Draft Guidelines

Australian Clinical Guidelines for Health Professionals Managing People with Whiplash-Associated Disorders, Fourth Edition

State Insurance
Regulatory Authority

NSW GOVERNMENT

1. Governance and stakeholders

1.1. Organisations

The *Australian Clinical Guidelines for Health Professionals Managing People with Whiplash-Associated Disorders, Fourth Edition* (referred to thereafter as 'guidelines') have been developed and published by the New South Wales (NSW) State Insurance Regulatory Authority (SIRA) in partnership with the John Walsh Centre for Rehabilitation Research (JWCRR), University of Sydney.

1.2. Funding and publication

The development and publication of these guidelines have been partially funded by SIRA and were published on 5 June 2023. ISBN: 978-0-7347-4805-8.

1.3. Editorial independence

JWCRR has drafted these guidelines with input from SIRA. To observe editorial independence, SIRA did not draft any content relating to the recommendations made in these guidelines. As a regulator, SIRA's role is to ensure that people injured in motor vehicle collisions (MVC) have access to treatment that will assist with their recovery. An independent Chair was appointed to convene guideline development working group (also known as guideline panel) meetings and a transparent voting system was developed and run by the working group secretariat. Only one SIRA representative on the working group was authorised to vote and make decisions regarding clinical recommendations.

1.4. Copyright information

1.5. Suggested citation

State Insurance Regulatory Authority, Papic, C., Rebbeck, T., Carvalho-e-Silva, A. P., Chia, L., Brown, K., Cameron, I. D., & the Whiplash Guideline Panel: Australian Clinical Guidelines for Health Professionals Managing People with Whiplash-Associated Disorders, Fourth Edition. Sydney, Australia.

1.6. Guideline development working group/guideline panel

Table 1: Guideline development working group members and discipline/expertise

Representative	Discipline / Expertise	Organisation	Role
Professor Maria Crotty	Professor of Rehabilitation, Aged and Extended Care	Flinders University	Chairperson
Technical Members			
Dr Katherine Brown	Postdoctoral Research Fellow	JWCRR, University of Sydney	Researcher
Professor Ian Cameron*	Professor of Rehabilitation Medicine, University of Sydney, and Senior Staff Specialist	JWCRR, Northern Sydney Local Health District and University of Sydney	Researcher, clinician, author
Dr Lionel Chia	Postdoctoral Researcher, Physiotherapist	Cleveland Guardians Baseball Co., USA, University of Sydney	Researcher, author
Dr Peter Edwards*	Accredited Exercise Physiologist, Senior Lecturer	Exercise and Sports Science Australia and Curtin University	Professional representative
Associate Professor Genevieve Grant*	Associate Professor and Director, Australian Centre for Justice Innovation	Australian Centre for Justice Innovation, Monash University	Professional representative
Professor Lisa Harvey*	Physiotherapist, Professor, University of Sydney	JWCRR, University of Sydney	Researcher
Dr Katie de Luca*	Senior Lecturer, Research Fellow CQUniversity	Chiropractic Australia	Professional representative, clinician
Dr Anthony McHugh*	Senior Policy Officer, Clinical Psychologist	Australian Psychological Society and University of Melbourne	Professional representative, clinician
Professor Zachary Munn	Director of Evidence-based Healthcare Research and Director JBI Adelaide GRADE Centre	JBI Adelaide and University of Adelaide	GRADE methodologist
Dr Christopher Papic*	Lecturer Clinical Exercise Physiology and Honorary	JWCRR, University of Sydney, and University of New England	Lead author, researcher, clinician

Representative	Discipline / Expertise	Organisation	Role
	Postdoctoral Research Fellow		
Professor Trudy Rebbeck*	Physiotherapist, Professor, University of Sydney	JWCRR, University of Sydney and Australian Physiotherapy Association	Researcher, professional representative, clinician, author
Dr Ana Paula Carvalho-e-Silva	Postdoctoral Research Fellow	JWCRR, University of Sydney	Researcher, author
Professor Michele Sterling*	Professor, RECOVER Injury Research Centre	University of Queensland	Researcher, subject matter expert
Professor Simon Willcock*	General Practitioner, Program Director of Primary Care and Wellbeing	Macquarie University Health and Sydney North Health Network	Professional representative, clinician
Industry Members			
Ms Kate Hopman*	Principal Road Safety and Regulatory Policy, Insurance Australia Group (IAG)	Insurance Council of Australia	Industry representative
Ms Purnima Kant*	Healthcare Manager, QBE Insurance	Insurance Council of Australia	Industry representative
Regulator Members			
Dr Anne Daly*	Clinical Lead – Allied Health	Transport Accident Commission, Victoria	Regulator representative, clinician
Ms Renee Hebson*	Principal Research Officer	Queensland Motor Accident Insurance Commission	Regulator representative
SIRA Members			
Mr Edward Jenkins	Manager, CTP Strategic Policy	NSW SIRA	Project manager, regulator representative
Ms Isabelle Lai	Senior Policy Officer, CTP Strategic Policy	NSW SIRA	Project manager, secretariat, regulator representative
Ms Bronwyn Martin*	Director, CTP Scheme Design, Policy and Performance	NSW SIRA	Project sponsor, regulator representative

Representative	Discipline / Expertise	Organisation	Role
Consumer Members			
Ms Elyse Barber*	Consumer	N/A	Consumer representative
Ms Sara Clark*	Consumer	N/A	Consumer representative

* Members of the panel who were eligible to vote on recommendations.

The guideline panel had nominated representatives from the following professional, insurance, and regulatory organisations:

1.7. Supporting documents

These guidelines are accompanied by the following supporting documents on the SIRA website: Summary of Recommendations, Technical Report Chapters 1-4, Draft Administrative Report and Draft Dissemination and Implementation Plan.

2. Contents

3. Abbreviations

BPNN = Back Propagation Neural Network
BPPT = Brachial Plexus Provocation Test
CBT = Cognitive behavioural therapy
CES-D = Centre for epidemiological Studies – Depression Scale
CNFDS = Copenhagen Neck Functional Disability Scale
COMT = Genetic marker
CPM = Conditioned Pain modulation
CPT = Cold pain thresholds
CSQ = Coping Strategies Questionnaire
CT = Computed tomography
DAR-5 = Dimensions of Anger Reactions
DASS = Depression Anxiety Stress Scale
DSM-5 = Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition
EDT = Electrical Detection Thresholds
EMG = Electromyography
EPT = Electrical Pain Thresholds
GP = General Practitioners
GRADE = Grading of Recommendations, Assessment, Development, and Evaluations
HADS = Hospital Anxiety and Depression Scale
HCP = Healthcare Professional
HPT = Heat Pain Thresholds
HVLA = High velocity low amplitude
I-C = Intervention minus control
IES = Impact of Events Scale
MD = Mean difference
MFI = Muscle Fat Infiltration
MPI = Multidimensional Pain Inventory
MRI = Magnetic Resonance Imaging
MRS = Magnetic Resonance Spectroscopy
MSK = Musculoskeletal
MVC = Motor vehicle collision
MVIF = Maximal voluntary isometric force
NDI = Neck Disability Index
NFR = Nociceptive Flexion Reflex
NHMRC = National Health and Medical Research Council
NHMRC = National Health and Medical Research Council
NRS = Numeric rating scale
NTNP = Non-Traumatic Neck Pain
OR = Odds ratio
PCL-5 = Posttraumatic Stress Disorder Checklist for DSM-5
PCS = Pain Catastrophizing Scale
PDI = Pain Disability Index
PDQ = Perceived Deficits Questionnaire
PDS = Post-traumatic Stress Diagnostic Scale
PEMT = pulsed electromagnetic therapy
PET = Positron Emission Tomography
PFActS-C = Pictorial Fear of Activities Scale
PHCP = Primary healthcare professional
PIPS = Psychological Inflexibility in Pain Scale
PPT = Pressure Pain Threshold
PSD = Positive Symptom Distress
PSEQ = Pain Self-Efficacy Questionnaire
PTSD = Post-traumatic stress disorder
PTSS = Post-traumatic stress symptoms
QST = Quantitative Sensory Testing
RCT = Randomised controlled trial
ROM = Cervical Range of Motion
RR = Risk ratio
SD = Standard Deviation
SES = Self-Efficacy Scale
SF-12 = Short Form 12 EQ-5D
SF-36 = Short Form 36 survey
SMD = Standardised mean difference

SPECT = Single Photon Emission Computed Tomography
SPNT = Pursuit Neck Torsion Test
TENS = Transcutaneous electrical nerve stimulation
TF-CBT = trauma-focused cognitive behavioural therapy
TSK = Tampa Scale of Kinesiophobia
US = Ultrasound
VAS = visual analogue scale
WAD = Whiplash-associated disorders
WDQ = Whiplash Disability Questionnaire

4. Introduction

4.1. Background

Whiplash injury is the transfer of force through the head and neck via the acceleration-deceleration mechanism. Whiplash-associated disorders (WAD) are the most common injury for the ~2.6 million Australians involved in a non-catastrophic motor vehicle collision (MVC) and characterised by symptoms and disorders following whiplash trauma to the neck (MAA, 2009). The grade of WAD is classified based on the clinical presentation of the person, as defined by the Quebec Task Force (QTF) classification system (Spitzer, 1995) (Table 2). Other symptoms and disorders that can occur in people with WAD include deafness, dizziness, tinnitus, headache, memory loss, dysphagia, and temporomandibular joint pain. Additionally, the acute and chronic Assessment sections of these guidelines detail clinical presentation features of WAD.

Table 2: Quebec Task Force classification of grades of whiplash-associated disorders

Whiplash grade	Classification
0	No complaint about the neck. No physical sign(s).
I	Complaint of neck pain, stiffness, or tenderness only. No physical sign(s).
II	Neck complaint AND musculoskeletal sign(s). Musculoskeletal signs include decreased range of movement and point tenderness.
III	Neck complaint AND neurological sign(s). Neurological signs include decreased or absent tendon reflexes, weakness, and sensory deficits.
IV	Neck complaint AND fracture or dislocation.

Whilst half of those Australians injured should see rapid recovery following a MVC, the clinical course is not so clear for the remaining 50% who may develop chronic pain, disability, psychological disorders (e.g., posttraumatic stress, depression, and anxiety) and continue to report long-term interference in daily life (Sterling et al., 2010; Campbell et al., 2018). Consequently, MVC injuries are a significant and increasing burden worldwide (Haagsma et al., 2016). For instance, economic costs associated with whiplash injuries in Australia exceed $950 million per annum and are greater than cumulative costs associated with spinal cord and traumatic injuries in Queensland (Nikles et al., 2017). Moreover, neck pain, which is the most common symptom associated with is one of the leading causes of Years Lived with Disability (Murray et al., 2015). To combat the large health and economic burden of WADs, researchers have focused on evaluating assessment strategies, factors influencing prognosis, and treatment interventions for acute and chronic WAD.

Most people with acute WAD following a MVC exhibit neck pain and reduced neck range of motion and are managed with conservative interventions. A variety of interventions are used to treat WAD, dependent upon the clinical presentation of the person with WAD and the treating healthcare professional (HCP). For example, exercise, education for the injured person, psychological and behavioural modification, analgesia, and multimodal therapy. The effect of these interventions on outcome of WAD is an ongoing challenge and poor outcomes often occur (Rebbeck et al., 2016), as WAD is heterogenous in nature and is predicated on the complex interaction of psychological and physical factors (Björsenius et al., 2020). When symptoms and disorders persist for three or more months following the injury this is defined as chronic WAD.

4.2. Purpose of these guidelines

The 2014 NSW SIRA "Guidelines for the management of acute whiplash-associated disorders – for health professionals. Sydney: third edition 2014" (SIRA, 2014) covered management of people with WAD in the first 12 weeks following an MVC. The 2008 Trauma and Injury Recovery "Clinical Guidelines for Best Practice Management of Acute and Chronic Whiplash-Associated Disorders" (TRACsa, 2008) provided some guidance on management of people with chronic WAD. However, many studies have been published since the release of these two guidelines. At present, the acute guidelines are mostly used across Australia. As per the Australian National Health and Medical Research Council (NHMRC) Standards for Guidelines, recommendations within clinical guidelines need to be based on current evidence to ensure ongoing relevance and reliability. There is a need for systematic review and collation of current evidence to update the existing Australian WAD guidelines and bridge the gap between research and clinical practice. Since the previous guidelines, the Grading of Recommendations, Assessment, Development, and Evaluations (GRADE) process for evaluating certainty of evidence and developing clinical recommendations is being increasingly used and is now a requirement of new Australian guidelines. The GRADE Evidence to Decision Framework was used to develop clinical recommendations presented in these guidelines. The overall purpose of developing these guidelines is to improve health and social outcomes of people with acute and chronic WAD by i) improving HCPs' understanding of the clinical features of WAD, ii) providing evidence based best practice recommendations for HCPs managing these people, and iii) de-implementing non-recommended assessment methods and treatment modalities. As per the implementation considerations detailed in these guidelines, clinical judgement should be used by HCPs when delivering care to these people in accordance with the Clinical Framework for the Delivery of Health Services (https://www.tac.vic.gov.au/providers/working-with-the-tac/clinical-framework).

4.3. Target populations

The recommendations detailed in these guidelines apply to the following target populations and settings:

- People with acute (injury until <3 months) or chronic (≥3 months post-injury) WAD (grade 0-III).
- HCPs who manage people with WAD:
    - Primary HCPs - General practitioners (GPs)
    - Primary/secondary HCPs - Allied health (e.g., physiotherapists, psychologists, chiropractors, exercise physiologists, occupational therapists)
    - Secondary HCPs – Medical and surgical specialists
    - Whiplash specialist - For these guidelines, defined as an allied or medical healthcare professional with advanced clinical expertise in managing whiplash. May include but not limited to specialist physiotherapists and specialist physicians.
- Emergency departments (ED)
- Insurance personnel
- Legal practitioners
- Insurance regulatory authorities

4.4. Critical outcomes

The guideline panel reached consensus on outcomes that were 'critical' for developing Prognosis and Treatment recommendations in these guidelines. Recommendations were based on studies that evaluated one or more critical outcomes defined in the Core Outcome Domain Set For Whiplash-Associated Disorders (CATWAD) (Chen et al., 2019): neck pain, neck disability, and/or psychological functioning. An additional critical outcome of perceived non-recovery was considered for Prognosis. Economic evaluation (e.g., cost effectiveness) was also extracted as a secondary outcome if reported in treatment clinical trials. Outcomes for Diagnosis and Assessment are defined in their relevant sections.

4.5. References: Introduction

Björsenius, V., Löfgren, M., & Stålnacke, B. M. (2020). One-year follow-up after multimodal rehabilitation for patients with whiplash-associated disorders. *International Journal of Environmental Research and Public Health*, *17*(13), 4784.

Campbell, L., Smith, A., McGregor, L., & Sterling, M. (2018). Psychological factors and the development of chronic whiplash–associated disorder (s). *The Clinical journal of pain*, *34*(8), 755-768.

Chen, K., Andersen, T., Carroll, L., Connelly, L., Côté, P., Curatolo, M., Elliott, J., Grant, G., Jull, G., & Kasch, H. (2019). Recommendations for core outcome domain set for whiplash-associated disorders (CATWAD). *The Clinical journal of pain, 35*(9), 727-736.

Haagsma, J. A., Graetz, N., Bolliger, I., Naghavi, M., Higashi, H., Mullany, E. C., ... & Phillips, M. R. (2016). The global burden of injury: incidence, mortality, disability-adjusted life years and time trends from the Global Burden of Disease study 2013. *Injury prevention*, *22*(1), 3-18.

MAA (2009). Motor Accident Authority of NSW Annual Report 2008/09. Sydney, Australia. https://www.opengov.nsw.gov.au/publications/12083;jsessionid=08A1CE1B40BE3500EFF1C7473D16A2AE

Murray, C. J., Barber, R. M., Foreman, K. J., Ozgoren, A. A., Abd-Allah, F., Abera, S. F., ... & Del Pozo-Cruz, B. (2015). Global, regional, and national disability-adjusted life years (DALYs) for 306 diseases and injuries and healthy life expectancy (HALE) for 188 countries, 1990–2013: quantifying the epidemiological transition. *The Lancet*, *386*(10009), 2145-2191.

Nikles, J., Yelland, M., Bayram, C., Miller, G., & Sterling, M. (2017). Management of whiplash associated disorders in Australian general practice. *BMC Musculoskeletal Disorders*, *18*(1), 1-9.

Rebbeck, T., Leaver, A., Bandong, A. N., Kenardy, J., Refshauge, K., Connelly, L., ... & Sterling, M. (2016). Implementation of a guideline-based clinical pathway of care to improve health outcomes following whiplash injury (Whiplash ImPaCT): protocol of a randomised, controlled trial. *Journal of Physiotherapy*, *62*(2), 111.

State Insurance Regulatory Authority: *Guidelines for the management of acute whiplash-associated disorders – for health professionals*. Sydney: third edition 2014.

Spitzer, W. O. (1995). Scientific monograph of the Quebec Task Force on Whiplash-Associated Disorders: redefining" whiplash" and its management. Spine, 20, 1S-73S.

Sterling, M., Hendrikz, J., & Kenardy, J. (2010). Compensation claim lodgement and health outcome developmental trajectories following whiplash injury: a prospective study. *Pain*, *150*(1), 22-28.

TRACsa. (2008). Clinical guidelines for best practice management of acute and chronic whiplash-associated disorders. TRACsa: Trauma and Injury Recovery, Adelaide, Australia.

5. Plain language summary

This guideline explains to healthcare professionals (HCPs) how to assess and manage people with whiplash, to ensure care provided is timely, effective, cost-effective, and safe. Recommendations are made for people early after injury (acute whiplash) and later (chronic whiplash).

5.1. Methods to make recommendations

A systematic review of literature from January 1995 until November 2022 pertaining to diagnosis, treatment, prognosis, and assessment was undertaken to inform this guideline. Two most recent Australian guidelines were also cross checked for appropriate studies. A guideline panel was assembled with stakeholder representation from health professions (general practice, physiotherapy, chiropractic, exercise physiology, psychology), insurance industry, government regulators and importantly consumers. The panel followed an internationally recommended method to appraise the evidence (Foroutan et al., 2020; Guyatt et al., 2008). The panel then made recommendations that ranged from **strongly for** to **strongly against** based on this appraisal.

5.2. Recommendations for acute whiplash

Diagnosis: HCPs should diagnose whiplash using the Quebec Task Force Classification system, grading whiplash from 0-IV. This involves following the Canadian C-Spine rule to determine if fracture is present (WAD IV), undertaking a neurological assessment to determine neurological injury (WAD III) then a cervical range of motion assessment and palpation to determine WAD 0-II.

Prognosis: HCPs should use one of two recommended risk prediction tools to determine whether people are at low risk (will recover well) or medium/high risk (at risk of ongoing pain and disability) early after injury. They should consider this risk-stratification to determine further assessment and treatment.

Assessment: HCPs are recommended to undertake a standard assessment for all people with whiplash includes assessing symptoms (pain, self-reported disability, number of pain sites), the steps to establish WAD grade (see diagnosis) and to establish prognostic risk (see prognosis). For people at medium/high risk HCP's may consider additional assessment of domains including physical / muscle assessment, pain sensitivity, sensorimotor control, and psychological assessment to guide treatment.

Treatment: HCPs are recommended to provide accurate advice, neck specific exercises and frontline medication (simple analgesics or non-steroidal anti-inflammatories) for people with whiplash. Dizziness specific exercises are recommended when dizziness is present and psychologically informed exercise is recommended for those at medium/high risk. HCPs should refer people at medium/high risk when not recovering to whiplash specialists and or psychologists

as appropriate. Clinical implementation strategies to educate clinicians are recommended. Other treatments (e.g., multimodal physical therapy, multi-disciplinary care, immobilisation, stronger medication, and passive therapies) may be considered in certain circumstances.

