement	Citation	Design
	Mirror therapy improves upper or lower limb motor function after a stroke. Note: It is likely that mirror therapy may benefit TBI patients.	([Cochrane] Thieme, Mehrholz, Pohl, Behrens, & Dohle, 2012)	Meta-analysis of randomized clinical trials

Evidence statements regarding neuromuscular re-education			
Strong evidence	Evidence statement	Citation	Design
	Early onset neurorehabilitation in a trauma centre and more intensive neurorehabilitation in a rehab facility have beneficial effects on the functional recovery of patients with M/S TBI as compared to usual care.	(Königs, Beurskens, Snoep, Scherder, & Oosterlaan, 2018)	Systematic review
Good evidence	Evidence statement	Citation	Design
	Constraint induced motor therapy (CIMT) provides a favorable effect immediately post treatment for stroke victims with paresis of one arm and good cognition.	([Cochrane] Sirtori, Corbetta, Moja, & Gatti, 2009)	Meta-analysis of clinical trials

Evidence statements regarding neuromuscular re-education			
Some evidence	Evidence statement	Citation	Design
	The motor function associated with CIMT is maintained at 24 months after treatment. Note: It is likely that mirror therapy may benefit patients with TBI. Therefore, CIMT is a recommended therapy for similarly affected patients with TBI.	(Wolf et al., 2008)	Meta-analysis of clinical trials

Evidence statements regarding the Meniett device			
Good evidence	Evidence statement	Citation	Design
	The Meniett device produces short-term symptomatic and functional benefit with daily use in individuals with established Ménière's disease, reduced vestibular function, and severe vertigo, which persist despite adequate medical therapy.	(Gates, Green, Tucci, & Telian, 2004; Gurkov et al., 2012)	Randomized clinical trials

Evidence statements regarding vestibular rehabilitation			
Good evidence	Evidence statement	Citation	Design
	Vestibular rehabilitation incorporating visual motion performed by the patient alone with brief instruction from a health care provider reduces dizziness and improves function.	([Cochrane] McDonnell & Hillier, 2015)	Meta-analysis of randomized clinical trials
Some evidence	Evidence statement	Citation	Design
	2 to 6 sessions of Mulligan sustained natural apophyseal glides (SNAGs) or Maitland mobilizations over 6 weeks are significantly more effective in reducing the intensity and frequency of cervicogenic dizziness than a placebo intervention in patients with chronic cervicogenic dizziness. The effects are maintained at 12 weeks post treatment.	(Reid et al., 2014)	Double-blind randomized clinical trial

Evidence statements regarding M/S TBI psychological/educational interventions			
Some evidence	Evidence statement	Citation	Design
	For patients with complicated mTBI and moderate TBI who have completed initial therapy, 12 weeks of telephone-based and in-person Cognitive Behavioral Therapy (CBT) interventions are no more effective than usual care for treating Major Depressive Disorder (MDD). Due to the differences noted between groups in this study, it is not possible to determine if telephone CBT is preferable to in-person CBT after initial treatment has been completed. However, telephone CBT allowed more participation by support persons, and this may be important to patients with TBI. It is interesting that secondary data showed high satisfaction with CBT, 84%, and only 26% with usual care.	(Fann et al., 2015)	Single-blind randomized clinical trial

Evidence statements regarding acute rehabilitation			
Strong evidence	Evidence statement	Citation	Design
	Early onset neurorehabilitation in a trauma centre and more intensive neurorehabilitation in a rehab facility have beneficial effects on the functional recovery of patients with M/S TBI as compared to usual care.	(Königs et al., 2018)	Systematic review

Evidence statements regarding outpatient rehabilitation services			
Good evidence	Evidence statement	Citation	Design
	Multidisciplinary rehabilitation by expert neurological rehabilitation services for patients with M/S TBI who required hospital admission are likely to benefit functionally and symptomatically.	([Cochrane] Turner-Stokes et al., 2005)	Systematic review of randomized trials, quasi-randomized trials, and quasi-experimental studies

Evidence statements regarding return to work			
Strong evidence	Evidence statement	Citation	Design
	In the setting of TBI, there is a negative association between psychiatric comorbidity (anxiety, depression, PTSD) and return to work; however, the magnitude of this effect has not been clearly established.	(Garrelfs et al., 2015)	Systematic review of observational studies

Evidence statements regarding driving evaluation and treatment			
Some evidence	Evidence statement	Citation	Design
	The Useful Field of View (UFOV) tool is a large screen computer that uses specialized software to evaluate and retrain 3 aspects of visual attention (visual processing speed, divided attention, and selective attention). It can improve driving performance in patients with a right hemisphere stroke and may be useful in patients with TBI.	(Cicerone et al., 2011)	Systematic review of clinical trials and observational studies

Evidence statements regarding outpatient rehabilitation: maintenance			
Good evidence	Evidence statement	Citation	Design
	Physical, occupational, or multi-disciplinary outpatient therapy reduces deterioration of ADLs and independence for stroke survivors living in the community. Note: It is likely that this also applies to patients with M/S TBI.	([Cochrane] Stroke Unit Trialists, 2007)	Meta-analysis of randomized clinical trials

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