5.3. Recommendations for chronic whiplash

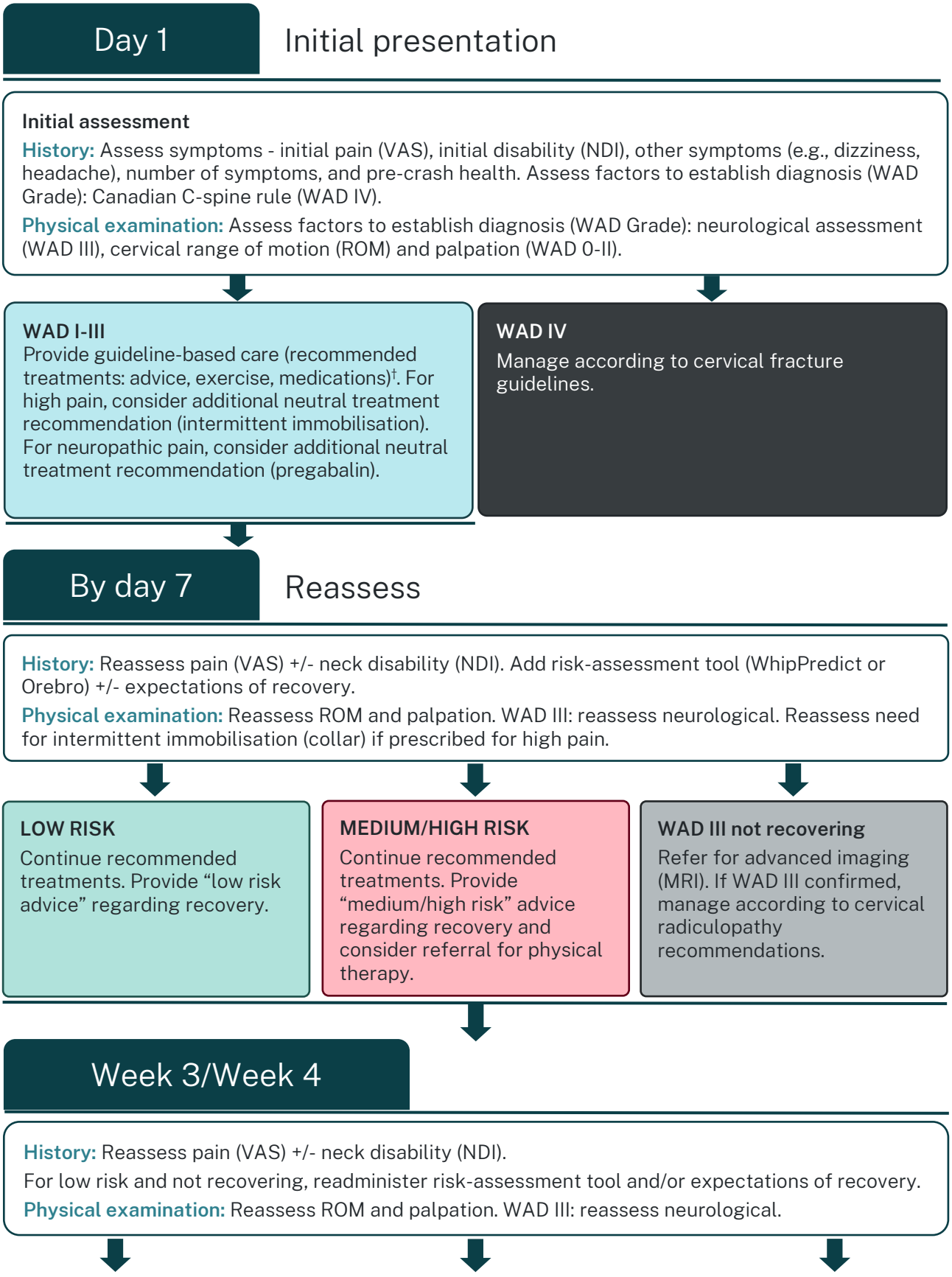
Diagnosis: HCPs are recommended to re-classify the whiplash grade (0-III) when people present during the chronic phase of the condition

Prognosis: HCPs should consider assessment of neck pain intensity, self-reported disability, depression, and perceived injustice to determine people who may have likely ongoing pain and disability.

Assessment: In addition to the steps taken to determine diagnosis, HCPs could consider additional assessment of domains including other symptoms (e.g., jaw pain, upper limb, sleep), initial symptoms, cervical muscle assessment, sensorimotor assessment, and psychological assessment to inform treatment.

Treatment: HCPs are recommended to provide accurate advice, neck specific exercises for people with chronic whiplash. Dizziness specific exercises are recommended when dizziness is present and psychologically informed exercise is recommended for those at medium/high risk. During this phase multimodal physical therapy, trauma focused cognitive behavioural therapy and multi-disciplinary care should be considered. Clinical implementation strategies to educate clinicians are recommended.

6. Acute whiplash injury care flowchart



LOW RISK

If recovering, continue recommended treatments.

WAD I-II MEDIUM/HIGH RISK

Assess for post-traumatic stress symptoms (PTSS) (PCL-5), +/- depression, pain catastrophising, coping strategies.

Additional physical examination: Consider assessment of muscle function, sensorimotor function, and pain sensitivity.

If recovering, continue recommended treatments.

If not recovering, consider psychologically informed exercise, multimodal treatment (based on additional physical examination) and/or multi-disciplinary care. Review medications. Refer to whiplash specialist‡ if not confident in above.

WAD III not recovering/ worsening

Consider specialist medical referral/ opinion for WAD III.

Week 6

History: Reassess pain (VAS) +/- neck disability (NDI).

Physical examination: Reassess ROM and palpation. WAD III: reassess neurological.

LOW RISK

If recovered, discontinue treatment.

If recovering, wean off recommended treatments such that self-managing by 12 weeks.

On average, 3 sessions are required.

MEDIUM/HIGH RISK

History: Reassess PTSS and other psychological factors (reapply metrics).

Additional physical examination: As week 3.

If recovering, continue treatment as week 3.

If not recovering, refer to psychologist if above threshold on PCL-5 and DASS-21. Refer to physician if pain remains high for medication review. Contact insurer +/- general practitioner to facilitate. Refer to whiplash specialist if not confident in recommended physical treatments. Treatment as week 3 or follow specialist advice.

Week 12

LOW RISK

Discharge.

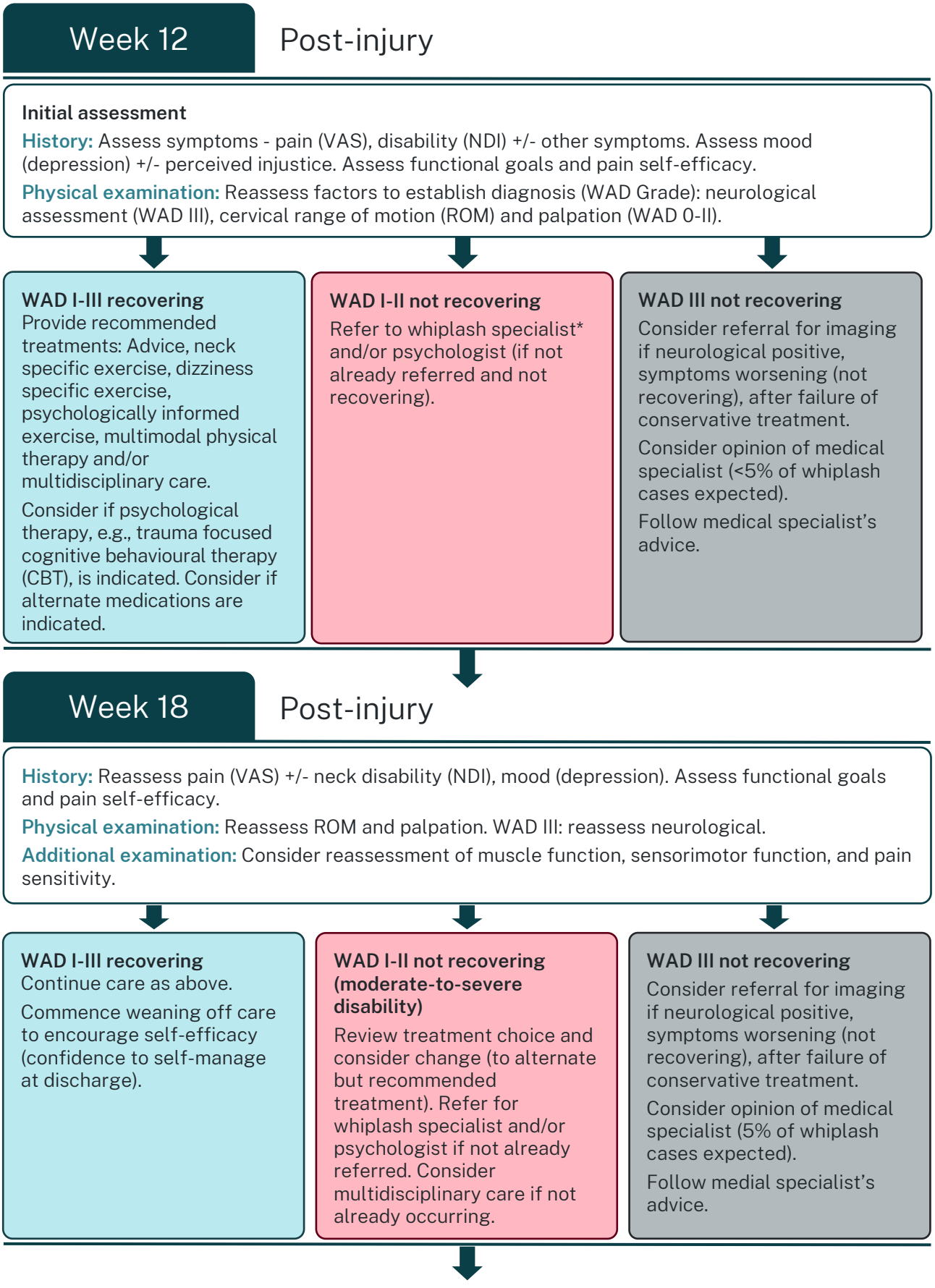
MEDIUM/HIGH RISK

See chronic guideline.

†Resources available at https://www.mywhiplash.com.au/

‡For the purpose of these guidelines, defined as an allied or medical healthcare professional with advanced clinical expertise in managing whiplash. May include but not limited to specialist physiotherapists and specialist physicians.

7. Chronic whiplash injury care flowchart



Week 24 Post-injury

History: Reassess pain (VAS) +/- neck disability (NDI), pain self-efficacy, and functional goals.
Physical examination: Reassess ROM. Reassess other domains as appropriate.

If recovering, discharge with advice.

If not recovered, follow advice from specialists. Care likely to be multidisciplinary – physical, medical, and psychological.

Week 24 to 12 months Post-injury

Provide care in accordance with the Clinical Framework** for the Delivery of Health Services, which includes negotiation for end of care.

*For the purpose of these guidelines, defined as an allied or medical healthcare professional with advanced clinical expertise in managing whiplash. May include but not limited to specialist physiotherapists and specialist physicians.

**https://www.tac.vic.gov.au/providers/working-with-the-tac/clinical-framework

8. Guidelines executive summary

8.1. Acute whiplash recommendations

The following sections provide an executive summary of the Diagnosis, Prognosis, Treatment, and Assessment recommendations for the management of people with acute WAD.

8.1.1. Summary of Diagnosis recommendations

Two systematic reviews and one observational study from a general literature search informed the recommendations for diagnosis for acute whiplash. The guideline panel made the following recommendations for the diagnosis of people with acute whiplash (Table 3).

Table 3: Executive summary of Diagnosis recommendations for people with acute whiplash

Domain (WAD grade)	Index test(s)	Strength of recommendation / Vote summary
Exclude / screen for fracture (WAD IV)	Canadian C-spine rule	Strong for *9/9 100% strong for*
Clinical neurological examination to screen for cervical radiculopathy (WAD III)	History: arm pain>neck pain, paraesthesia, and numbness. Physical Examination: Neurological deficit, antalgic postures.	Conditional for *3/11 27% strong for; 8/11 73% conditional for*
Refer for imaging to determine probable diagnosis of cervical radiculopathy (WAD III)	MRI	Conditional for (consensus recommendation) *1/12 8% strong for; 11/12 92% conditional for*

See 'Acute whiplash: Diagnosis recommendations' (section 10) for implementation considerations for the diagnosis of people with acute WAD.

8.1.2. Summary of Prognosis recommendations

57 prospective longitudinal cohort studies from an electronic search of databases from Jan 1995 to 31 July 2022 informed the recommendations for prognosis for acute whiplash. The guideline panel made the following recommendations for the prognosis of people with acute whiplash (Table 4).

Table 4: Executive summary of Prognosis recommendations for people with acute whiplash

Domain	Tool / factor	Strength of recommendation / Vote summary
Prognostic tools	1. WhipPredict 2. SF-OMPSQ (Orebro)	Strong for *9/9 100% strong for*
Symptom factors	Initial pain intensity	Strong for *9/12 75% strong for; 3/12 25% conditional for*
	Initial neck disability	
	Number of painful body areas	
	Number of painful symptoms	
Psychological factors	Post-traumatic stress symptoms	Strong for *12/13 92% strong for; 1/13 8% conditional for*
	Expectations of recovery	
Psychological factors	Depression	Conditional for *8/13 62% conditional for; 5/13 38% strong for*
	Pain catastrophising	
	Coping strategies	
Physical assessment factors	Cervical ROM	Conditional for *11/12 92% conditional for; 1/12 8% strong for*
	Pain Sensitivity (cold hyperalgesia)	
Compensation factors	Claim status	Conditional for *8/10 80% conditional for; 2/10 20% neutral*
	Lawyer retention	
Pre-crash	Widespread body pain	Conditional for *11/12 92% conditional for; 1/12 8% strong for*
	Chronic neck pain	
	Pre-crash general health	
	Pre-crash mental health	
Physical assessment factors	Muscle function	Neutral *11/12 92% neutral; 1/12 8% conditional for*
	Sensorimotor function	
	Sympathetic nervous system response	
	Cervical bony tenderness (manual palpation)	
	BMI	
Pre-crash	Co-morbid conditions	Neutral *12/12 100% neutral*
Prognostic tools	Cancelliere et al 2021	Neutral
	Bohman et al 2012	

	PPS-WAD	*8/11 73% neutral; 2/11 18% conditional against; 1/11 5% conditional for*
Socio-demographic	Age	Conditional against *11/13 85% conditional against, 2/13 15% conditional for*
	Gender	
	Education	
	Employment status	
	Living status	
	BMI	
	Occupation	
	Income	
Health care utilisation	Primary HCP	Conditional against *6/12 50% conditional against, 3/12 strong against, 2/12 neutral, 1/12 conditional for*
	Hospital	
	GP	
Crash factors	Injury severity score	Conditional against *9/13 69% conditional against, 4/13 21% strong against*
	Head restraint	
	Head position at impact	
	Awareness of collision	
	Vehicle type (injured person)	
	Speed	
	Seatbelt	
	Self-reported collision severity	
	Position in vehicle	
	Airbag	
	Direction of impact	
Radiological factors	Imaging: MRI, Xray CT	Strong against *10/11 91% strong against, 1/11 9% conditional against*

See 'Acute whiplash: Prognosis recommendations' (section 11) for implementation considerations for the prognosis of people with acute WAD.

8.1.3. Summary of Treatment recommendations

44 randomised controlled trials were retrieved from the existing Australian whiplash guidelines (1990-2007) and an electronic search of databases from 2007 to November 2022 informed the

acute WAD treatment recommendations. The guideline panel made the following recommendations for the treatment of people with acute whiplash (Table 5).

Table 5: Executive summary of Treatment recommendations for people with acute whiplash

Domain	Intervention	Strength of recommendation / Vote summary
Advice	Specific educational information	Conditional for *13/16 81% conditional for; 2/16 13% strong for; 1/16 6% neutral*
Physical therapy: Exercise	Neck specific exercises	Conditional for *12/12 100% conditional for*
	Dizziness specific exercises	Conditional for *13/14 93% conditional for; 1/14 7% neutral*
	Psychologically informed exercise interventions	Conditional for *11/14 79% conditional for; 2/14 14% strong for; 1/14 7% neutral*
HCP education	HCP implementation strategy	Conditional for *8/14 57% conditional for; 4/14 29% strong for; 2/14 14% neutral*
Medications	Simple analgesics	Conditional for *9/9 100% conditional for*
	Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)	Conditional for *9/9 100% conditional for*
Physical therapy	Multimodal physical therapy (exercise, manual therapy + other)	Neutral *7/13 54% neutral; 4/13 31% conditional for; 2/13 15% strong for*
Multidisciplinary	Multidisciplinary care	Neutral *8/9 89% neutral; 1/9 11% conditional for*
Immobilisation	Intermittent immobilisation (soft collar)	Neutral *8/10 80% neutral; 2/10 20% conditional for*
Medications	Amitriptyline	Neutral *6/9 67% neutral; 3/9 33% conditional for*
	Pregabalin	Neutral *8/8 100% neutral*
Passive physical therapy	Massage	Neutral *11/13 85% neutral; 2/13 15% conditional for*
	Acupuncture	Neutral *10/11 91% neutral; 1/11 9% conditional against*
		Thoracic – neutral

	Manipulation – high velocity low amplitude	*12/13 92% neutral; 1/13 8% conditional against*
		Cervical – Conditional against *8/13 62% conditional against; 3/13 23% strong against; 2/13 15% neutral*
Medications	Opioids	Conditional against *8/10 80% conditional against; 2/10 20% neutral*
Passive physical therapy	Electrotherapy	Conditional against *9/11 82% conditional against; 2/11 strong against*
	Needling techniques	Conditional against *8/11 73% conditional against; 3/11 27% neutral*
Injections	Botulinum toxin-A	Conditional against *13/15 87% conditional against; 1/15 strong against; 1/15 neutral*
	Corticosteroid injection	Strong against *13/14 93% strong against; 1/14 7% conditional against*
	IV steroid injection	Strong against *12/15 80% strong against; 3/15 20% conditional against*
Other	Treatment for WAD associated headache	No specific recommendation - follow headache guidelines

See 'Acute whiplash: Treatment recommendations' (section 12) for implementation considerations for the treatment of people with acute WAD.

8.1.4. Summary of Assessment consensus recommendations

32 studies retrieved from an electronic search of databases from existing TRACsa Australian whiplash guideline (database 1999- 2007), and an electronic search of databases from 2007 to June 2022 informed the assessment recommendations for people with acute whiplash. Studies were included if they compared people with whiplash to either controls or another pain condition or compared different sub-groups of people with whiplash. The assessment factor needed to be clinically feasible to assess and potentially inform treatment direction. The guideline panel made the following recommendations for the assessment of people with acute whiplash (Table 6).

Table 6: Executive summary of Assessment consensus recommendations for people with acute whiplash

Domain	Physical assessment factor	Strength of recommendation / Vote summary
Physical assessment	Cervical ROM	Strong consensus for *12/12 100% strong for*
Pain sensitivity	Thermal hyperalgesia	Conditional consensus for *11/12 92%conditional for; 1/12 8% neutral*
	Pressure hyperalgesia	
	Dynamic pain sensitivity	
	Brachial plexus provocation test	
Additional symptoms	Jaw pain	Conditional consensus for *10/12 17% conditional for; 2/12 83% neutral*
	Upper limb symptoms	
	Sleep quality/ disturbance	
Physical assessment	Cervical muscle function	Neutral consensus *1/1 9% conditional for; 10/11 91% neutral*
	Cervical muscle performance	
Sensorimotor assessment	Joint position error	Neutral consensus *1/12 8% conditional for; 11/12 92% neutral*
	Cervical movement sense	
	Oculomotor disturbance	
	Balance	
Additional psychological factors	Fear avoidance	Neutral consensus *12/12 100% neutral*
	Pain Self Efficacy	
Pain sensitivity	Vibration hyperalgesia	Conditional consensus against *9/12 (75%) conditionals against; 1/12(5%) strong against; 1/12 neutral (5%); 1/12 (5%) conditional for)*
	Nociceptive Flexion reflex	
Advanced clinical (medical) testing	Stress hormones	Strong consensus against *11/12 92% strong against; 1/112 8% conditional against)*
	Inflammatory biomarkers	Strong consensus against *11/12 92% strong against; 1/112 8% conditional against)*
Advanced Imaging	MRI to assess muscle size and morphology (muscle fat infiltration)	Strong consensus against *10/12 strong against (83%), 1/12 conditional against, 1/12 conditional for)*
	Advanced ultrasound to assess muscle stiffness	Strong consensus against *10/12 strong against (83%), 1/12 conditional against, 1/12 conditional for)*

See ‘Acute whiplash: Assessment consensus recommendations’ (section 13) for implementation considerations for the assessment of people with acute WAD.

8.2. Chronic whiplash recommendations

The following sections provide an executive summary of the Prognosis, Treatment, and Assessment recommendations for the management of people with chronic WAD.

8.2.1. Summary of Prognosis recommendations

Six prospective longitudinal studies from an electronic search of databases from Jan 1995 to Jul 2022 informed the recommendations for prognosis of chronic whiplash. The guideline panel made the following recommendations regarding prognostic factors relevant to be assessed in people with chronic WAD (Table 7).

Table 7: Executive summary of Prognosis recommendations for people with chronic whiplash

Domain / Vote summary	Tool/ factor	Strength of recommendation / Vote summary
Symptom factors	Neck pain intensity	Conditional for *11/13 85% conditional for; 2/13 15% neutral*
	Neck disability	
Psychological factors	Depression	Conditional for *11/13 85% conditional for; 2/13 15% neutral*
	Perceived injustice	
Physical assessment factors	Cervical ROM	Neutral *12/13 92% neutral; 1/13 8% conditional for*
	Joint position error	
	Cervical flexor and extensor strength	
Compensation factors	Claim status	Neutral *13 votes: 12/13 92% neutral; 1/13 8% conditional for*
	Time to admit liability	
	Economic loss claim	
	Prior claim	
Previous health	Smoker	Neutral *12/13 92% neutral; 1/13 8% conditional for*
	Physical activity levels	
	Physical health	
	Previous pain episodes	
	General health	

Sociodemographic	Age	Conditional against *9/13 69% conditional against; 2 strong against, 2 neutral, 1 strong for*
	Gender	
	Employment status	
	Education status	
	Socio-economic status	
Crash factors	Driver	Conditional against *13 votes: 9/13 69% conditional against; 2 strong against, 2 neutral, 1 strong for*
	Collision speed	

See 'Chronic whiplash: Prognosis recommendations' (section 15) for implementation considerations for the prognosis of people with chronic WAD.

8.2.2. Summary of Treatment recommendations

19 RCT's retrieved from the existing TRACsa Australian whiplash guideline (database inception-2007) and an electronic search of databases from 2007 to November 2022 informed the chronic WAD treatment recommendations. The guideline panel made the following recommendations for the treatment of people with chronic whiplash (Table 8).

Table 8: Executive summary of Treatment recommendations for people with chronic whiplash

Domain	Intervention	Strength of recommendation / Vote summary
Advice	Specific educational information	Conditional for *12/16 75% conditional for; 3/16 19% neutral; 1/16 6% strong for*
Physical therapy: Exercise	Neck specific exercises	Conditional for *11/13 85% conditional for; 2/13 15% neutral*
	Dizziness specific exercises	Conditional for *12/13 92% conditional for; 1/13 8% neutral*
	Psychologically informed exercise interventions	Conditional for *9/13 69% conditional for; 4/13 31% strong for*
Physical therapy	Multimodal physical therapy (exercise, manual therapy and other)	Conditional for *9/12 75% conditional for; 2/12 17% neutral; 1/12 8% strong for*
Psychological Interventions	Trauma focused CBT	Conditional for *13/16 81% conditional for; 3/16 19% neutral*
HCP education	HCP implementation strategy	Conditional for

		8/14 57% conditional for; 4/14 29% strong for; 2/14 14% neutral
Multidisciplinary care	Multidisciplinary care	Conditional for *9/9 100% conditional for*
Medications	Simple analgesics	Neutral *8/9 89% neutral; 1/9 11% conditional for*
	NSAIDs	Neutral *8/9 89% neutral; 1/9 11% conditional for*
	Amitriptyline	Neutral *6/9 67% neutral; 3/9 33% conditional for*
	Pregabalin	Neutral *9/9 100% neutral*
Psychological interventions	Exposure therapy	Neutral *8/15 53% neutral; 7/15 47% conditional for*
Passive physical therapy	Massage	Neutral *8/13 62% neutral; 3/13 23% conditional against; 2/13 15% conditional for*
	Acupuncture	Neutral *12/12 100% neutral*
Surgery	Surgery for cervical radiculopathy	Neutral *7/8 88% neutral; 1/8 12% conditional against*
Medications	Opioids	Conditional against *7/10 70% conditional against; 2/10 20% neutral; 1/10 10% strong against*
Passive physical therapy	Electrotherapy	Conditional against *9/11 82% conditional against; 2/11 18% strong against*
	Manipulation (high velocity low amplitude: cervical/thoracic)	Conditional against *8/13 62% conditional against; 3/13 23% strong against; 2/13 15% neutral*
	Needling techniques	Conditional against *8/11 73% conditional against; 3/11 27% neutral*

Medical procedure	Radiofrequency neurotomy (RFN)	Conditional against *9/11 82% conditional against; 2/11 18% strong against*
Injections	Corticosteroid injection	Strong against *10/15 67% strong against; 5/15 33% conditional against*
	Botulinum toxin-A	Strong against *10/14 71% strong against; 4/14 29% conditional against*
	IV steroid injection	Strong against *9/15 60% strong against; 6/15 40% conditional against*
Other	Treatment for WAD associated headache	No specific recommendation - follow headache guidelines

See 'Chronic whiplash: Treatment recommendations' (section 16) for implementation considerations for the treatment of people with chronic WAD.

8.2.3. Summary of Assessment consensus recommendations

133 studies retrieved from an electronic search of databases from existing TRACsa Australian whiplash guideline (database 1999- 2007), and an electronic search of databases from 2007 to June 2022 informed the assessment recommendations for people with chronic whiplash. Studies were included if they compared people with whiplash to either controls or another pain condition or compared different sub-groups of people with whiplash. The assessment factor needed to be clinically feasible to assess and potentially inform treatment. The guideline panel made the following recommendations for the assessment of people with chronic whiplash (Table 9).

Table 9: Executive summary of Assessment consensus recommendations for people with chronic whiplash

Domain	Physical assessment factor	Strength of recommendation / Vote summary
Physical assessment	Cervical ROM	Strong consensus for *11/11 100% strong for*
Pain sensitivity	Thermal hyperalgesia	Conditional consensus for *12/12 100% conditional for*
	Pressure hyperalgesia	
	Brachial plexus provocation test	
Additional psychological factors	Depression	Conditional consensus for *12/12 (100% neutral for)*

Additional symptoms	Jaw pain	Conditional consensus for *10/12 17% conditional for; 2/2 83% neutral*
	Upper limb symptoms	
	Sleep quality/ disturbance	
Physical assessment muscle function	Cervical endurance	Conditional consensus for *12/12 100% conditional for*
	Cervical muscle strength	
Sensorimotor	Joint position error	Conditional consensus for *11/12 92% conditional for; 1/12 8% neutral*
	Cervical movement sense	
	Oculomotor disturbance	
	Balance	
Physical Assessment	Cervical muscle performance	Neutral consensus *1/11 9% conditional for; 10/11 91% neutral*
Pain sensitivity	Dynamic pain sensitivity	Neutral consensus *1/12 8%conditional for; 11/12 92% neutral*
Sensorimotor	Coordination Other proprioceptive tests	Neutral consensus *2/12 17% conditional for; 10/12 83% neutral*
Additional psychological factors	Psychological distress	Neutral consensus *12/12 100% neutral*
	Perceived cognitive deficits	
Pain sensitivity	Vibration hyperalgesia	Conditional consensus against *11/11 100% conditional against*
	Nociceptive flexion reflex	
Advanced clinical (medical) testing	Stress hormones	Strong consensus against *1/12 8% strong for; 11/12 92% strong against*
	Inflammatory biomarkers	
Advanced imaging	MRI to assess muscle size and morphology (muscle fat infiltration	Strong consensus against *10/10 100% strong against*
	Advanced US to assess muscle stiffness	

See 'Chronic whiplash: Assessment consensus recommendations' (section 17) for implementation considerations for the Assessment of people with chronic WAD.

9. Methods

9.1. Guideline development working group/guideline panel

SIRA and JWCRR convened a multidisciplinary guideline development working group of relevant stakeholders including subject matter experts and representatives from clinical health professions, insurance, other state and territory motor accident regulatory bodies and people with lived experience of whiplash injury (section 1.6, Table 1).

Subject matter experts who were Scientific Advisory group members for the "Guidelines for the management of acute whiplash-associated disorders – for health professionals. Sydney: third edition 2014" (SIRA, 2014) were identified and invited via email to contribute to these guidelines by either joining the guideline development working group or independently reviewing the guidelines. An independent Chair who had previous guideline development experience in a related area, and no conflict of interests related to the whiplash guidelines, was appointed by SIRA to convene the working group meetings.

Peak medical and allied health associations, insurance and legal organisations, and motor accident regulatory bodies from each Australian jurisdiction were invited to nominate professional representatives from their organisation to contribute to guideline development in one of three ways: (i) join the guideline development working group; (ii) review the draft guidelines; or (iii) elect to receive the draft guidelines when distributed for public consultation. The peak medical and allied health associations were invited on the basis that HCPs from those associations play a key role in the management and treatment of people with WAD. The Australian Physiotherapy Association (NSW) (APA), Australian Psychological Society (NSW) (APS), Chiropractic Australia, Exercise and Sports Science Australia (ESSA), Insurance Council of Australia (ICA) and the Australian Centre for Justice Innovation each nominated professional representatives to join the guideline development working group. These representatives were authorised to represent the views of their agency and make decisions on its behalf regarding identified evidence and proposed recommendations.

9.2. Guideline steering committee

A project steering committee comprising of members from SIRA and JWCRR was established to ensure the delivery of the project, including the development and publication of the guidelines in accordance with the procedures and requirements for meeting the NHMRC Standards for clinical practice guidelines. Guideline steering committee members are also part of the guideline development working group.

Key decisions affecting project delivery were made by the steering committee. Roles and responsibilities included:

- Developing, reviewing, and endorsing documents related to the project.
- Monitoring progress through regularly tracking the project management plan and list of NHMRC requirements.
- Identifying and mitigating project risks.
- Making decisions regarding prioritisation of project deliverables.
- Making decisions regarding working group membership and management of conflicts of interest.
- Addressing roadblocks that may cause major implications for the project's success.
- Supporting timely and accurate project reporting to SIRA, the NHMRC and other interested parties.

The steering committee met on a fortnightly basis during the initial project planning phase to determine project timelines, assign project roles and responsibilities, establish the guideline development working group and determine processes for working group meetings. Following the formation of the guideline development working group, the steering committee met monthly, or more frequently if the need arose.

9.3. Conflicts of interest

SIRA developed a conflict-of-interest policy in accordance with the NHMRC Guidelines for identifying and managing conflicts of interest. The policy required all guideline development working group members to declare any interests and established a process for determining if a declared interest represents a conflict of interest and how that will be managed. At the commencement of the guideline development process and prior to any involvement in decision-making associated with guideline development, all working group members were asked to declare any potential or perceived conflicts of interest and sign a declaration of interest form. Members were also required to declare any new interests as they arose during the development of the guidelines to the Chair of the guideline development working group. As the guideline development working group comprised of HCPs who were nominated by their professional organisation or who were involved in the development of the previous iterations of whiplash guidelines, these individuals had organisational interests to declare. There were no declared interests that represented a conflict of interest that would have a material impact on guideline development.

Conflicts of interest was a standing item on the agenda for each guideline development working group meeting. Working group members disclosed any conflicts of interest in relation to an item on the agenda or informed the Chair if a new conflict arose. Members deemed to have a conflict of interest excused themselves from discussions and decisions in relation to the relevant agenda item, abstained from voting and took any other such measures to effectively manage that conflict of interest as directed by the Chair of the working group.

9.4. Collaboration

Painaustralia worked alongside the two consumer representatives on the guideline development working group to support them, if required, in interpreting evidence and communicating their experiences when developing recommendations. Representatives on the working group liaised with their professional organisation throughout the guidelines development process to provide recommendation updates and ensure that they are accurately representing the broad views of their organisation. The guidelines have been developed with ongoing methodological consultation from Professor Zachary Munn, Director, JBI Adelaide GRADE Centre.

9.5. Endorsement

The following organisations will be approached to formally endorse the guidelines. Among these are organisations who endorsed the "Guidelines for the management of acute whiplash-associated disorders – for health professionals. Sydney: third edition 2014" (SIRA, 2014) and organisations with representative members on the guideline development working group.

- Australian Chiropractors Association
- Australian Pain Management Association
- Australian Physiotherapy Association
- Australian Psychological Society
- Chiropractic Australia
- Exercise and Sports Science Australia
- Occupational Therapy Australia
- Osteopathy Australia
- Painaustralia
- Royal Australian College of General Practitioners

9.6. Clinical questions

9.6.1. Development of clinical questions

Clinical questions were developed by the guideline panel based on those presented in the existing whiplash guidelines, extant literature identified from the evidence review, current clinical practice, and input from the guideline panel on areas (e.g., treatment modalities) that are important to an Australian healthcare context. Further detail on individual methods for the development of clinical questions for each section of these guidelines is outlined in the technical report chapters: Diagnosis (Chapter 1, section 7.1.5), Assessment (Chapter 2, section 6.1.5), Prognosis (Chapter 3, section 8.1.5), and Treatment (Chapter 4, section 7.1.5). The panel reached consensus on clinical questions for prioritisation in the guidelines for the Diagnosis (see section 9.6.2), Prognosis (see

section 9.6.3), Treatment (see section 9.6.4), and Assessment (see section 9.6.5) of acute and chronic WAD. Prognosis clinical questions were developed to determine what factors HCPs should assess in people with acute or chronic WAD to evaluate their risk of poor prognosis. To our knowledge, our approach to prognostic recommendations is novel in the development of clinical guidelines.

9.6.2. Diagnosis clinical questions

Table 10: Acute whiplash Diagnosis clinical questions for prioritisation

Diagnosis (Whiplash grade)	Clinical question
Fracture (IV)	What clinical examination rule (Canadian C-spine rule vs NEXUS) is most accurate to screen for whiplash cervical fracture (WAD IV) in people with acute WAD?
Cervical radiculopathy (III)	What neurological examination assessments should HCPs use to screen for cervical radiculopathy (WAD III) in people with acute WAD?
Cervical radiculopathy (III)	When should health care professionals refer people with acute WAD and evidence of cervical radiculopathy from neurological examination for imaging?

9.6.3. Prognosis clinical questions

Table 11: Prognosis clinical questions for prioritisation

Prognostic domain	Clinical question
Acute	
Prognostic tools	What clinical prognostic tools are predictive of long-term neck pain, neck disability, non-recovery, and psychological distress in people with acute whiplash associated disorders?
Acute	
1. Symptom	What initial symptom-related factors are predictive of long-term neck pain, neck disability, psychological distress, and perceived recovery in people with acute whiplash associated disorders?
2. Radiological	What initial radiological factors are predictive of long-term neck pain, neck disability, psychological distress, and perceived recovery in people with acute whiplash associated disorders?
3. Psychological	What psychological-related factors are predictive of long-term neck pain, neck disability, psychological distress, and perceived recovery in people with acute whiplash associated disorders?

Prognostic domain	Clinical question
4. Sociodemographic	What initial sociodemographic factors are predictive of long-term neck pain, neck disability, psychological distress, and perceived recovery in people with acute whiplash associated disorders?
5. Crash	What crash-related factors are predictive of long-term neck pain, neck disability, psychological distress, and perceived recovery in people with acute whiplash associated disorders?
6. Physical impairment	What physical impairment factors are predictive of long-term neck pain, neck disability, psychological distress, and perceived recovery in people with acute whiplash associated disorders?
7. Pre-crash	What pre-crash factors are predictive of long-term neck pain, neck disability, psychological distress, and perceived recovery in people with acute whiplash associated disorders?
8. Compensation	What compensation-related factors are predictive of long-term neck pain, neck disability, psychological distress, and perceived recovery in people with acute whiplash associated disorders?
9. Healthcare utilisation	What healthcare utilisation factors are predictive of long-term neck pain, neck disability, psychological distress, and perceived recovery in people with acute whiplash associated disorders?
Chronic	
Chronic whiplash	What factors are predictive of ongoing neck pain, neck disability, non-recovery, and psychological distress in people with chronic whiplash associated disorders?

9.6.4. Treatment clinical questions

Table 12: Treatment clinical questions for prioritisation

Intervention classification	Clinical question
Active	
Neck-specific exercises	Are neck-specific exercises compared with general activity and advice other interventions effective for the management of people with acute or chronic whiplash associated disorders?
Psychologically informed exercise	Are psychologically informed exercise interventions compared with usual care effective for the management of acute or chronic WAD?
Dizziness-specific exercises	Are dizziness-specific exercises effective for the management of acute or chronic WAD with concurrent dizziness symptoms?
Multimodal physical therapy	Is multimodal physical therapy (e.g., exercise and manual therapy, and another treatment modality) compared with single interventions (e.g., advice for activity) effective for the management of acute or chronic WAD?
Psychological	

Intervention classification	Clinical question
Trauma-focused cognitive behavioral therapy	Is trauma focused cognitive behavioral therapy compared with no intervention effective for the management of people with chronic WAD and post-traumatic stress disorder?
Exposure therapy	Is exposure therapy for fear of neck movement compared with advice effective for the management of acute or chronic WAD?
Education	
Specific information	Are specific education interventions compared with general advice effective for the management of acute or chronic WAD?
HCP implementation strategy	Are implementation strategies involving education compared with dissemination of clinical practice guidelines effective for the management of acute or chronic WAD?
Manual therapies	
Manipulation HVLA	Is manipulation (high-velocity low amplitude thrust (HVLA)) of the spine compared with usual care effective for the treatment of acute or chronic WAD?
Massage	Are massage techniques in addition to usual care effective for the management of people with acute or chronic WAD?
Passive therapies	
Soft collar	Is intermittent use of a cervical soft collar in addition to usual care effective for the management of acute WAD?
Electrotherapy	Are electrotherapy techniques in addition to usual care effective for the management of acute or chronic WAD?
Acupuncture	Are acupuncture techniques in addition to usual care effective for the treatment of acute or chronic WAD?
Trigger point needling	Are trigger point needling techniques in addition to usual care effective for the treatment of acute or chronic WAD?
Pharmacological (injection)	
Botulinum toxin-A injection	Are botulinum toxin-A injections compared with placebo injections effective for the management of acute or chronic WAD?
Corticosteroid injection	Are facet joint corticosteroid injections compared with placebo injections effective for the management of acute or chronic WAD?
Intravenous steroid injection	Are intravenous steroid injections compared with placebo injections effective for the management of acute or chronic WAD?
Pharmacological (oral)	
Simple analgesics	Are simple analgesics (e.g., paracetamol) compared with placebo effective for the management of acute or chronic WAD?
NSAIDs	Are non-steroidal anti-inflammatory drugs (NSAIDS) compared with placebo effective for the management of acute or chronic WAD?

Intervention classification	Clinical question
Amitriptyline	Is amitriptyline compared with placebo effective for the management of acute or chronic WAD?
Pregabalin	Is pregabalin compared with placebo effective for the management of acute or chronic WAD?
Opioids	Are opioid analgesics compared with placebo effective for the management of acute or chronic WAD?
Multidisciplinary care	
Multidisciplinary care	Are multidisciplinary one-to-one interventions compared with usual care effective for the management of people with acute or chronic whiplash associated disorders?
Medical procedures	
Radiofrequency neurotomy	Is a radiofrequency neurotomy compared with placebo treatment effective for the management of cervical zygapophyseal-joint pain in people with chronic WAD?
Surgical intervention	Is spinal surgery compared with non-surgical treatment effective for the management of people with WAD and radiculopathy (WAD grade III)?
Other	
Treatment for WAD associated headache*	Are treatments for WAD associated headache effective for the management of people with acute or chronic WAD?

9.6.5. Assessment clinical questions

The following clinical question was applied to each of the primary assessment categories. What clinical assessments assist in:

a) classifying the grade of acute whiplash associated disorders;

b) determining dysfunction in people with acute or chronic whiplash associated disorders compared with other populations (e.g., healthy, idiopathic neck pain);

c) determining the direction of treatment(s); and/or

d) evaluating the effectiveness of treatment intervention(s)?

The primary assessment categories were:

1. Physical Musculoskeletal Impairment
2. Sensorimotor
3. Pain sensitivity
4. Additional Psychological Factors
5. Additional Symptoms
6. Advanced medical testing
7. Imaging

Studies in each category were then sub-categorised according to the factors assessed, test performance, or the technique used (Table 13). These sub-categories were developed to facilitate panel consensus recommendations.

Table 13: Assessment of whiplash-associated disorders subcategories

Assessment domain	Subcategories
Physical musculoskeletal Impairment	Trigger points, Cervical Range of Motion (ROM) Muscle performance/postural changes Muscle function
Sensorimotor	Cervical joint position error Cervical movement sense Oculomotor disturbance Balance Coordination Test Others – Proprioception
Pain sensitivity	Pressure hyperalgesia Thermal hyperalgesia Dynamic pain sensitivity testing Quantitative Sensory Testing (QST) (vibration) Brachial Plexus Provocation Test (BPPT) Nociceptive Flexion Reflex (NFR) Others
Additional psychological factors	Fear avoidance Self-efficacy Mental disorder, Psychological distress Cognitive deficits
Additional symptoms	Additional symptoms Sleep disturbance Jaw symptoms Disability
Advanced medical testing	Stress hormones Inflammatory biomarkers Cerebral blood flow Others
Advanced imaging	Morphological Structural changes Morphological Muscle Fat Infiltration Morphological Muscle Size Metabolites measured by Magnetic resonance spectroscopy Brain characteristics Nerve Mobility Others

9.7. Review of evidence

The primary objective of our evidence review was to identify studies that were published after database searches performed in the previous whiplash guidelines (SIRA, 2014; TRACsa, 2008).

Evidence from these systematic reviews and the previous guidelines were synthesised under relevant clinical questions and used to inform recommendations in these guidelines.

9.7.1. Systematic reviews

Database searches were performed specific to the population group (whiplash injury) and study design criteria for each section of these guidelines: observational studies for diagnosis/assessment, prospective longitudinal cohort studies for prognosis, and randomised controlled intervention trials (RCTs) for treatment studies. Further detail on the search strategies for each section of these guidelines is detailed in their respective technical report chapters under the heading "Search strategy". Searches were performed separately for Diagnosis/Assessment, Prognosis, and Treatment sections using the following databases: Allied and Complementary Medicine Database (Amed), American College of Physicians Journal Club (Prognosis section only), CINAHL, Cochrane (Systematic Reviews Database), EBM Reviews (Prognosis section only), Embase, Medline, Physiotherapy Evidence Database (PEDro – Treatment section only), PsycINFO, and Web of Science Core Collection. The following systematic reviews informed these guidelines:

1. Diagnosis/Assessment: an electronic search of databases from January 2007 to 1 June 2022 with inclusion of eligible studies from the TRACsa (2008) guidelines (search from 1999-2007).
2. Prognosis: an electronic search of databases from January 1995 to 31 July 2022.
3. Treatment: an electronic search of databases from January 2007 to 30 November 2022 with inclusion of eligible studies from the existing Australian whiplash guidelines (searches from 1990-2007).

Articles from the database searches, those included in the existing guidelines, and those identified from reference lists of relevant systematic reviews were screened against population, study design, and whiplash grade inclusion criteria.

9.7.2. Absence of evidence procedures

Our search strategy did not identify studies evaluating the diagnostic accuracy of clinical examination tools available for primary HCPs to screen for possible cervical fracture. To our knowledge no studies of this type have focused specifically on whiplash injury. Studies that have evaluated the accuracy of clinical examination tools for cervical fractures are based on mixed injury mechanisms to the cervical spine such as MVC or blunt trauma. As a result, a general literature search for appropriate systematic reviews was performed and a Cochrane systematic review comparing the Canadian C-spine rule and NEXUS was identified (Nitzsche et al., 2020). The abstract stated that an additional 9 studies had been identified since the 2012 review on the same topic (Michaleff et al., 2012). The research team contacted the authors of the Cochrane review who

noted that the review is ongoing. From the preliminary results (N=15 studies) the authors concluded that the diagnostic accuracy of Canadian C-spine rule appears to be greater compared to NEXUS. However, these results were consistent with the studies included in the 2012 review and therefore the panel agreed to use the 2012 review (Michaleff et al., 2012) to inform our recommendation. The review evaluated the accuracy of the Canadian C-spine rule and NEXUS to screen for clinically important cervical spine injury (fracture).

To our knowledge there are no studies that have focused on evaluating the accuracy of neurological examination assessments for detecting cervical radiculopathy in people with WAD. A general literature search for appropriate systematic reviews identified a systematic review that evaluated the diagnostic value of the injured person's history and physical tests in diagnosing cervical radiculopathy (Thoomes et al., 2018). Further, the research team identified a cross-sectional study that evaluated the diagnostic accuracy of injured person's interview items and other assessments for diagnosis of cervical radiculopathy published after the systematic review (Sleijser-Koehorst et al., 2021). The guideline panel agreed to use these studies to inform the recommendation for these clinical questions. It is to be noted that there is no gold standard for diagnosing cervical radiculopathy and caution is advised when interpreting diagnostic accuracy values of physical assessments (Sleijser-Koehorst et al., 2021). A combination of results from several assessments and consistency with the person's history is likely to be the most effective method when screening for cervical radiculopathy (Sleijser-Koehorst et al., 2021; Thoomes et al., 2018). In conjunction with positive neurological signs and person's history, imaging (MRI) of the cervical region can be used to diagnose probable cervical radiculopathy (e.g., evidence of foraminal stenosis matching the person's clinical presentation).

There is limited high-quality (RCTs) evidence for the management of people with WAD using pharmacological and surgical treatment interventions. Where no evidence was found, but the treatment is used in an Australian context for managing WAD and may have associated adverse effects, evidence and recommendations from other clinical guidelines were reviewed. Five pharmacological treatment clinical questions were developed for these guidelines. Where there was no direct evidence for WAD populations, the panel agreed to review evidence and recommendations pertaining to other pain conditions presented in the following clinical guidelines: i) Australian and New Zealand College of Anaesthetists and Faculty of Pain Medicine: Acute Pain Management Scientific Evidence (5th ed, 2020) (Schug et al., 2020); ii) United Kingdom National Institute for Health and Care Excellence's (NICE) Chronic Pain Assessment and Management Guidelines (NICE, 2021).

No evidence was found for surgical management of WAD, and limited evidence is present for the surgical management of other neck-pain conditions. The panel agreed to use a systematic review on spinal surgery (decompression or decompression with fusion) for the management of chronic neck pain and radiculopathy to inform the recommendation (van-Middelkoop et al., 2013). This

systematic review was relevant for our guidelines as a small subgroup of people with WAD experience cervical radiculopathy (<5%), based on NSW State Insurance Regulatory Authority report data. Screening for cervical radiculopathy (WAD grade III) is considered in the Diagnosis section of these guidelines.

9.7.3. Data extraction and analysis

Study characteristics and outcome data were extracted for included studies. For further detail on these methods and individual study data for each section please review the Technical Reports. Treatment effects, difference between intervention and control at follow-up, on neck pain, neck disability, and/or psychological functioning was extracted for treatment. Accuracy statistics (e.g., sensitivity and specificity) were extracted for diagnostic studies and prognostic tools. Multivariate adjusted measures of association such as risk ratios (RR) and odds ratios (OR) were extracted and considered as primary evidence when developing prognosis recommendations. Multivariate adjusted correlation coefficients were extracted and considered as secondary evidence for prognosis recommendations. The presence or absence of a significant difference between groups was extracted for assessment studies (e.g., *P*-value).

Where appropriate, data were transformed (e.g., median and range transformed to estimated mean and standard deviation) and meta-analyses were performed if there were two or more studies with similar outcomes. Meta analyses for treatment were performed using the inverse variance weighting random-effect model to compute a pooled estimate of mean difference (MD) or standardised mean difference (SMD), and respective 95% confidence intervals (95% CI). Meta-analyses of multivariate adjusted odds ratios (OR) were derived from weighted averages of the estimates of the logarithm of the OR (log[OR]) for prognostic outcomes. In all other instances, evidence was synthesised narratively. Statistical heterogeneity was assessed using the chi-squared test and I^2 statistic where $I^2 < 50\%$ was considered as not important, 50-75% as moderate, and > 75% as high heterogeneity (Higgins et al., 2003). Statistical significance was accepted at $P<0.05$ for all tests.

9.7.4. Certainty of evidence

The GRADE system was used to evaluate the certainty of diagnostic accuracy, treatment effects and prognostic associations (Foroutan et al., 2020; Guyatt et al., 2008). The certainty rating (very low, low, moderate, high) provided an indication of the likelihood that the estimated effect was close to that of the true effect and was used to inform recommendations.

Evidence certainty was evaluated against each of the four primary GRADE domains:

1. Risk of bias: based on the risk of bias evaluation for included studies and considering the weighting of each study (sample size) to the summarised effect. For further details on the

individual tools used in these guidelines see “Risk of bias assessment” in the Diagnosis, Prognosis, and Treatment Technical Reports.

2. **Inconsistency:** extent of heterogeneity in the study findings as evaluated by visual inspection of the effects and confidence intervals for narrative summaries, and/or heterogeneity statistics for meta-analyses.
3. **Indirectness:** extent to which the included studies were applicable to the clinical question and an Australian healthcare context.
4. **Imprecision**: i) whether there was optimal information size (e.g., >400 participants for continuous outcomes); ii) by considering the position of the estimated effect and width of confidence intervals and the clinically meaningful threshold (see below).

For Diagnosis and prognostic tools, accuracies of 0.5 - <0.70, 0.70 - <0.90, and ≥0.90 were indicative of low, moderate, and high predictive ability, respectively (Fischer et al., 2003). A clinical decision threshold of 0.9 (high predictive ability) was set for detecting cervical fracture and 0.70 (moderate predictive ability) for detecting cervical radiculopathy. A clinical decision threshold of 0.70 (moderate predictive ability) was set for prognostic tools. Clinically meaningful treatment effects for people with acute and chronic WAD were considered as measurable difference in neck pain (at least a 2-point difference on the 0-10 NRS for pain), neck disability (at least 10% difference in NDI), or psychological functioning (as reported as clinically significant by the study authors on a known scale, or at least 10% difference) between intervention and control groups (Sterling et al., 2019).

9.8. Recommendation development procedures

9.8.1. Clinical recommendations

The GRADE Evidence to Decision Framework (Alonso-Coello et al., 2016) and recommendation classification (strong for, to strong against, five category Likert scale) was used for recommendations developed in these guidelines, irrespective of the strength of the evidence. The framework was modified for prognosis recommendations to consider the magnitude of association and possible adverse effects by assessing these factors (e.g., possible exacerbation of symptoms by provocative tests). The magnitude of effects (benefits/adverse effects) and strength of evidence were considered as critical outcomes by the panel when developing recommendations. Resources, equity, acceptability, and feasibility framework elements received input from HCPs, consumers, and insurers on the guideline panel. Follow-up rates in clinical trials were used as an indicator of treatment acceptability by participants.

Following review and panel agreement on content presented in the Evidence to Decision Framework, an anonymous online voting system (https://www.menti.com/) was used by the panel to reach consensus on a recommendation classification. Interpretation of recommendation

classifications for Diagnosis, Prognosis, and Treatment are outlined in Table 14. If no clear consensus was present after the first vote the panel would critically discuss before re-voting. Clinical implementation points were developed for all recommendations that were neutral, conditional for, or strong for. These points were informed by the systematic evidence review (e.g., type and dosage of exercise for treatment, clinical cut-offs for prognostic factors) and input from the guideline panel (e.g., experts, consumers).

Table 14: GRADE clinical recommendation classifications and their interpretation in these guidelines

Recommendation classification	Interpretation
Strong for	**Diagnosis** • Healthcare professionals should use the (rule or assessment) in all or almost all people, in all or almost all circumstances to screen for (cervical fracture/radiculopathy), in accordance with the implementation considerations. "The guideline panel strongly recommend that healthcare professionals use (rule or assessment) to screen for (cervical fracture/radiculopathy) in people with acute WAD". **Prognosis** • Healthcare professionals should assess the factor in all or almost all people, in all or almost all circumstances, and in accordance with the implementation considerations to determine prognosis. "The guideline panel strongly recommend that HCPs assess (factor) to determine long-term prognosis in people with acute/chronic WAD". **Treatment** • Healthcare professionals should provide the intervention to all or almost all people, in all or almost all circumstances, in accordance with the implementation considerations. "The guideline panel strongly recommend that healthcare professionals use (treatment) for the management of people with acute/chronic WAD".

Conditional for	**Diagnosis** • Healthcare professionals should use the (rule or assessment) in most people, but not all, to screen for (cervical fracture/radiculopathy) in accordance with the implementation considerations. "The guideline panel suggest that healthcare professionals use (rule or assessment) to screen for (cervical fracture/radiculopathy) in people with acute WAD". **Prognosis** • Healthcare professionals should assess the factor in most people, but not all, and in accordance with the implementation considerations to determine prognosis. "The guideline panel suggest that healthcare professionals may assess (factor) to determine long-term prognosis in people with acute/chronic WAD". **Treatment** • Healthcare professionals should provide the intervention to most people, but not all, in accordance with the implementation considerations. "The guideline panel suggest that healthcare professionals use (treatment) for the management of acute/chronic WAD".
Neutral	**Diagnosis** • Neither for nor against using the (rule or assessment). Healthcare professionals could use (rule or assessment) to screen for (cervical fracture/radiculopathy) in some instances, in accordance with the implementation considerations. "The guideline panel cannot recommend for or against the (rule or assessment) to screen for (cervical fracture/radiculopathy) in people with acute WAD". **Prognosis** • Neither for nor against assessing the factor. Healthcare professionals could assess the factor in some instances, and in accordance with the implementation considerations to determine long-term prognosis. "The guideline panel cannot recommend for or against (factor) to determine long-term prognosis in people with acute/chronic WAD". **Treatment** • Neither for nor against the intervention. Healthcare professionals could provide the intervention as an adjunct treatment in some instances, in accordance with the implementation considerations. "The guideline panel cannot recommend for or against (treatment) for the management of people with acute/chronic WAD"

Conditional against	**Diagnosis** • Healthcare professionals should not use the (rule or assessment) to screen for (cervical fracture/radiculopathy) in most people. "The guideline panel suggest that healthcare professionals do not use (rule or assessment) to screen for (cervical fracture/radiculopathy) in people with acute WAD". **Prognosis** • Healthcare professionals should not assess the factor in most people to determine long-term prognosis. "The guideline panel suggest that healthcare professionals not assess (factor) to determine long-term prognosis in people with acute/chronic WAD". **Treatment** • Healthcare professionals should not provide the intervention to most people. "The guideline panel suggest that healthcare professionals do not use (treatment) for the management of people with acute/chronic WAD".
Strong against	**Diagnosis** • Healthcare professionals should not use the (rule or assessment) to screen for (cervical fracture/radiculopathy) in all or almost all people in all or almost all circumstances. "The guideline panel strongly recommend that healthcare practitioners do not use (rule or assessment)) to screen for (cervical fracture/radiculopathy) in people with acute WAD". **Prognosis** • Healthcare professionals should not assess the factor in all or almost all people, in all or almost all circumstances to determine long-term prognosis. "The guideline panel strongly recommend that healthcare professionals not assess (factor) to determine long-term prognosis in people with acute/chronic WAD". **Treatment** • Healthcare professionals should not provide the intervention to all or almost all people in all or almost all circumstances. "The guideline panel strongly recommend that healthcare professionals do not use (treatment) for the management of people with acute/chronic WAD".

9.8.2. Consensus recommendations

We developed "panel consensus recommendations" for factors, assessment methods, and test/techniques HCPs should use when assessing people with WAD. These consensus recommendations differed from the GRADE approved method as evaluation of risk of bias, extraction of point estimate data, and certainty of evidence ratings were not performed for the Assessment section. The clinical feasibility of assessing or performing the test, strength of association (number and proportion of participants/studies finding significant differences between groups), and undesirable effects were considered critical outcomes by the panel when developing consensus recommendations. Different studies that used the same population cohort had their results (significant or not significant) counted once to not overestimate the strength of association evidence. Resources, equity, and acceptability framework elements received input from healthcare professionals, consumers, and insurers on the guideline panel. Consensus recommendations were developed separately for acute and chronic WAD. The consensus recommendation classifications and their interpretation are outlined in Table 15.

Table 15: Panel consensus recommendation classifications and their interpretation in these guidelines

Consensus classification	Interpretation
Strong consensus for	Healthcare professionals should assess the factor in all or almost all people, in all or almost all circumstances, in accordance with the implementation considerations. "There was strong guideline panel consensus that healthcare professionals assess the following (factor, perform test, technique, or imaging) in people with (acute/chronic) WAD"
Conditional consensus for	Healthcare professionals should measure the factor in most people, but not all, in accordance with the implementation considerations. "There was guideline panel consensus to suggest that healthcare professionals assess the following (factor, perform test, technique, or imaging) in people with (acute/chronic) WAD"
Neutral	Neither for nor against assessing the factor. In some instances, healthcare professionals could assess the factor in accordance with the implementation considerations, such as people who present impairment for the factor or assessing the factor may assist in guiding treatment direction. "The guideline panel cannot reach consensus for or against assessing the following (factor, perform test, technique, or imaging) in people with (acute/chronic) WAD"
Conditional consensus against	Healthcare professionals should not measure the factor in most people. "There was guideline panel consensus to suggest that healthcare professionals do not assess the following (factor, perform test, technique, or imaging) in people with (acute/chronic) WAD"

Strong consensus against	Healthcare professionals should not measure the factor in all or almost all people, in all or almost all circumstances. "There was strong guideline panel consensus that primary healthcare practitioners do not assess the following (factor, perform test, technique, or imaging) in people with acute/chronic WAD"

9.9. Limitations of these guidelines

While search strategies were broad, there was limited evidence found on population subgroups applicable to an Australian context, such as, Culturally and Linguistically Diverse (CALD) groups and Aboriginal and/or Torres Strait Islander peoples. Assessment of sociodemographic factors to determine prognosis was recommended against in these guidelines as associations with poor outcome were inconclusive. However, we will be conducting qualitative focus groups to ensure recommendations are applicable and views of these groups are adequately addressed in these guidelines.

The evidence synthesis and recommendation development procedures for Diagnosis are potentially limited by the following factors:

- Our systematic review was not sensitive for identifying clinical examination rules and assessments to screen for cervical fracture or radiculopathy. Systematic reviews were used as evidence to inform our recommendations. However, the recommended Canadian C-Spine rule is consistent with the previous guidelines and current practice in Australia, and there is high certainty in the evidence for near perfect sensitivity.
- There is an ongoing Cochrane systematic review which identified 9 additional studies comparing the Canadian C-spine rule and NEXUS to screen for cervical fracture. However, their current results are identical to the systematic review we have included in this guideline, as they have not yet analysed the additional studies. As noted above, the C-spine rule is highly sensitive and consistent with Australian practice.
- There is no gold reference standard for diagnosing cervical radiculopathy and caution is advised when interpreting diagnostic accuracy values of physical assessments (Sleijser-Koehorst et al., 2021). We have taken a pragmatic approach to recommending a combination of neurological examinations that are unlikely to exacerbate symptoms and have provided a criterion for detecting possible cervical radiculopathy.
- Risk of bias outcomes were extracted from the systematic reviews and not conducted by the research team. Based on these outcomes, risk of bias was rated as serious for all GRADE certainty ratings.

The evidence synthesis and recommendation development procedures for Prognosis are potentially limited by the following factors:

- Calculation of pooled absolute risk is preferred when determining the certainty of evidence, as relative estimates will differ depending on the risk of poor outcome in all people with WAD (i.e., risk of ongoing pain, disability, poor recovery, and psychological distress at 12-months) (Foroutan et al., 2020). There were insufficient data presented in whiplash prognostic studies on risk of outcome in the entire cohort and/or heterogeneity in critical outcome measures between studies (e.g., if there were two assessment tools used to evaluate depressive symptoms). However, prevalence of poor outcome following whiplash injury is high (up to 50%) and therefore a 20% increase in risk as per our clinical threshold would indicate a significantly greater number of people with poor long-term outcomes.

The evidence synthesis and recommendation development procedures for Treatment are potentially limited by the following factors:

- Most treatment recommendations were based on low certainty evidence due to heterogeneity in study design and low pooled sample size for critical outcome measures. Critical outcome effects were evaluated separately for short- (2 weeks to 3 months) and long-term (>3 months to years) follow-up, which reduced the overall magnitude of evidence for pooled analyses.
- Certainty in the evidence was also reduced due to variation in the implementation of physical and multimodal treatments compared with usual care control interventions which may have induced heterogeneity in pooled estimates. Further, control interventions for physical interventions (e.g., neck specific exercises, multimodal physical therapy) generally included advice for activity, which meant that clinically meaningful effects between interventions were rare as both interventions involved physical activity. Where appropriate, subgroup analyses were considered when developing recommendations, for example, where people with higher disability exhibited a greater magnitude of improvement in critical outcome(s) compared with those with lower disability scores.
- Effect sizes were calculated based on the between group difference at follow-up timepoints, with the assumption that the random allocation of participants eliminated any initial variation between them. This assumption may hold true for trials with large samples, but it may not be accurate for smaller ones. We extracted data on significant baseline group differences and considered group similarity in our risk of bias evaluation.

The evidence synthesis and recommendation development procedures for Assessment are potentially limited by the following factors:

- Studies included in the assessment section are low quality observational studies comparing a WAD group to a control group and risk of bias evaluation was not performed.

- Extent of heterogeneity in what studies assessed technique or test used. A more narrative approach to summarising the finding was used as statistical analysis and performing the magnitude of evidence for pooled analyses were not feasible for these guidelines.
- The certainty of evidence was not evaluated as part of this section of the guidelines. The evidence synthesis was based on consistency of findings and the number of studies and participants.
- The GRADE Evidence to Decision Framework (Alonso-Coello et al., 2016) was adapted to develop recommendations. The recommendation is not based on a method as robust as the other portions of these guidelines, and therefore we noted that recommendations were a "panel consensus recommendation".

9.10. References: Methods

Alonso-Coello, P., Schünemann, H. J., Moberg, J., Brignardello-Petersen, R., Akl, E. A., Davoli, M., Treweek, S., Mustafa, R. A., Rada, G., & Rosenbaum, S. (2016). GRADE Evidence to Decision (EtD) frameworks: a systematic and transparent approach to making well informed healthcare choices. 1: Introduction. *BMJ*, 353.

Fischer, J. E., Bachmann, L. M., & Jaeschke, R. (2003). A readers' guide to the interpretation of diagnostic test properties: clinical example of sepsis. *Intensive Care Medicine*, 29, 1043-1051.

Foroutan, F., Guyatt, G., Zuk, V., Vandvik, P. O., Alba, A. C., Mustafa, R., Vernooij, R., Arevalo-Rodriguez, I., Munn, Z., & Roshanov, P. (2020). GRADE Guidelines 28: Use of GRADE for the assessment of evidence about prognostic factors: rating certainty in identification of groups of patients with different absolute risks. *Journal of Clinical Epidemiology*, 121, 62-70.

Guyatt, G. H., Oxman, A. D., Vist, G. E., Kunz, R., Falck-Ytter, Y., Alonso-Coello, P., & Schünemann, H. J. (2008). GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ*, 336(7650), 924-926.

Higgins, J. P. T., Thompson, S. G., Deeks, J. J., & Altman, D. G. (2003). Measuring inconsistency in meta-analyses. *BMJ*, 327(7414), 557-560. https://doi.org/10.1136/bmj.327.7414.557

Michaleff, Z. A., Maher, C. G., Verhagen, A. P., Rebbeck, T., & Lin, C. W. (2012, Nov 6). Accuracy of the Canadian C-spine rule and NEXUS to screen for clinically important cervical spine injury in patients following blunt trauma: a systematic review. *CMAJ*, 184(16), E867-876. https://doi.org/10.1503/cmaj.120675

NICE (2021). Chronic pain (primary and secondary) in over 16s: assessment of all chronic pain and management of chronic primary pain. National Institute for Health and Care Excellence, United Kingdom.

Nitzsche, R., Saragiotto, B., Maher, C., Lin, C., Verhagen, A., Goergen, S., & ZA, M. (2020). Diagnostic Accuracy of Canadian C-spine rule and NEXUS for detecting clinically important cervical spine injury following blunt trauma. In: Advances in Evidence Synthesis. special issue Cochrane Database of Systematic Reviews 9 Suppl 1. https://doi.org/https://doi.org/10.1002/14651858.CD202001

Schug, S. A., Palmer, G. M., Scott, D. A., Alcock, M., Halliwell, R., & Mott, J. (2020). Acute pain management: scientific evidence. Australian and New Zealand College of Anaesthetists.

Sleijser-Koehorst, M. L. S., Coppieters, M. W., Epping, R., Rooker, S., Verhagen, A. P., & Scholten-Peeters, G. G. M. (2021, Jun). Diagnostic accuracy of patient interview items and clinical tests for cervical radiculopathy. *Physiotherapy*, 111, 74-82. https://doi.org/10.1016/j.physio.2020.07.007

State Insurance Regulatory Authority: Guidelines for the management of acute whiplash-associated disorders – for health professionals. Sydney: third edition 2014.

Sterling, M., Smeets, R., Keijzers, G., Warren, J., & Kenardy, J. (2019). Physiotherapist-delivered stress inoculation training integrated with exercise versus physiotherapy exercise alone for acute whiplash-associated disorder (StressModex): a randomised controlled trial of a combined psychological/physical intervention. *British Journal of Sports Medicine*, 53(19), 1240-1247.

Thoomes, E. J., van Geest, S., van der Windt, D. A., Falla, D., Verhagen, A. P., Koes, B. W., Thoomes-de Graaf, M., Kuijper, B., Scholten-Peeters, W. G. M., & Vleggeert-Lankamp, C. L. (2018). Value of physical tests in diagnosing cervical radiculopathy: a systematic review. *Spine J*, 18(1), 179-189. https://doi.org/10.1016/j.spinee.2017.08.241

TRACsa. (2008). Clinical guidelines for best practice management of acute and chronic whiplash-associated disorders. TRACsa: Trauma and Injury Recovery, Adelaide, Australia.

van Middelkoop, M., Rubinstein, S. M., Ostelo, R., van Tulder, M. W., Peul, W., Koes, B. W., & Verhagen, A. P. (2013, 2013/01/01). Surgery versus conservative care for neck pain: a systematic review. *European Spine Journal*, 22(1), 87-95. https://doi.org/10.1007/s00586-012-2553-z

Draft Guidelines

Recommendations for the Management of People with Acute Whiplash-Associated Disorders

State Insurance
Regulatory Authority

NSW GOVERNMENT

10. Acute whiplash: Diagnosis recommendations

10.1. Clinical examination rule to screen for whiplash cervical fracture

Question: What clinical examination rule (Canadian C-spine rule vs NEXUS) is most accurate to screen for whiplash cervical fracture (WAD IV) in people with acute WAD?

Two clinical examination rules are available to primary healthcare professionals (PHCPs) when screening for possible cervical fracture following whiplash injury: i) Canadian C-spine rule; ii) National Emergency X-Radiography Utilization Study (NEXUS) criteria. The gold standard for diagnosing cervical fracture following injury is by imaging methods (e.g., radiography or computed tomography).

Recommendation: The guideline panel strongly recommend that primary healthcare professionals use the Canadian C-spine rule to screen for cervical fracture (WAD IV) in people with acute WAD. (Panel vote summary: 9/9 (100%) strong for)

Strong Against	Conditional against	Neutral	Conditional for	Strong for

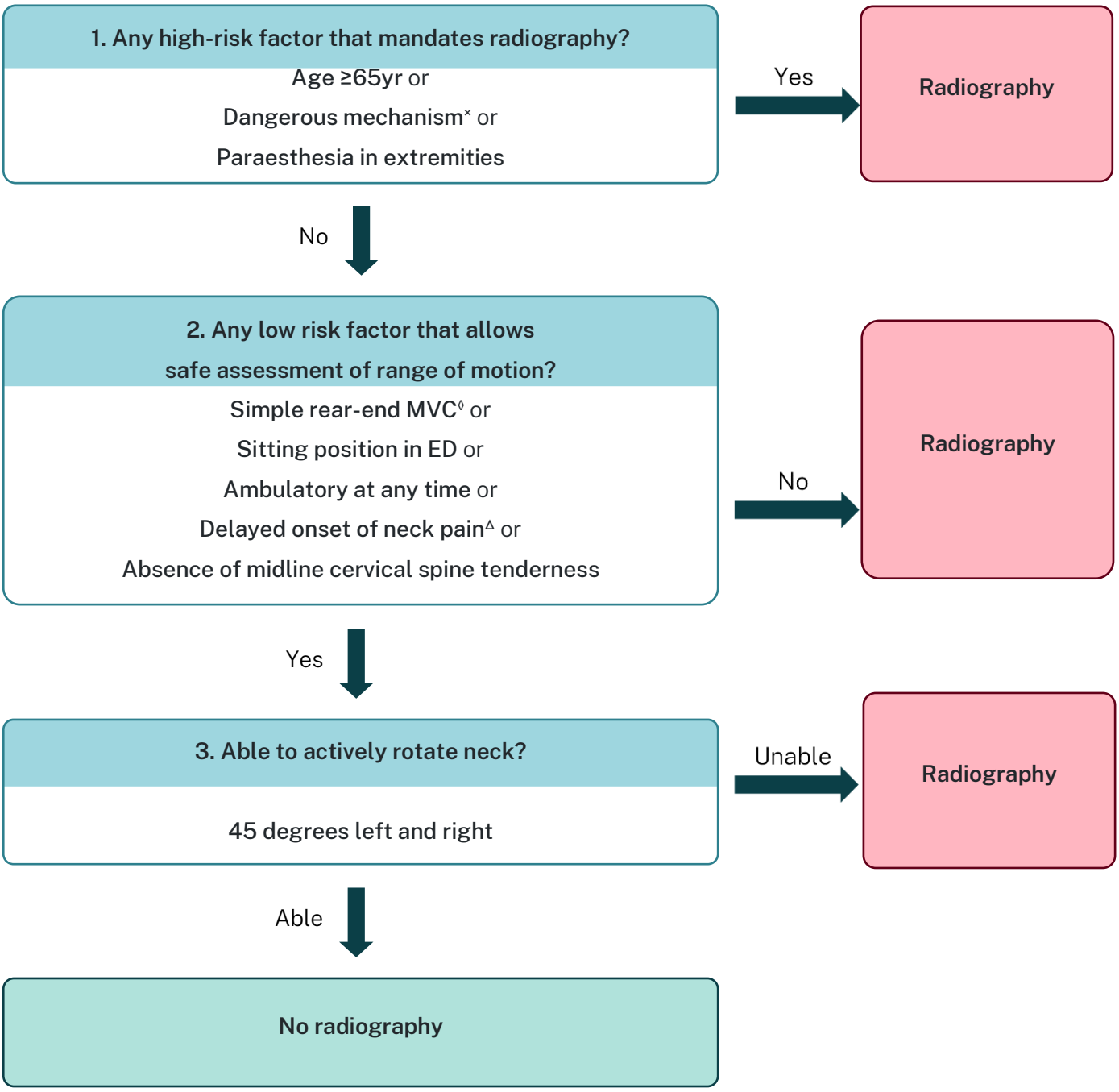
Justification	*Evidence summary:* • The Canadian C-spine rule is highly sensitive (range 0.90-1.00) for screening for cervical fracture. High certainty in the evidence for near perfect sensitivity and low specificity. • Specificity is low for both clinical examination rules, however, the Canadian C-spine rule reduces unnecessary imaging by 44% compared with 36% by NEXUS. • In a single comparison between the two rules, the Canadian C-spine rule has significantly greater diagnostic accuracy than NEXUS (Stiell et al., 2003). • The Canadian C-spine rule has significantly greater diagnostic accuracy than HCP judgement (Bandiera et al., 2003). *Consistency:* • The recommendation is consistent with previous guidelines and current practice in an Australian context. *Acceptability and feasibility:* • The Canadian C-spine rule was derived and validated in emergency department (ED) settings. If first contact is in primary care settings, then HCP should apply the C-spine rule. Diagnostic accuracy is unlikely to be influenced negatively in primary care settings and may have higher specificity than in ED settings (mechanism of injury and symptoms associated with greater risk of fracture are more likely to result in admission of the person to ED following a motor vehicle collision).

Subgroup considerations	• Outcome of the rule (positive) determines the subgroup of WAD once confirmed by imaging (WAD IV – cervical fracture).
Implementation	*Indications:* • The rule should be applied upon first contact (ED or primary care) with a person following a MVC who is alert (GCS score = 15) and medically stable, and when cervical spine injury is a concern. *How to apply the rule:* • HCPs should ask questions around the dangerous mechanism related to the crash and/or paraesthesia in the extremities to determine if positive/negative on the rule. • Apply the rule as outlined in Figure 1. *Result:* • A positive result is an indication for imaging to determine possible cervical fracture. • Management of people with acute WAD is then guided by the imaging result, i.e., for cervical fracture (WAD IV) or WAD 0-III. Recommendations for the management of WAD 0-III are addressed in these guidelines (see Assessment, Prognosis, and Treatment recommendations). • If a cervical fracture is detected there should be urgent referral to a Hospital Emergency Department or immediate surgical consultation. Management is according to cervical fracture guidelines. *Additional considerations:* • The Canadian C-spine rule relates to mechanism of injury and includes the nature of the MVC (dangerous mechanism). While we have not recommended for asking questions relating to the nature of the MVC for determining prognosis, it is required for application of the Canadian C-spine rule.

Please refer to D.1 in the Diagnosis Technical Report (Chapter 1) for further details.

Figure 1: Canadian C-spine rule to screen for cervical fracture (WAD IV)

For alert (GCS score = 15) and stable trauma people when cervical spine injury is a concern.



[x]Dangerous mechanism:

- fall from elevation ≥91.5cm/5 stairs,
- axial load to head, e.g., diving
- MVC high speed (>100km/h), rollover, ejection,
- motorised recreational vehicles,
- bicycle crash.

[◊]Simple read-end MVC excludes:

- pushed into oncoming traffic,
- hit by bus/large truck,
- rollover,
- hit by high-speed vehicle.

[Δ]Delayed: Not immediate onset of neck pain.

10.2. Diagnosis: Neurological examination to screen for cervical radiculopathy (WAD III)

Question: What neurological examination assessments should HCPs use to screen for cervical radiculopathy (WAD III) in people with acute WAD?

A neurological examination consisting of physical assessments can be performed by PHCPs to screen for possible cervical radiculopathy which can result in referral for MRI and surgical opinion.

Recommendation: The guideline panel suggest that primary healthcare professionals perform the following neurological examination assessments to screen for cervical radiculopathy (WAD grade III):
Interview (arm pain>neck pain, paraesthesia/numbness), assessment of neurological signs (sensory deficit – dermatomal abnormality, muscle weakness – myotomal abnormality, reduced reflexes), and relief signs (hand in pocket, shoulder abduction relief test).
(Panel vote summary: 8/11 (73%) conditional for; 3/11 917%) strong for

Strong Against	Conditional against	Neutral	Conditional for	Strong for

Justification	*Evidence summary:* • No research evaluating the accuracy of neurological examination assessments for diagnosing cervical radiculopathy in people with acute WAD. • Overall, variable diagnostic accuracy for interview with the person and neurological examination assessments for detecting cervical radiculopathy. • Spurling test (N=4): Very low certainty in the evidence for moderate sensitivity and moderate certainty in the evidence for high specificity. • Upper limb neural tension test (N=2): Very low certainty in the evidence for moderate sensitivity and low certainty in the evidence for moderate specificity. • Specificity overall was greater using these assessments than sensitivity. More likely to rule out cervical radiculopathy in people with acute WAD. • No adverse events occurred from performing the clinical tests (Sleijser-Koehorst 2021). This study included provocative, relief, evaluation of neurological signs, and interview assessments. However, provocative tests could exacerbate pain and symptoms associated with radiculopathy. • A combination of results from several neurological assessments and consistency with the person's history is likely to be the most effective method when screening for cervical radiculopathy (Sleijser-Koehorst 2021; Thoomes 2018). *Undesirable effects:* • Large proportion of people with WAD grade II were still receiving an MRI (Bandong 2018) in an Australian context. Use of these

	assessments may reduce unnecessary imaging, possible negative consequences associated with imaging, and economic burden. *Feasibility:* • PHCPs (e.g., physiotherapists) can carry out neurological examination assessments as part of routine consultation and these assessments are taught in tertiary settings.
Subgroup considerations	• Cervical radiculopathy is present in <5% of people with acute WAD. • Management of people with acute WAD and possible cervical radiculopathy is then guided by the imaging result, i.e., for probable cervical radiculopathy (WAD III) or WAD I-II.
Implementation	It is to be noted that there is no gold standard for diagnosing cervical radiculopathy and caution is advised when interpreting diagnostic accuracy values of physical assessments. *Indications (history):* PHCPs should quantify arm and neck pain using a NRS and evaluate whether arm pain is greater. 1. PHCPs should consider whether the person has signs of paraesthesia / numbness by asking questions during their initial interview with the person. 2. A pattern of radiculopathy is present during ROM assessment (when determining WAD grade). 3. PHCPs should undertake these the assessments below if clinically indicated (arm pain>neck pain and neurological symptoms identified from the interview with the person). *How to conduct a neurological examination:* a) A combination of results from several assessments and consistency with the person's history is likely to be the most effective method when screening for cervical radiculopathy. b) HCPs should ensure that they have adequate training to determine this/carry out these assessments. c) Note that cervical radiculopathy is not radicular pain, and radiculopathy is where there is objective neurological abnormality. d) *Consumer comment (panel member) "de-implementation of provocative tests is important".* e) PHCPs should assess for neurological signs and relief signs (antalgic postures) that may be indicative of cervical radiculopathy: **Neurological signs:** sensory deficit (dermatomal abnormalities), muscle weakness (myotomal abnormalities), reduced reflexes. Guidance on how to perform these assessments is available on Whiplash Navigator. **Relief signs (antalgic postures):** shoulder abduction relief test, hand in pocket (unloading of arm) – relief in pain with antalgic posture(s). *Interpretation and actions:*

	• Presence of radiculopathy indications from interview and relief signs **AND** • Two or more neurological abnormalities present (Section 5.8 in version 9.1 of the Motor Accident Guidelines, available at https://www.sira.nsw.gov.au/resources-library/motor-accident-resources/publications/for-professionals/motor-accident-guidelines) • Conservative treatments should be considered before referral, as per the acute WAD treatment guidelines for medium-high risk subgroups. • HCPs should reassess the neurological examination to evaluate whether there has been any meaningful change over time. • **Please refer to the panel consensus recommendation on when to refer for MRI (see D.2.4).** • If imaging occurs, HCPs should consider the person's history (subjective information), neurological examination, and imaging findings to determine the probable diagnosis of radiculopathy (WAD III). • In some circumstances, injection / spinal surgery may be considered (see spinal surgery recommendation in Treatment section T.25). • In other circumstances, conservative treatment guidelines / recommendations for managing cervical radiculopathy should be followed.

Please refer to D.2 in the Diagnosis Technical Report (Chapter 1) for further details.

10.3. When to refer for imaging to determine probable diagnosis of cervical radiculopathy (WAD III)

Question: When should healthcare professionals refer for imaging to determine probable diagnosis of cervical radiculopathy (WAD III) in people with acute WAD and evidence of cervical radiculopathy from neurological examination?

In conjunction with positive neurological signs and the person's history, MRI of the cervical region can be used to diagnose probable cervical radiculopathy (e.g., evidence of foraminal stenosis and nerve root compression).

Consensus Recommendation: There was guideline panel consensus that primary healthcare professionals refer people with acute WAD and suspected cervical radiculopathy, as assessed from a neurological examination, for imaging (MRI).

(Panel vote summary: 11/12 (92%) conditional for, 1/12 (8%) strong for

Strong Against	Conditional against	Neutral	Conditional for	Strong for

Justification	*Evidence summary:* • No research evaluating the appropriate length of time for when MRI referral should occur in people with acute WAD and signs of cervical radiculopathy. • A combination of neurological examination assessments is likely to have high specificity and rule out cervical radiculopathy in a

	considerable portion of people with acute WAD. Very-low certainty in the evidence for moderate sensitivity (Spurling test, upper limb neural tension test). • In clinical trials that evaluated the effect of surgical intervention on people with cervical radiculopathy, these people had to have had high pain intensity, evidence of radiculopathy, and ineffective conservative care to be considered for surgery. As a result, conservative care should be considered prior to MRI referral and surgical opinion. *Adverse effects:* • Structural abnormalities in the cervical spine are prevalent even in asymptomatic control populations. Referral for MRI for people with WAD grade II is unlikely to provide important information for management of WAD and negative consequences may be associated with imaging. • Large proportion of people with WAD grade II were still receiving an MRI (Bandong 2018) in an Australian context. It is to be noted that these people had compensation scheme claims at the time which could influence rates of imaging compared with non-claimants. Use of neurological examination assessments may reduce unnecessary imaging, possible negative consequences associated with imaging, and economic burden.
Sub-groups	• Possible referral: People with acute WAD and evidence of radiculopathy (WAD grade III) present – from a neurological examination (see D.2.3). • MRIs for people with acute WAD grade II are unlikely to provide important information for management of WAD and negative consequences may be associated with imaging.

Implementation	*Indication (when to refer):*
	• See neurological examination recommendation (D.2.3) for cervical radiculopathy neurological examination.
	• Referral for MRI could be considered necessary if there is:
	  ○ Subjective history of neurological signs (e.g., arm pain>neck pain, paraesthesia/numbness)
	  AND
	  ○ **Two or more** neurological abnormalities present.
	• Conservative treatments should be considered before referral, as per the acute WAD treatment guidelines for medium-high risk subgroups.
	• HCPs should reassess the neurological examination to evaluate whether there has been any meaningful change over time.
	• Evidence of cervical radiculopathy present
	Considerations:
	• If referral for MRI has been requested based on the above criteria, the insurer should prioritise approval (consumer input).

	When not to refer: • People with WAD grade II (no neurological signs). • Presence of radicular pain but absence of neurological signs.

Please refer to D.2 in the Diagnosis Technical Report (Chapter 1) for further details

10.4. References: Diagnosis

Apelby-Albrecht, M., Andersson, L., Kleiva, I. W., Kvale, K., Skillgate, E., & Josephson, A. (2013). Concordance of upper limb neurodynamic tests with medical examination and magnetic resonance imaging in patients with cervical radiculopathy: a diagnostic cohort study. Journal of Manipulative & Physiological Therapeutics, 36(9), 626-632. https://doi.org/10.1016/j.jmpt.2013.07.007

Coffey, F., Hewitt, S., Stiell, I., Howarth, N., Miller, P., Clement, C., Emberton, P., & Jabbar, A. (2011). Validation of the Canadian c-spine rule in the UK emergency department setting. Emergency Medicine Journal, 28(10), 873-876. https://doi.org/10.1136/emj.2009.089508

Dickinson, G., Stiell, I. G., Schull, M., Brison, R., Clement, C. M., Vandemheen, K. L., Cass, D., McKnight, D., Greenberg, G., Worthington, J. R., Reardon, M., Morrison, L., Eisenhauer, M. A., Dreyer, J., & Wells, G. A. (2004). Retrospective application of the NEXUS low-risk criteria for cervical spine radiography in Canadian emergency departments. Ann Emerg Med, 43(4), 507-514. https://doi.org/10.1016/j.annemergmed.2003.10.036

Duane, T. M., Mayglothling, J., Wilson, S. P., Wolfe, L. G., Aboutanos, M. B., Whelan, J. F., Malhotra, A. K., & Ivatury, R. R. (2011). National Emergency X-Radiography Utilization Study criteria is inadequate to rule out fracture after significant blunt trauma compared with computed tomography. Journal of Trauma-Injury Infection & Critical Care, 70(4), 829-831. https://doi.org/10.1097/TA.0b013e31820ea6b3

Duane, T. M., Wilson, S. P., Mayglothling, J., Wolfe, L. G., Aboutanos, M. B., Whelan, J. F., Malhotra, A. K., & Ivatury, R. R. (2011). Canadian Cervical Spine rule compared with computed tomography: a prospective analysis. Journal of Trauma-Injury Infection & Critical Care, 71(2), 352-355; discussion 355-357. https://doi.org/10.1097/TA.0b013e318220a98c

Griffith, B., Bolton, C., Goyal, N., Brown, M. L., & Jain, R. (2011). Screening cervical spine CT in a level I trauma center: overutilization? AJR. American Journal of Roentgenology, 197(2), 463-467. https://doi.org/10.2214/AJR.10.5731

Gumina, S., Carbone, S., Albino, P., Gurzi, M., & Postacchini, F. (2013). Arm Squeeze Test: a new clinical test to distinguish neck from shoulder pain. Eur Spine J, 22(7), 1558-1563. https://doi.org/10.1007/s00586-013-2788-3

Hoffman, J. R., Mower, W. R., Wolfson, A. B., Todd, K. H., & Zucker, M. I. (2000). Validity of a set of clinical criteria to rule out injury to the cervical spine in patients with blunt trauma. National Emergency X-Radiography Utilization Study Group. N Engl J Med, 343(2), 94-99. https://doi.org/10.1056/NEJM200007133430203

Mahler S, P. S., Caldito G, et al. (2009). Use of a clinical sobriety assessment tool with the NEXUS low-risk cervical spine criteria to reduce cervical spine imaging in blunt trauma patients with acute alcohol or drug use: a pilot study. Ann Emerg Med, 54.

Michaleff, Z. A., Maher, C. G., Verhagen, A. P., Rebbeck, T., & Lin, C. W. (2012). Accuracy of the Canadian C-spine rule and NEXUS to screen for clinically important cervical spine injury in patients following blunt trauma: a systematic review. CMAJ, 184(16), E867-876. https://doi.org/10.1503/cmaj.120675

Migliore S, S. A., Matteucci M. (2011). The NEXUS criteria: inter-rater reliability between residents versus attending physicians in the emergency department. Acad Emerg Med, 18.

Miller, P., Coffey, F., Reid, A. M., & Stevenson, K. (2006). Can emergency nurses use the Canadian cervical spine rule to reduce unnecessary patient immobilisation? Accid Emerg Nurs, 14(3), 133-140. https://doi.org/10.1016/j.aaen.2006.03.003

Nitzsche R, S. B., Maher CG, Lin CC, Verhagen AP, Goergen S, Michaleff ZA. (2020). Diagnostic Accuracy of Canadian C-spine rule and NEXUS for detecting clinically important cervical spine injury following blunt trauma. In: Advances in Evidence Synthesis. special issue Cochrane Database of Systematic Reviews 9 Suppl 1. https://doi.org/https://doi.org/10.1002/14651858.CD202001

Rethnam, U., Yesupalan, R., & Gandham, G. (2008). Does applying the Canadian Cervical Spine rule reduce cervical spine radiography rates in alert patients with blunt trauma to the neck? A retrospective analysis. BMC Med Imaging, 8, 12. https://doi.org/10.1186/1471-2342-8-12

Shabat, S., Leitner, Y., David, R., & Folman, Y. (2012). The correlation between Spurling test and imaging studies in detecting cervical radiculopathy. J Neuroimaging, 22(4), 375-378. https://doi.org/10.1111/j.1552-6569.2011.00644.x

Shah, K. C., & Rajshekhar, V. (2004). Reliability of diagnosis of soft cervical disc prolapse using Spurling's test. Br J Neurosurg, 18(5), 480-483. https://doi.org/10.1080/02688690400012350

Sleijser-Koehorst, M. L. S., Coppieters, M. W., Epping, R., Rooker, S., Verhagen, A. P., & Scholten-Peeters, G. G. M. (2021). Diagnostic accuracy of patient interview items and clinical tests for cervical radiculopathy. Physiotherapy, 111, 74-82. https://doi.org/10.1016/j.physio.2020.07.007

Stiell, I. G., Clement, C. M., Grimshaw, J., Brison, R. J., Rowe, B. H., Schull, M. J., Lee, J. S., Brehaut, J., McKnight, R. D., Eisenhauer, M. A., Dreyer, J., Letovsky, E., Rutledge, T., MacPhail, I., Ross, S., Shah, A., Perry, J. J., Holroyd, B. R., Ip, U., . . . Wells, G. A. (2009). Implementation of the Canadian C-Spine Rule: prospective 12 centre cluster randomised trial. BMJ, 339, b4146. https://doi.org/10.1136/bmj.b4146

Stiell, I. G., Clement, C. M., McKnight, R. D., Brison, R., Schull, M. J., Rowe, B. H., Worthington, J. R., Eisenhauer, M. A., Cass, D., Greenberg, G., MacPhail, I., Dreyer, J., Lee, J. S., Bandiera, G., Reardon, M., Holroyd, B., Lesiuk, H., & Wells, G. A. (2003). The Canadian C-spine rule versus the NEXUS low-risk criteria in patients with trauma. N Engl J Med, 349(26), 2510-2518. https://doi.org/10.1056/NEJMoa031375

MacKenzie, T., & Wells, G. A. (2010). Multicentre prospective validation of use of the Canadian C-Spine Rule by triage nurses in the emergency department. CMAJ, 182(11), 1173-1179. https://doi.org/10.1503/cmaj.091430

Stiell, I. G., Wells, G. A., Vandemheen, K. L., Clement, C. M., Lesiuk, H., De Maio, V. J., Laupacis, A., Schull, M., McKnight, R. D., Verbeek, R., Brison, R., Cass, D., Dreyer, J., Eisenhauer, M. A., Greenberg, G. H., MacPhail, I., Morrison, L., Reardon, M., & Worthington, J. (2001). The Canadian C-spine rule for radiography in alert and stable trauma patients. JAMA, 286(15), 1841-1848. https://doi.org/10.1001/jama.286.15.1841

Thoomes, E. J., van Geest, S., van der Windt, D. A., Falla, D., Verhagen, A. P., Koes, B. W., Thoomes-de Graaf, M., Kuijper, B., Scholten-Peeters, W. G. M., & Vleggeert-Lankamp, C. L. (2018). Value of physical tests in diagnosing cervical radiculopathy: a systematic review. Spine Journal: Official Journal of the North American Spine Society, 18(1), 179-189. https://doi.org/10.1016/j.spinee.2017.08.241

Vaillancourt, C., Stiell, I. G., Beaudoin, T., Maloney, J., Anton, A. R., Bradford, P., Cain, E., Travers, A., Stempien, M., Lees, M., Munkley, D., Battram, E., Banek, J., & Wells, G. A. (2009). The out-of-hospital validation of the Canadian C-Spine Rule by paramedics. Ann Emerg Med, 54(5), 663-671 e661. https://doi.org/10.1016/j.annemergmed.2009.03.008

Viikari-Juntura, E., Porras, M., & Laasonen, E. M. (1989). Validity of clinical tests in the diagnosis of root compression in cervical disc disease. Spine (Phila Pa 1976), 14(3), 253-257. https://doi.org/10.1097/00007632-198903000-00003

11. Acute whiplash: Prognosis recommendations

11.1. Prognostic tools: WhipPredict and SF-OMPSQ

Question: What prognostic tools are accurate in predicting poor outcome (ongoing pain, disability, and non-recovery) for people with acute whiplash?

Prognostic tools are derived from a combination of known individual factors associated with poor outcome. These factors undergo rigorous statistical testing to determine the combination of factors that are most accurate in predicting the outcome.

Recommendation: The guideline panel strongly recommend that healthcare professionals use the WhipPredict or Orebro (SF-OMPSQ) prognostic tools to predict the risk of poor outcome in people with acute WAD. (Panel vote summary: 9/9 100% strong for)

Strong Against	Conditional against	Neutral	Conditional for	Strong for

Justification	*Evidence summary:* • Moderate predictive ability (low-moderate certainty in the evidence) for the WhipPredict and Orebro tools for critical outcomes of poor prognosis. • These two tools had several studies that evaluated the predictive ability across multiple critical outcomes (disability, non-recovery, and psychological distress), when compared with the other tools. *Consistency:* • These tools were specifically developed (developed, validated, cross-validated) for whiplash or musculoskeletal pain conditions in Australia. • WhipPredict is derived from known adverse prognostic factors (e.g., neck disability and psychological distress) • Orebro is derived from known adverse prognostic factors for musculoskeletal chronic pain (e.g., pain severity, duration, expectations of recovery). *Acceptability and feasibility:* • These tools are easy to use and interpret and are readily available online. • These tools are already used in Australia.
Implementation	The choice of tool to use may depend on the clinical presentation and care pathways available. For example, the Orebro may be helpful when people have multiple areas injured, whilst WhipPredict may be more useful in people with neck pain. *How to interpret*: • WhipPredict is automated in MyWhiplashNavigator (www.mywhiplash.com.au). WhipPredict will stratify people at low, medium, and high risk of poor outcome, based on age, neck disability and hyperarousal sub-scale scores. The Orebro will stratify people at

	low risk (<50/100) and high risk ≥50/100 of poor outcome and is automated on a few websites (e.g., Mypainhub.com). *What to do:* • Communicate outcome of prognostic risk tool to injured people (MyWhiplashNavigator has some recommended ways to communicate this both in written and video format. • Match clinical pathway to the risk stratification. People *at low risk (of poor outcome)* recover well, require less treatment and it is important not to overtreat these people as this can lead to poor outcomes. • For people who are *med/high risk of poor outcome,* consider earlier referral to whiplash specialist +/- psychologist and interventions recommended for people at med/high risk. • Provide education around the importance of psychological health. Individualise this to the injured person with respect of their scores on the individual items.

Please refer to P.1 in the Prognosis Technical Report (Chapter 3) for further details.

11.2. Prognostic tools: Canelliere et al. (2021), PPS WAD, and Bohman et al. (2012).

Question: What prognostic tools are accurate in predicting poor outcome (ongoing pain, disability, and non-recovery) for people with acute whiplash?

Prognostic tools are derived from a combination of known individual factors associated with poor outcome. These factors undergo rigorous statistical testing to determine the combination of factors that are most accurate in predicting the outcome.

Recommendation: The guideline panel cannot recommend for or against Cancelliere et al (2021), PPS-WAD, and Bohman et al. (2012) prognostic tools to evaluate the risk of poor outcome in people with acute WAD.

(Panel vote summary: 8/11 73% neutral, 2/11 18% conditional against, 1/11 5% conditional for)

Strong Against	Conditional against	Neutral	Conditional for	Strong for

Justification	*Evidence:* • Moderate predictive ability for these prognostic tools, with lower certainty in the evidence (very low to low certainty in the evidence) compared with the Orebro and WhipPredict tools and evaluation of one critical outcome only. *Consistency:* • These tools have not been developed or validated in an Australian context. *Acceptability and feasibility:* • These tools are not available online or easily accessible.
Implementation	• These tools may be validated in an Australian context in future and become more readily available. However, at the present time we would

	not recommend implementation of these tools in an Australian context over the WhipPredict or Orebro tools. • HCPs could consider implement these tools if working in the countries where these tools were validated in.

Please refer to P.1 in the Prognosis Technical Report (Chapter 3) for further details.

11.3. Symptom factors: Neck pain, neck disability, number of painful areas, number of symptoms

Question: What initial symptom-related factors are predictive of ongoing neck pain, neck disability, psychological distress, and perceived non-recovery in people with acute whiplash associated disorders?

Symptom factors refer to subjective reports of people's experiences such as pain, headache, dizziness and how they feel these symptoms impact their ability to function.

Recommendation: The guideline panel strongly recommend that healthcare professionals assess initial pain intensity, initial neck related disability, number of painful areas, and number of symptoms to determine poor prognosis in people with acute whiplash. (Panel vote summary: 9/12 75% strong for; 25% conditional for)

Strong Against	Conditional against	Neutral	Conditional for	Strong for

Justification	*Evidence summary:* • There are a high number of studies (n=25) of that informed this evidence. Most showed a positive associating with the outcome (e.g., 7/8 studies show an association of high initial neck pain with the outcome ongoing disability. Certainty of evidence varies, however is moderate in many cases (e.g., moderate certainty in the evidence for a very strong association between high initial neck pain and long-term disability). *Consistency:* • The findings are consistent with well-regarded systematic reviews on prognosis, and with previous guidelines. *Acceptability and feasibility:* • Considered acceptable and feasible, freely available on MyWhiplashNavigator (www.mywhiplash.com.au). • Other factors: Some treatment studies included in this guideline have also included participants with similar characteristics (factors) seen in the prognostic studies.
Implementation	*How to measure and interpret:* • Measure pain intensity with a numerical rating scale (NRS). People with scores of ≥6/10 are considered at higher risk of poor recovery.

	• Measure neck- related disability with the Neck Disability Index (NDI). People with scores of ≥ 15/50 (30%) are considered at higher risk of poor recovery. • People with more than 7 painful sites are considered at risk of poor recovery. *What to do:* • Consider implementation within the consultation and discuss with the person. This may require a longer consult time within a primary care setting (e.g., 30 minutes instead of 15 minutes). • Consider referral to a whiplash expert when people are above the threshold score and the person is not recovering.

Please refer to P.2 in the Prognosis Technical Report (Chapter 3) for further details.

11.4. Psychological factors: Post-traumatic stress symptoms, expectations of recovery

Question: What psychological factors are predictive of ongoing neck pain, neck disability, psychological distress, and perceived non-recovery in people with acute whiplash associated disorders?

Psychological factors in this guideline refer to a person's distress (e.g., post-traumatic stress), mood (e.g., feeling anxious, depressed, or angry) and their beliefs (e.g., recovery expectations, how confident they feel).

Recommendation: The guideline panel strongly recommend that healthcare professionals assess post-traumatic stress symptoms (PTSS) and expectations of recovery to determine poor prognosis in people with acute whiplash.

(Panel vote summary: 12/13 92% strong for; 1/13 8% conditional for)

Strong Against	Conditional against	Neutral	Conditional for	Strong for

Justification	*Evidence summary:* • There were 35 studies overall that informed the recommendations. For PTSS, most studies show an association with the outcome (8/13) with a significant odds ratio's when meta-analysis was possible (e.g., OR = 2.11 (1.51 to 2.95) for the outcome of pain). There was a high certainty of evidence. For expectations of recovery, the majority of studies (9/10) showed an association with the outcome, (OR 2.68 (1.00 to 7.18)- 3 studies) with moderate certainty of evidence. *Consistency:* • The findings are consistent with well-regarded systematic reviews on prognosis, and with previous guidelines. *Balance of effects:* • Low risk of negative consequence

	Acceptability and feasibility: • Questionnaires able to be administered during or after a consultation. They are commonly used in Australia and are freely available on either the internet or WhiplashNavigator. Other factors: Some treatment studies included in this guideline have also included participants with similar characteristics (factors) seen in the prognostic studies.
Subgroup considerations	• People at low risk of poor recovery are unlikely to present with psychological distress. They are unlikely to require assessment of these factors.
Implementation	**Post-traumatic stress symptoms** *How to measure and interpret:* • Screen for Post-Traumatic Stress Symptoms (PTSS) with the PCL 5. Scores of ≥34/80 could indicate a diagnosis of Post-Traumatic Stress Disorder. • Other tools such as the DAR-5 can be used. Scores of ≥12/25 could indicate dysfunctional post-traumatic anger. *Indications:* • Measure approx. 3-4 weeks after injury. Indicated when people show signs of PTS symptoms in interview (e.g., nightmares, flashbacks or anxiety driving) *What to do:* • Consider referral to psychologist by 6 weeks if not improving. **Expectations of recovery** *How to measure and interpret:* • Recommendations to ask the question "How do you think you will recover." Alternate options are "when" or "why" do think you will recover. *Considerations:* • Consider the client's expectations of recovery in context to their personalised model of recovery. In the absence of a personalised model of recovery it is less likely that clients will recover. *What to do:* • Provide a positive message as positive expectations of recovery are associated with actual recovery.

Please refer to P.4 in the Prognosis Technical Report (Chapter 3) for further details.

11.5. Psychological factors: Depression, pain catastrophising, and coping strategies

Recommendation: The guideline panel suggest that healthcare professionals may assess depression, pain catastrophising and coping strategies to determine poor prognosis in people with acute whiplash.

(Panel vote summary: 8/13 62% conditional for; 5/13 38% strong for)

Strong Against	Conditional against	Neutral	Conditional for	Strong for

Justification	*Evidence summary:* • Most studies showed an association of these factors with the outcome (depression 8/13, pain catastrophising 8/13, coping strategies 4/5), however the GRADE process determined low to moderate evidence for a small to moderate association with the outcome. *Consistency:* • The findings are consistent with well-regarded systematic reviews on prognosis, and with previous guidelines. *Balance of effects:* • Low risk of negative consequence *Acceptability and feasibility:* • Questionnaires able to be administered during or after consultation with the injured person. They are commonly used in Australia and are freely available on either the internet or WhiplashNavigator. Other factors: Some treatment studies included in this guideline have also included participants with similar characteristics (factors) seen in the prognostic studies.
Subgroup considerations	• People at low risk of poor recovery are unlikely to present with psychological distress. They are unlikely to require assessment of these factors.
Implementation	*How to measure and interpret* • Measure depressive symptoms with the DASS 21. When moderate or severe consider referral to psychologist. ≥ 15 out of 63 could indicate a probable major depressive disorder (Guest et al., 2018) • Measure expectations of recovery with these questions: How / why or when do you think you will recover". Those with higher expectations of recovery are more likely to recover. *What to do:* • Consider administering questionnaires according to clinical judgement. Situations where it may be indicated are: i) when people are stratified as medium/ high risk of poor recovery or ii) when they present with low mood (possible depression), use catastrophic language (pain catastrophising) or other symptoms of psychological distress during the interview with the injured person.

	• When people are above the scale cut-off thresholds (defined above), consider referral to a psychologist and/or HCP with expertise in providing psychologically informed exercise or interventions recommended for the medium/high risk group (see Treatment section of guideline). • Additional training may be required for HCP's to effectively administer and interpret the questionnaires.

Please refer to P.4 in the Prognosis Technical Report (Chapter 3) for further details.

11.6. Physical impairment factors: Cervical Range of Motion (ROM) and Cold Hyperalgesia

Question: What physical impairment factors are predictive of ongoing neck pain, neck disability, psychological distress, and perceived non-recovery in people with acute whiplash associated disorders?

Physical Impairments include reduced range of motion, reduced neck muscle strength, reduced neck and head co-ordination or pain sensitivity. In this guideline, they refer to impairments that HCPs can assess physically in the clinical setting.

Recommendation: The guideline panel suggest that healthcare professionals may assess the following physical impairment factors to determine poor prognosis in people with acute whiplash: Cervical ROM and cold hyperalgesia (e.g., Ice Pain Test). (Panel vote summary: 11/12 92% conditional for; 1/12 8% strong for)				
Strong Against	Conditional against	Neutral	Conditional for	Strong for

Justification	*Evidence summary:* • There were 10 studies that informed the recommendations for physical impairment. Of all the factors, cervical ROM, and cold hyperalgesia (measured by cold pain threshold) have moderate to strong certainty of evidence of associations with critical outcomes. *Consistency:* • Findings for cold hyperalgesia and Cervical ROM are consistent with previous guidelines and systematic reviews. • Cervical ROM assessment is also required to determine the grade of WAD. *Acceptability and feasibility:* • The assessment techniques are common practice for HCP's when working with people with other musculoskeletal conditions.
Subgroup considerations	• The assessments can be used to identify medium to high-risk sub-groups, particularly with regard to high pain sensitivity.
Implementation	*How to measure:*

	• Cervical Range of Motion (C-ROM) can be measured in clinical settings using a bubble inclinometer or inclinometer app on a phone (see Assessment section). In addition to being helpful for prognosis, assessment of ROM is required to determine the WAD Grade (i.e., Classification of people as WAD grade I and II requires ROM includes decreased ROM) and can inform treatment direction. • Cold hyperalgesia can be assessed in clinical settings using the Ice Pain Test instead of specialised equipment (Rebbeck et al., 2015;). HCPs can apply a cube of ice to the neck and upper trapezius and ask the client to rate their pain (NRS). People with elevated pain sensitivity can present with cold hyperalgesia e.g., NRS>5/10 for pain associated with cold (Maxwell and Sterling 2013). *Considerations:* • Assessment of mechanical hyperalgesia (e.g., pressure pain thresholds) are less helpful in terms of prognosis but could be used to inform treatment or assess outcome. • Be cautious when testing for pain sensitivity in people who present with widespread pain as some people may have a temporary increase in pain as a result of the assessment. Advise people that there may be some change to their pain levels when conducting these tests. *What to do:* • Use results during testing to explain the pain type to the person. • Resources on how to perform CROM and Pain sensitivity assessments are freely available from Whiplash Navigator https://mywhiplash.com.au/

Please refer to P.7 in the Prognosis Technical Report (Chapter 3) for further details.

11.7. Compensation factors

Question: What compensation factors are predictive of ongoing neck pain, neck disability, psychological distress, and perceived non-recovery in people with acute whiplash associated disorders?

Compensation factors include retaining a lawyer, submitting a claim, or previously submitting a claim.

Recommendation: The guideline panel suggest that healthcare professionals could consider assessing whether people have submitted a claim or retained a lawyer to determine poor prognosis in people with acute whiplash. (Panel vote summary: 8/10 82% conditional for; 2/10 20% neutral)

Strong Against	Conditional against	Neutral	Conditional for	Strong for

Justification	*Evidence summary:* • There were 10 studies that informed the recommendations for compensation factors. The evidence varied, however these two factors

	had low to high certainty of evidence for associations with long-term poor outcome. *Consistency:* • The conclusions are similar to those made by other systematic reviews of whiplash. • There are known associations with compensation status and retention of a lawyer and poor outcome in other MSK injuries.
Implementation	• Some people may feel unsupported and not know what legal services are available. Having someone ask if they have made a claim and assisting them can make a difference to their recovery. • For others, asking the question may negatively impact health, for example if they are already feeling unwell or have not had a good recovery and/ or claim experience.

Please refer to P.9 in the Prognosis Technical Report (Chapter 3) for further details.

11.8. Pre-crash health factors: Widespread body pain, chronic neck pain, pre-crash general and mental health

Question: What pre-crash health factors are predictive of ongoing neck pain, neck disability, psychological distress, and perceived non-recovery in people with acute whiplash associated disorders?

Pre-crash health refers to the persons physical, medical, and psychological health before the accident.

Recommendation: The guideline panel suggest that healthcare professionals may assess the following pre-crash health factors to determine poor prognosis in people with acute whiplash: widespread body pain, chronic neck pain, pre-crash general and mental health. (Panel vote summary: 11/12 92% conditional for; 1/12 8% strong for)				
Strong Against	Conditional against	Neutral	Conditional for	Strong for

Justification	*Evidence summary:* • Other pre-crash pain condition, pre-crash general health, and pre-crash mental health have large associations with critical outcomes of poor prognosis at 12months post whiplash injury (high certainty in the evidence). Assessing pre-crash neck pain for determining prognosis following whiplash injury was inconclusive overall, however, it is likely that it has a strong association with ongoing disability at 12months (moderate certainty in the evidence). *Consistency:* • The association between these factors and poor prognosis is consistent with other known musculoskeletal pain conditions. *Acceptability and feasibility:*

	• These factors are easy for HCPs to assess for during routine consultation and are generally expected by clients as part of past medical history information. • Trivial adverse effects expected.
Implementation	• If a factor is identified during a routine consultation, HCPs should consider following up with a question to identify how they think the factor is influencing their recovery. For example: "How do you think [factor xx] is impacting your recovery?"

Please refer to P.8 in the Prognosis Technical Report (Chapter 3) for further details.

11.9. Physical impairment factors: muscle and sensorimotor function, sympathetic nervous system response, cervical bony tenderness, and BMI

Recommendation: The guideline panel cannot recommend for or against the assessment of muscle, sensorimotor, sympathetic nervous system response, cervical bony tenderness (manual palpation) and BMI to determine poor prognosis in people with acute whiplash.

(Panel vote summary: 11/12 92% neutral; 1/12 8% conditional for)

Strong Against	Conditional against	Neutral	Conditional for	Strong for

Justification	*Evidence summary:* • Inconclusive evidence for associations with long-term prognosis due to few studies, low certainty of evidence, and non-significant associations. • While cervical bony tenderness by manual palpation was shown to have a moderate association with ongoing disability, the certainty of the evidence was low due to wide confidence intervals nearing 1.0 at the lower bound and findings being reported from a single study. *Consistency:* • These findings are consistent with other guidelines and systematic reviews.
Subgroup considerations	• These factors could be assessed for medium/high risk subgroups to inform treatment.
Implementation	• Assessment of physical factors have mixed evidence and are less helpful in determining prognosis. *Indications:* • Muscle and sensorimotor function could be assessed when the person's clinical presentation indicates the need for assessment. Findings from these assessments can inform treatment direction. For example, assessment of cervical flexor endurance can inform neck-specific strengthening exercises. • Manual palpation of mid-cervical bony tenderness is a criterion that is assessed for the Canadian C-Spine rule (see Diagnosis section) but is less helpful informing prognosis.

	• Assessment of body mass index (BMI) could be an indicator of general health status and may be appropriate to assess as part of a person-centred approach to treatment. • Sympathetic nervous system assessment is not clinically feasible. • Resources on how to perform muscle and sensorimotor assessments are freely available from Whiplash Navigator https://mywhiplash.com.au/

Please refer to P.7 in the Prognosis Technical Report (Chapter 3) for further details.

11.10. Pre-crash health: Pre-crash co-morbid conditions

Recommendation: The guideline panel cannot recommend for or against assessing for pre-crash co-morbid conditions to determine poor prognosis in people with acute whiplash.

(Panel vote summary: 12/12 100% neutral)

Strong Against	Conditional against	Neutral	Conditional for	Strong for

Justification	*Evidence summary:* • Inconclusive associations between pre-crash comorbid conditions and critical outcomes of poor prognosis. *Acceptability and feasibility:* • These factors are easy for HCPs to assess for during routine consultation and are generally expected by clients as part of past medical history information. • Trivial adverse effects expected. • While pre-crash comorbid conditions were inconclusive for predicting poor prognosis, individuals with WAD may report that these factors influence their recovery.
Implementation	• If a factor is identified during a routine consultation, HCPs should consider following up with a question to identify how they think the factor is influencing their recovery. For example: "How do you think [factor xx] is impacting your recovery?"

Please refer to P.8 in the Prognosis Technical Report (Chapter 3) for further details.

11.11. Sociodemographic factors

Question: What sociodemographic factors are predictive of ongoing neck pain, neck disability, psychological distress, and perceived non-recovery in people with acute whiplash associated disorders?

Sociodemographic factors refer to personal information (e.g., age, gender) and social information (e.g., living status, educational level, socio-economic status, employment).

Recommendation: The guideline panel suggest that healthcare professionals do not assess socio-demographic factors to determine poor prognosis in people with acute whiplash.

(Panel vote summary: 11/13 85% conditional against, 2/13 15% conditional for)

Strong Against	Conditional against	Neutral	Conditional for	Strong for

Justification	*Evidence summary:* • There were 28 studies that informed the recommendations. The majority of the studies concluded no or indeterminate associations with sociodemographic factors and outcome. The exception is age, which is included as a factor in WhipPredict (see prognostic tools). Sociodemographic variables are often used in analyses as covariates with pain, disability, psychological distress. *Consistency:* • The recommendation is consistent with other guidelines and systematic reviews. *Acceptability and feasibility:* • Most sociodemographic factors are non-modifiable or unable to be targeted in management. However, most are routinely collected to understand the person.
Implementation	• HCPs are not recommended to assess sociodemographic factors for the purpose of prognosis. However, these factors are often collected to understand the person, and are applicable to person-centred management, return to work and support plans.

Please refer to P.5 in the Prognosis Technical Report (Chapter 3) for further details.

11.12. Health care utilisation factors

Question: What healthcare utilisation factors are predictive of ongoing neck pain, neck disability, psychological distress, and perceived non-recovery in people with acute whiplash associated disorders?

Healthcare utilisation refers to the clinical services a person may seek to help manage their injury.

Recommendation: The guideline panel suggest that healthcare professionals do not measure health care utilisation to determine poor prognosis in people with acute whiplash.

(Panel vote summary: 8/13 62% conditional for; 5/13 38% strong for)

Strong Against	Conditional against	Neutral	Conditional for	Strong for

Justification	*Evidence summary:* • Three studies informed the recommendations for health care-utilisation. While there is a strong positive association between primary healthcare practitioner treatment (physiotherapy or chiropractic) and non-recovery, a causal relationship cannot be inferred. *Acceptability and feasibility:* • Questions around healthcare utilisation is expected by clients as part of a routine consultation.

Subgroup considerations	• There is an issue around over-treating people; those at low-risk require less treatment. This sub-group may not recover as well if they are over-treated. It is important not to create a problem by giving unnecessary treatment.
Implementation	• HCPs need to monitor their own practice, for example, by following the Clinical Framework for the Delivery of Health Services when treating people with WAD. • HCPs also need to ensure they do not continue treatment where there is no benefit. • Asking about healthcare utilisation might be helpful for other reasons (change of care).

Please refer to P.10 in the Prognosis Technical Report (Chapter 3) for further details.

11.13. Crash factors

Question: What crash factors are predictive of ongoing neck pain, neck disability, psychological distress, and perceived non-recovery in people with acute whiplash associated disorders?

Crash factors include position in the vehicle (e.g., driver vs passenger) and details of the crash such as collision speed, awareness of the collision, direction of impact or airbag deployment.

Recommendation: The guideline panel suggest that healthcare professionals do not assess crash factors to determine poor prognosis in people with acute whiplash.
(Panel vote summary: 9/13 69% conditional against, 4/13 21 % strong against)

Strong Against	Conditional against	Neutral	Conditional for	Strong for

Justification	*Evidence summary:* • There were 10 studies informing the recommendations and of these, most studies show no association with any crash-related factor and outcome. *Consistency:* • The findings are consistent with systematic reviews on WAD prognosis and with previous guidelines. *Acceptability and feasibility:* • Not efficient/ does not add value, and for some people re-living the accident can be distressing.
Implementation	• Not recommended for prognosis. However, some crash factors (e.g., speed > 100km/hr, ejection, rollover) may need to be assessed to establish diagnosis. (See Canadian C-Spine Rule in Diagnosis section).

Please refer to P.6 in the Prognosis Technical Report (Chapter 3) for further details.

11.14. Radiological factors

Question: What radiological factors are predictive of ongoing neck pain, neck disability, psychological distress, and perceived non-recovery in people with acute whiplash associated disorders?

Radiological factors in this guideline refer to imaging such as X-ray, Computed Tomography (CT) scan or Magnetic Resonance Imaging (MRI).

Recommendation: The guideline panel strongly recommend against referral for X-ray, CT or MRI to determine poor prognosis in people with acute whiplash.

(Panel vote summary: 10/11 (91%) strong against, 1/11 (9%) conditional against.

Strong Against	Conditional against	Neutral	Conditional for	Strong for

Justification	*Evidence summary:* • Overall inconclusive based on 4 studies, but all find no association with the outcome. *Consistency:* • Consistent with systematic reviews and recommendations for similar musculoskeletal conditions (e.g., low back pain). *Balance of effects:* • Unnecessary imaging is costly and can be associated with significance being attached to imaging findings that are reported as abnormal but are known to be present in asymptomatic people.
Implementation	• Not recommended, therefore no implementation considerations for the purposes of prognosis. • Please refer to the Diagnosis guidelines for recommendations on when it is reasonable to refer for imaging to establish diagnosis (WAD III).

Please refer to P.3 in the Prognosis Technical Report (Chapter 3) for further details.

11.15. References: Acute whiplash prognostic tools

Bohman, T., Côté, P., Boyle, E., Cassidy, J. D., Carroll, L. J., & Skillgate, E. (2012). Prognosis of patients with whiplash-associated disorders consulting physiotherapy: development of a predictive model for recovery. *BMC musculoskeletal disorders*, *13*, 1-11.

Cancelliere, C., Boyle, E., Côté, P., Holm, L. W., Salmi, L. R., & Cassidy, J. D. (2021). Predicting nonrecovery in adults with incident traffic injuries including post-traumatic headache. *Accident Analysis & Prevention*, *159*, 106265.

Griffin, A. R., Sterling, M., Ritchie, C., Kifley, A., Jagnoor, J., Cameron, I. D., & Rebbeck, T. (2022). Do expectations of recovery improve risk assessment for people with whiplash-associated disorders? Secondary analysis of a prospective cohort study. *BMC Musculoskeletal Disorders*, *23*(1), 395.

Ritchie, C., Hendrikz, J., Kenardy, J., & Sterling, M. (2013). Derivation of a clinical prediction rule to identify both chronic moderate/severe disability and full recovery following whiplash injury. *Pain*, *154*(10), 2198-2206.

Ritchie, C., Hendrikz, J., Jull, G., Elliott, J., & Sterling, M. (2015). External validation of a clinical prediction rule to predict full recovery and ongoing moderate/severe disability following acute whiplash injury. *journal of orthopaedic & sports physical therapy*, *45*(4), 242-250.

Rydman, E., Ponzer, S., Ottosson, C., & Järnbert-Pettersson, H. (2017). Predicting nonrecovery among whiplash patients in the emergency room and in an insurance company setting. *European spine journal*, *26*, 1254-1261.

Sterling, M., Ritchie, C., Rebbeck, T., Cameron, I. D., Griffin, A., Jagnoor, J., ... & Warren, J. (2021). Comparison of the accuracy of WhipPredict to that of a modified version of the Short-Form Örebro Musculoskeletal Pain Screening Questionnaire to predict poor recovery after whiplash injury. *Journal of Orthopaedic & Sports Physical Therapy*, *51*(5), 207-215.

11.16. References: Acute whiplash prognostic factors

Ameratunga, S., Tin, S. T., Connor, J., & Norton, R. (2010). Chronic neck pain following car crashes: A population-based study from Auckland, New Zealand. *Internal Medicine Journal, 40*(10), 704-709. https://doi.org/https://dx.doi.org/10.1111/j.1445-5994.2009.02101.x

Andersen, T. E., Sterling, M., Maujean, A., & Meredith, P. (2019). Attachment insecurity as a vulnerability factor in the development of chronic whiplash associated disorder - A prospective cohort study. *Journal of psychosomatic research, 118*, 56-62. https://doi.org/https://dx.doi.org/10.1016/j.jpsychores.2019.01.008

Asenlof, P., Bring, A., & Soderlund, A. (2013). The clinical course over the first year of whiplash associated disorders (WAD): pain-related disability predicts outcome in a mildly affected sample. *BMC musculoskeletal disorders, 14*, 361. https://doi.org/https://dx.doi.org/10.1186/1471-2474-14-361

Atherton, K., Wiles, N. J., Lecky, F. E., Hawes, S. J., Silman, A. J., Macfarlane, G. J., & Jones, G. T. (2006). Predictors of persistent neck pain after whiplash injury. *Emergency medicine journal: EMJ, 23*(3), 195-201. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=med6&NEWS=N&AN=16498156

Berglund, A., Bodin, L., Jensen, I., Wiklund, A., & Alfredsson, L. (2006). The influence of prognostic factors on neck pain intensity, disability, anxiety and depression over a 2-year period in subjects with acute whiplash injury. *Pain, 125*(3), 244-256. https://doi.org/https://dx.doi.org/10.1016/j.pain.2006.05.026

Borenstein, P., Rosenfeld, M., & Gunnarsson, R. (2010). Cognitive symptoms, cervical range of motion and pain as prognostic factors after whiplash trauma. *Acta Neurologica Scandinavica, 122*(4), 278-285.

https://doi.org/10.1111/j.1600-0404.2009.01305.x

Bostick, G. P., Carroll, L. J., Brown, C. A., Harley, D., & Gross, D. P. (2013). Predictive capacity of pain beliefs and catastrophizing in Whiplash Associated Disorder. *Injury, 44*(11), 1465-1471. https://doi.org/https://dx.doi.org/10.1016/j.injury.2012.10.007

Buitenhuis, J., Jaspers, J. P. C., & Fidler, V. (2006b). Can kinesiophobia predict the duration of neck symptoms in acute whiplash? *The Clinical journal of pain, 22*(3), 272-277. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=med6&NEWS=N&AN=16514328

Buitenhuis, J., de Jong, P. J., Jaspers, J. P., & Groothoff, J. W. (2006). Relationship between posttraumatic stress disorder symptoms and the course of whiplash complaints. *Journal of psychosomatic research, 61*(5), 681-689.

Buitenhuis, J., de Jong, P. J., Jaspers, J. P., & Groothoff, J. W. (2008). Catastrophizing and causal beliefs in whiplash. *Spine, 33*(22), 2427-2433.

Buitenhuis, J., Spanjer, J., & Fidler, V. (2003). Recovery from acute whiplash: the role of coping styles. *Spine, 28*(9), 896-901.

Carroll, L. J., Holm, L. W., Ferrari, R., Ozegovic, D., & Cassidy, J. D. (2009). Recovery in whiplash-associated disorders: do you get what you expect? *The Journal of rheumatology, 36*(5), 1063-1070.

Carroll, L. J., Liu, Y., Holm, L. W., Cassidy, J. D., & Côté, P. (2011). Pain-related emotions in early stages of recovery in whiplash-associated disorders: their presence, intensity, and association with pain recovery. *Psychosomatic medicine, 73*(8), 708-715.

Carstensen, T. B. W., Fink, P., Oernboel, E., Kasch, H., Jensen, T. S., & Frostholm, L. (2015). Sick Leave within 5 Years of Whiplash Trauma Predicts Recovery: A Prospective Cohort and Register-Based Study. *PloS one, 10*(6), e0130298. https://doi.org/https://dx.doi.org/10.1371/journal.pone.0130298

Carstensen, T. B. W., Frostholm, L., Oernboel, E., Kongsted, A., Kasch, H., Jensen, T. S., & Fink, P. (2009). Post-trauma ratings of pre-collision pain and psychological distress predict poor outcome following acute whiplash trauma: a 12-month follow-up study. *Pain, 139*(2), 248-259. https://doi.org/https://dx.doi.org/10.1016/j.pain.2008.04.008

Carstensen, T. B. W., Frostholm, L., Oernboel, E., Kongsted, A., Kasch, H., Jensen, T. S., & Fink, P. (2012). Are there gender differences in coping with neck pain following acute whiplash trauma? A 12-month follow-up study. *European journal of pain (London, England), 16*(1), 49-60. https://doi.org/https://dx.doi.org/10.1016/j.ejpain.2011.06.002

Casey, P. P., Feyer, A. M., & Cameron, I. D. (2015a). Associations with legal representation in a compensation setting 12 months after injury. *Injury, 46*(5), 918-925.

Casey, P. P., Feyer, A. M., & Cameron, I. D. (2015b). Course of recovery for whiplash associated disorders in a compensation setting. *Injury, 46*(11), 2118-2129.

Cobo, E. P., Mesquida, M. E. P., Fanegas, E. P., Atanasio, E. M., Pastor, M. B. S., Pont, C. P., Prieto, C. M., Gomez, G. R., & Cano, L. G. (2010). What factors have influence on persistence of neck pain after a whiplash? *Spine, 35*(9), E338-343. https://doi.org/https://dx.doi.org/10.1097/BRS.0b013e3181c9b075

Gehrt, T. B., Carstensen, T. B. W., Ørnbøl, E., Fink, P. K., Kasch, H., & Frostholm, L. (2015). The role of illness perceptions in predicting outcome after acute whiplash trauma: a multicenter 12-month follow-up study. *The Clinical journal of pain, 31*(1), 14-20.

Griffin, A. R., Sterling, M., Ritchie, C., Kifley, A., Jagnoor, J., Cameron, I. D., & Rebbeck, T. (2022). Do expectations of recovery improve risk assessment for people with whiplash-associated

disorders? Secondary analysis of a prospective cohort study. *BMC musculoskeletal disorders, 23*(1), 395. https://doi.org/https://dx.doi.org/10.1186/s12891-022-05242-8

Gun, R. T., Osti, O. L., O'Riordan, A., Mpelasoka, F., Eckerwall, C. G. M., & Smyth, J. F. (2005). Risk factors for prolonged disability after whiplash injury: a prospective study. *Spine, 30*(4), 386-391. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=med6&NEWS=N&AN=15706334

Hendriks, E. J. M., Scholten-Peeters, G. G. M., van der Windt, D., Neeleman-van der Steen, C. W. M., Oostendorp, R. A. B., & Verhagen, A. P. (2005, Apr). Prognostic factors for poor recovery in acute whiplash patients [Article]. *Pain, 114*(3), 408-416. https://doi.org/10.1016/j.pain.2005.01.006

Holm, L. W., Carroll, L. J., Cassidy, J. D., Skillgate, E., & Ahlbom, A. (2007). Widespread pain following whiplash-associated disorders: incidence, course, and risk factors. *The Journal of rheumatology, 34*(1), 193-200.

Holm, L. W., Carroll, L. J., Cassidy, J. D., Skillgate, E., & Ahlbom, A. (2008). Expectations for recovery important in the prognosis of whiplash injuries. *PLoS medicine, 5*(5), e105. https://doi.org/https://dx.doi.org/10.1371/journal.pmed.0050105

Johansson, M. P., Liane, M. S. B., Bendix, T., Kasch, H., & Kongsted, A. (2011). Does cervical kyphosis relate to symptoms following whiplash injury? *Manual therapy, 16*(4), 378-383. 27.

Kasch, H., Bach, F. W., & Jensen, T. S. (2001). Handicap after acute whiplash injury: a 1-year prospective study of risk factors. *Neurology, 56*(12), 1637-1643.

Kongsted, A., Sorensen, J. S., Andersen, H., Keseler, B., Jensen, T. S., & Bendix, T. (2008). Are early MRI findings correlated with long-lasting symptoms following whiplash injury? A prospective trial with 1-year follow-up. *European spine journal : official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society, 17*(8), 996-1005. https://doi.org/https://dx.doi.org/10.1007/s00586-008-0687-9

Kongsted, A., Jørgensen, L. V., Leboeuf-Yde, C., Qerama, E., Korsholm, L., & Bendix, T. (2008). Are altered smooth pursuit eye movements related to chronic pain and disability following whiplash injuries? A prospective trial with one-year follow-up. *Clinical Rehabilitation, 22*(5), 469-479.

Kuperman, P., Granovsky, Y., Fadel, S., Bosak, N., Buxbaum, C., Hadad, R., Sprecher, E., Bahouth, H., Ben Lulu, H., Yarnitsky, D., & Granot, M. (2021). Head- and neck-related symptoms post-motor vehicle collision (MVC): Separate entities or two-sides of the same coin? *Injury, 52*(5), 1227-1233. https://doi.org/https://dx.doi.org/10.1016/j.injury.2021.03.003

Kyhlbäck, M., Thierfelder, T., & Söderlund, A. (2002). Prognostic factors in whiplash-associated disorders. *International Journal of Rehabilitation Research, 25*(3), 181-187.

Mayou, R., & Bryant, B. (1996). Outcome of 'whiplash' neck injury. *Injury, 27*(9), 617-623.

Mayou, R., Tyndel, S., & Bryant, B. (1997). Long-term outcome of motor vehicle accident injury. *Psychosomatic medicine, 59*(6), 578-584.

Mayou, R., & Bryant, B. (2002). Psychiatry of whiplash neck injury. *The British journal of psychiatry : the journal of mental science, 180*, 441-448. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=med4&NEWS=N&AN=11983642

Miettinen, T., Airaksinen, O., Lindgren, K.-A., & Leino, E. (2004). Whiplash injuries in Finland--the possibility of some sociodemographic and psychosocial factors to predict the outcome after one year. *Disability and rehabilitation, 26*(23), 1367-1372.

Miettinen, T., Leino, E., Airaksinen, O., & Lindgren, K.-A. (2004). The possibility to use simple validated questionnaires to predict long-term health problems after whiplash injury. *Spine, 29*(3), E47-E51.

Olsson, I., Bunketorp, O., Carlsson, S. G., & Styf, J. (2002). Prediction of outcome in whiplash-associated disorders using West Haven–Yale Multidimensional Pain Inventory. *The Clinical journal of pain, 18*(4), 238-244.

Osterland, T. B., Kasch, H., Frostholm, L., Bendix, T., Jensen, T. S., Jensen, J. S., & Carstensen, T. B. W. (2019). Precollision Medical Diagnoses Predict Chronic Neck Pain Following Acute Whiplash Trauma. *The Clinical journal of pain, 35*(4), 304-314. https://doi.org/https://dx.doi.org/10.1097/AJP.0000000000000683

Ozegovic, D., Carroll, L. J., & Cassidy, J. D. (2009, Jun). Does expecting mean achieving? The association between expecting to return to work and recovery in whiplash associated disorders: a population-based prospective cohort study [Article]. *European Spine Journal, 18*(6), 893-899. https://doi.org/10.1007/s00586-009-0954-4

Palmlöf, L., Côté, P., Holm, L. W., Carroll, L. J., Cassidy, J. D., & Skillgate, E. (2015). Are prevalent self-reported cardiovascular disorders associated with delayed recovery from whiplash-associated disorders: a population-based cohort study. *The Clinical journal of pain, 31*(3), 247-253.

Pedler, A., & Sterling, M. (2011). Assessing fear-avoidance beliefs in patients with whiplash-associated disorders: a comparison of 2 measures. *The Clinical journal of pain, 27*(6), 502-507. https://doi.org/https://dx.doi.org/10.1097/AJP.0b013e31820d97b0

Pedler, A., Kamper, S. J., & Sterling, M. (2016). Addition of posttraumatic stress and sensory hypersensitivity more accurately estimates disability and pain than fear avoidance measures alone after whiplash injury. *Pain, 157*(8), 1645-1654.

Phillips, L. A., Carroll, L. J., Cassidy, J. D., & Cote, P. (2010). Whiplash-associated disorders: who gets depressed? Who stays depressed? *European spine journal: official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society, 19*(6), 945-956. https://doi.org/https://dx.doi.org/10.1007/s00586-010-1276-2

Pobereskin, L. H. (2005). Whiplash following rear end collisions: a prospective cohort study. *Journal of neurology, neurosurgery, and psychiatry, 76*(8), 1146-1151. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=med6&NEWS=N&AN=16024895

Radanov, B. P., & Sturzenegger, M. (1996). Predicting recovery from common whiplash. *European neurology, 36*(1), 48-51.

Ravn, S. L., Karstoft, K.-I., Sterling, M., & Andersen, T. E. (2019). Trajectories of posttraumatic stress symptoms after whiplash: A prospective cohort study. *European journal of pain (London, England), 23*(3), 515-525. https://doi.org/https://dx.doi.org/10.1002/ejp.1325

Richter, M., Ferrari, R., Otte, D., Kuensebeck, H., Blauth, M., & Krettek, C. (2004). Correlation of clinical findings, collision parameters, and psychological factors in the outcome of whiplash associated disorders. *Journal of Neurology, Neurosurgery & Psychiatry, 75*(5), 758-764.

Rydman, E., Ponzer, S., Brisson, R., Ottosson, C., & Pettersson-Jarnbert, H. (2018). Long-term follow-up of whiplash injuries reported to insurance companies: a cohort study on patient-reported outcomes and impact of financial compensation. *European spine journal: official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society, 27*(6), 1255-1261. https://doi.org/https://dx.doi.org/10.1007/s00586-018-5507-2

Rydman, E., Ponzer, S., Ottosson, C., & Jarnbert-Pettersson, H. (2017). Predicting nonrecovery among whiplash patients in the emergency room and in an insurance company setting. *European spine journal: official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society, 26*(4), 1254-1261. https://doi.org/https://dx.doi.org/10.1007/s00586-016-4652-8

Skillgate, E., Cote, P., Cassidy, J. D., Boyle, E., Carroll, L., & Holm, L. W. (2016). Effect of Early Intensive Care on Recovery From Whiplash-Associated Disorders: Results of a Population-Based Cohort Study. *Archives of physical medicine and rehabilitation, 97*(5), 739-746. https://doi.org/https://dx.doi.org/10.1016/j.apmr.2015.12.028

Söderlund, A., & Lindberg, P. (2003). Whiplash-associated disorders–predicting disability from a process-oriented perspective of coping. *Clinical Rehabilitation, 17*(1), 101-107.

Söderlund, A., Löfgren, M., & Stålnacke, B.-M. (2018). Predictors before and after multimodal rehabilitation for pain acceptance and engagement in activities at a 1-year follow-up for patients with whiplash-associated disorders (WAD) — A study based on the Swedish Quality Registry for Pain Rehabilitation (SQRP). *The spine journal, 18*(8), 1475-1482.

Sterling, M., Hendrikz, J., & Kenardy, J. (2010). Compensation claim lodgement and health outcome developmental trajectories following whiplash injury: A prospective study. *Pain, 150*(1), 22-28. https://doi.org/https://dx.doi.org/10.1016/j.pain.2010.02.013

Sterling, M., Hendrikz, J., & Kenardy, J. (2011). Similar factors predict disability and posttraumatic stress disorder trajectories after whiplash injury. *Pain, 152*(6), 1272-1278. https://doi.org/https://dx.doi.org/10.1016/j.pain.2011.01.056

Sterling, M., Jull, G., Vicenzino, B., Kenardy, J., & Darnell, R. (2005). Physical and psychological factors predict outcome following whiplash injury. *Pain, 114*(1-2), 141-148.

Vetti, N., Kråkenes, J., Eide, G. E., Rørvik, J., Gilhus, N. E., & Espeland, A. (2010, 2010/11/11). Are MRI high-signal changes of alar and transverse ligaments in acute whiplash injury related to outcome? *BMC musculoskeletal disorders, 11*(1), 260. https://doi.org/10.1186/1471-2474-11-260

Williamson, E., Williams, M. A., Gates, S., & Lamb, S. E. (2015). Risk factors for chronic disability in a cohort of patients with acute whiplash associated disorders seeking physiotherapy treatment for persisting symptoms. *Physiotherapy, 101*(1), 34-43. https://doi.org/https://dx.doi.org/10.1016/j.physio.2014.04.004

12. Acute whiplash: Treatment recommendations

12.1. Advice: Specific education interventions

Question: Are specific education interventions compared with general advice effective for the management of people with acute WAD?

Refers to education provided to people with acute WAD on the nature of their injury, self-management strategies, advice for activity/exercise, and prognosis.

Recommendation: The guideline panel suggest that specific education interventions, such as video-based educational resources, be used for the management of people with acute WAD.

(Panel vote summary: 13/16 81% conditional for; 2/16 13% strong for; 1/16 6% neutral)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were four acute WAD trials included (Brison 2005; Ferrari 2005; Oliveira 2006; Rydman 2020)*. • Small benefits in short-term neck pain compared with general advice. *Adverse effects:* • No expected adverse effects from a short educational intervention in the acute phase following whiplash injury. *Consistency:* • Education is a key element for management of other musculoskeletal conditions. *Acceptability and feasibility:* • Specific educational information in addition to advice (e.g., 15-20min educational video) is acceptable to people with acute WAD. • Development of video-based educational content is low cost and easily accessible if distributed online.
Implementation	*Include education on:* • Pathophysiology of whiplash injury. • Advice about activity and exercise. • How psychological distress influences pain and physical function. • Prognostic risk-based advice. *Considerations:* • Could be presented in tertiary (e.g., emergency) or primary/secondary care settings. • Specific advice on whiplash injury management (concepts listed above) has been shown to be just as effective delivered orally compared with a written pamphlet for the management of people with acute WAD (Kongsted et al., 2008).

	• Appropriate stakeholder consultation when developing information videos.

*First author only included in citations for Treatment recommendations.

Please refer to T.7 in the Treatment Technical Report (Chapter 4) for further details.

12.2. Physical therapy (Exercise): Neck-specific exercises

Question: Are neck-specific exercises compared with general activity and advice effective for the management of people with acute WAD?

Neck specific exercises refer to low-load neck and shoulder exercises aimed at improving mobility, strength, endurance, and sensorimotor control of the head and neck.

Recommendation: The guideline panel suggests that healthcare professionals use neck-specific exercises for the management of people with acute WAD.

(Panel vote summary: 12/12 100% conditional for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification

Evidence summary:

- There were four acute WAD trials included (Ask 2009; Bunketorp, 2006; Rosenfeld, 2003; Soderlund, 2000).
- Overall effects were variable between the four trials, with little to no difference in neck pain and neck disability, except for two trials that showed clinically significant benefits in long-term neck pain (Rosenfeld, 2003) and short-term neck disability and psychological functioning (Bunketorp, 2006).
- Small overall benefits compared with active control interventions (advice for activity or global exercises), with two trials showing clinically significant effects on some critical outcomes.
- Evidence certainty ranged from very low to low for short- and long-term critical outcome measures.

Adverse effects:

- No adverse effects reported in included trials. Neck-specific exercises are low load and are unlikely to have significant adverse effects.

Consistency:

- Neck-specific exercises are generally included as part of psychologically informed exercise and multimodal physical therapy.
- Consistent with current recommended practice.

Acceptability and feasibility:

- Acceptable intervention to people in supervised and home-based settings.
- Intervention is feasible to implement in healthcare settings in Australia and is consistent with current recommended practice.

Implementation	*Training:* • Required to effectively implement neck-specific exercises. • Exercises are freely available on MyWhiplashNavigator (www.mywhiplash.com.au) *Dose:* • 1-2x/week for 6 weeks as supervised sessions. *Considerations:* • Develop the injured person's skills to independently perform neck-specific exercises (e.g., home exercise programme). • Healthcare professionals require training to implement neck-specific exercises. • Evaluate critical outcomes regularly.

Please refer to T.1 in the Treatment Technical Report (Chapter 4) for further details.

12.3. Physical therapy (Exercise): Dizziness-specific exercises

Question: Are dizziness-specific exercises effective for the management of people with acute WAD and concurrent dizziness symptoms?

Dizziness-specific exercises includes vestibular, phasic, and sensorimotor exercises, for example: keeping eyes still on a target whilst the head moves, standing on foam and turning the head from side to side, walking on a slope and turning the head from side to side, standing on a trampoline and moving eyes from side to side.

Recommendation: The guideline panel suggest that healthcare professionals use dizziness-specific exercises (e.g., vestibular training, phasic head, and neck exercises) for the management of people with acute WAD and dizziness symptoms.

(Panel vote summary: 13/14 93% conditional for; 1/14 7% neutral)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • No acute WAD trials, but two included trials for chronic WAD (Ekvall-Hannsson 2006; Fitz-Ritson, 1995). The guideline panel agreed to include dizziness ability as a critical outcome for this question as it was specific to a subgroup of people with WAD and concurrent dizziness symptoms. • Dizziness-specific exercises resulted in reductions to dizziness disability and clinically significant reductions in neck disability in people with chronic WAD. • Very low certainty in the evidence for dizziness specific exercises for the management of people with chronic WAD, due to two studies with different primary outcomes and fair study quality.

	Adverse effects: • Dizziness-specific exercises are low load and are unlikely to have significant adverse effects. *Consistency:* • While these results were from two studies in chronic WAD with small sample sizes and fair study quality (risk of bias present), dizziness specific exercises are prescribed for other dizziness-related conditions in both acute and chronic phases. *Acceptability and feasibility:* • People accept the delivery of exercise-based interventions by HCPs. • Dizziness-specific exercises can be prescribed as part of routine consultation.
Subgroup considerations	• People presenting with acute WAD and symptoms of dizziness, coordination deficits, and/or balance deficits.
Implementation	*Indications*: • For people presenting with symptoms of dizziness, coordination deficits, and/ or balance deficits coordination deficits, and/or balance deficits. • Provide intervention for short periods, and in conjunction with other recommended treatments. *Training*: • Provided HCP's have some training and access to information on these exercises. • Exercises are freely available on MyWhiplashNavigator (www.mywhiplash.com.au) *Dose:* • 1-2x/ week for 6 weeks. • Consider feasible/acceptable dosage for the injured person. *Considerations:* • Differential diagnosis – e.g., mild traumatic brain injury. • Evaluate outcomes (dizziness-specific outcomes) and usual recommended outcomes regularly. • Consider referral (to whiplash or dizziness expert) if outside HCP expertise.

Please refer to T.3 in the Treatment Technical Report (Chapter 4) for further details.

12.4. Physical therapy (Exercise): Psychologically informed exercise

Question: Are psychologically informed exercise interventions compared with usual care (advice/exercise) effective for the management of people with acute WAD?

Psychologically informed exercise interventions are implemented by HCPs (e.g., physiotherapist) and target early stress symptoms using cognitive behavioural approaches in addition to exercise.

Recommendation: The guideline panel suggest that healthcare professionals use psychologically informed exercise interventions for the management of people with acute WAD.

(Panel vote summary: 11/14 79% conditional for; 2/14 14% strong for; 1/14 7% neutral)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were three acute WAD trials included (Bring 2016, Lamb 2012, Sterling 2019). • Psychologically informed exercise compared with usual care (exercise and advice) likely results in a moderate reduction in short-term neck pain in acute WAD. Little to no differences between interventions was shown for other critical variables. • Certainty in the evidence ranged from low to moderate for short- and long-term critical outcome measures. *Adverse effects:* • Undesirable effects were trivial, even for participants who were medium-high risk of poor recovery and presented with hyperarousal symptoms. *Consistency:* • Neck specific exercises (see 9.2) are included in psychologically informed exercise interventions and are recommended for the management of people with acute WAD. *Acceptability and feasibility:* • Most people found the psychological techniques in the study by Sterling (2019) to be helpful in managing stress and pain, coping with their injury, and returning to function (Silva-Guerrero, 2022). • More training may be required for HCPs to implement these techniques when managing people who are medium-high risk. *Cost-effectiveness:* • Cost-effectiveness likely depends on stratified care approaches (i.e., not all people with acute WAD require targeted psychologically informed exercise like stress inoculation as it will be more appropriate for those at medium-high risk of poor recovery).
Subgroup considerations	• Psychologically informed exercise interventions could be applied to both low and medium/high risk acute WAD groups.

	• Sterling (2019): stress inoculation intervention is more appropriate for medium/high risk subgroup (elevated pain and hyperarousal symptoms). • Stewart (2007): participants with high levels of pain intensity and disability were associated with greater short- and long-term treatment effects compared with lower pain and disability.
Implementation	*Indications:* • Appropriate for people at medium-high risk of poor outcome (e.g., Sterling (2019) provided intervention for medium-high risk subgroup in acute WAD. Stewart (2007) found people with higher pain and disability had greater treatment response in chronic WAD. *Training*: • Additional formal training required (feasible given HCP's require continuing professional development (CPD) points for registration. • Where and how to access training will be a point for implementation (e.g., online modules). *Dose:* • 2x/ week for 6 weeks. Consider acceptable dosage for the person. *Considerations:* • Exercise interventions were delivered by primary HCP's (e.g., physiotherapists). • Psychologically informed interventions (e.g., cognitive behavioural therapy, stress management skill development) were used. • HCP's require formal training in psychological interventions by a psychologist. • Evaluate outcomes regularly. • Non-responders who are exhibiting high distress should be referred to a whiplash specialist +/- psychologist.

Please refer to T.2 in the Treatment Technical Report (Chapter 4) for further details.

12.5. HCP education: HCP implementation strategy

Question: Are implementation strategies involving education compared with dissemination of clinical practice guidelines effective for the management of people with acute WAD?
Intervention consisted of dissemination of whiplash guidelines, initial education by opinion leaders one-day workshop, and follow-up educational outreach session approximately 6 months after.
Recommendation: The guideline panel suggest that implementation strategies for healthcare professionals, involving education on clinical practice recommendations and their implementation, be used for the management of people with acute WAD. (Panel vote summary: 8/14 57% conditional for; 4/14 29% strong for; 2/14 14% neutral)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There was one trial included for acute WAD (Rebbeck 2006). The guideline panel agreed to include HCP specific outcomes as a critical outcome for this question as it was specific to educating HCPs who manage people with WAD and holds implications for implementation of these guidelines. • Significant improvements in HCP knowledge and implementation of clinical practice guidelines recommendations with an implementation education session. • Little to no difference on the person's short- and long-term neck disability was found between groups which may have been due to high quality of treatment prescription at baseline by both groups (e.g., most physiotherapists prescribed exercise in-line with guidelines recommendations before, during, and after the trial in both groups). • Certainty of evidence ranged from very low for the person's neck disability outcomes, to low certainty for HCP outcomes. *Adverse effects:* • No adverse effects reported. • HCP implementation sessions were developed based on guidelines recommendations and therefore unlikely to have undesirable effects on the injured person if implemented effectively. *Acceptability and feasibility:* • HCPs would need to be prepared to undertake the training. • Possible online modules/online delivered educational sessions. *Cost-effectiveness:* • Cost-effective per-person compared with dissemination of guidelines, however, costs associated with development and delivery of educational workshop.
Subgroup considerations	• Education would be tailored to included specific subgroup recommendations that are presented in these guidelines.
Implementation	*Indications:* • For HCPs who are less familiar or unclear about evidence-based interventions for whiplash injury. *Dose:* • Interactive education provided by opinion leaders (over 1-2 day workshops) resulted in change in PHCP behaviour to be more consistent with guidelines. *Considerations:*

	• Feasible as HCPs require CPD for registration. • Time and costs associated with developing and delivering clinical education sessions. • Possible future modes of delivery could include online delivery. • Tailor to HCP's impacted by these guidelines.

Please refer to T.8 in the Treatment Technical Report (Chapter 4) for further details.

12.6. Medications: Simple analgesics

Question: Are simple analgesics (e.g., paracetamol) compared with placebo effective for the management of people with acute WAD?
Simple oral analgesics such as paracetamol for pain management in acute whiplash.
Recommendation: The guideline panel suggest that simple analgesics (e.g., paracetamol) could be used for the management of people with acute WAD. (Panel vote summary: 9/9 100% conditional for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • No clinical trials included for acute WAD. Evidence relating to the use of simple analgesics for acute pain management was sourced from the Australian and New Zealand College of Anaesthetists and Faculty of Pain Medicine: Acute Pain Management Scientific Evidence (5th ed) (Schug et al., 2020). See "Absence of evidence procedures" (section 9.7.2) for further details. • Paracetamol is known to be an effective analgesic for acute pain and the incidence of adverse effects is comparable to placebo. *Adverse effects:* • Can be implemented safely if dosage recommendations are followed, as there are known significant dose related adverse effects, and if not used by people with known contraindicated conditions. *Acceptability and feasibility:* • Widely available and used in Australia, acceptable for people for pain management.
Subgroup considerations	• Simple analgesics could be used to alleviate pain in the short-term for people with WAD grades II and III.
Implementation	*Indications:* • Simple analgesics could be used to alleviate pain in the short-term. Use as a first line pharmacological treatment in conjunction with other recommended treatments if there are clinically significant reductions in neck pain and disability.

	Dose:
	• Calculate total paracetamol dosage that person is currently taking and ensure that it falls within guidelines (given known dose related side-effects)
	Considerations:
	• Inform person about
	  ○ known dose-related side-effects.
	  ○ that paracetamol might be present in mixed oral medications (over the counter or prescribed). For example, cold and flu medication.
	  ○ outside Australia paracetamol has different brand names (e.g., acetaminophen).
	Contraindications:
	• People with allergy to paracetamol
	• Have already taken the recommended dose within a 24-hour period.
	• People with liver, kidney conditions, alcohol problems or if severely underweight.

Please refer to T.18 in the Treatment Technical Report (Chapter 4) for further details.

12.7. Medications: Nonsteroidal anti-inflammatory drugs (NSAIDs)

Question: Are non-steroidal anti-inflammatory drugs compared with placebo effective for the management of people with acute WAD?

Oral NSAIDs for pain management in acute whiplash.

Recommendation: The guideline panel suggest that nonsteroidal anti-inflammatory drugs could be used for the management of people with acute WAD. (Panel vote summary: 9/9 100% conditional for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • No clinical trials included for acute WAD. Evidence relating to the use of NSAIDs for acute pain management was sourced from the Australian and New Zealand College of Anaesthetists and Faculty of Pain Medicine: Acute Pain Management Scientific Evidence (5th ed) (Schug 2020). See “Absence of evidence procedures” (section 9.7.2) for further details. • NSAIDs can be used to alleviate pain in the short-term. • Nonselective NSAIDs are effective in the treatment of acute muscle injury. • Nonselective NSAIDs given in addition to paracetamol improve analgesia compared with either medicine given alone for acute pain management.

	Adverse effects: • Common side effects after taking NSAIDs include nausea, heartburn, and indigestion. *Consistency*: • Used as part of a conservative treatment in whiplash clinical trials, without significant side effects reported. *Acceptability and feasibility:* • Can be implemented safely if dosage recommendations are followed, as there are known dose related adverse effects, and if not used by people with known contraindicated conditions. • Available over the counter at low cost in multiple forms (e.g., tablet).
Subgroup considerations	• NSAIDs could be used to alleviate pain in the short-term for people with WAD grades II and III.
Implementation	*Indications:* • If simple analgesics are ineffective, short-term use of NSAIDs may be used if there are clinically significant reductions in neck pain. *Considerations:* • Inform person of known side-effects (which appear to be dose related). • NSAIDs being present in different medications and under different names. *Contraindications:* • People allergic or hypersensitive to NSAIDs • Pregnancy or planning a pregnancy. • People with kidney or liver conditions • People with have a gastrointestinal (gut) ulcer or bleeding. • People who have a NSAID-exacerbated respiratory disease. • Care should be taken when prescribing NSAIDs to older adults with hypertension and/or heart disease.

Please refer to T.18 in the Treatment Technical Report (Chapter 4) for further details.

12.8. Physical therapy: Multimodal physical therapy

Question: Is multimodal physical therapy (e.g., exercise and manual therapy, and another treatment modality) compared with single interventions (e.g., advice for activity) effective for the management of people with acute WAD?

Multimodal physical therapy was defined as an intervention consisting of exercise and manual therapy, and another treatment modality (e.g., education, psychological, electrotherapy).

Recommendation: The guideline panel cannot recommend for or against multimodal physical therapy consisting of exercise, manual therapy, and one or more additional treatment modalities

(e.g., psychological support, electrotherapy, education) for the management of people with acute WAD. (Panel vote summary: 7/13 54% neutral; 4/13 31% conditional for; 2/13 15% strong for)				
Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were seven acute WAD trials included (Cote 2019; Dehner 2009; Lamb 2012; McKinney 1989; Provinciali 1996; Scholten-Peeters 2006; Wiangkham 2019). • Small reduction in short-term on neck pain, but small undesirable effects on neck disability in long-term. • Overall certainty of evidence was very low, however, certainty in critical outcomes varied from very low to high for short- and long-term acute WAD outcomes. • Control groups included advice to be active and management strategies for WAD. • Heterogeneity was present in treatment effects and interventional designs. *Consistency:* • Studies included under this clinical question are generally older with a higher proportion of manual/passive therapies in addition to exercise, when compared with current clinical practice that favours active therapies. *Acceptability and feasibility:* • Injured people accept the delivery of this intervention by HCPs for the management of whiplash injury and other musculoskeletal conditions in an Australian context.
Subgroup considerations	• Stratified care approach needed. E.g., higher pain group in Scholten-Peeters (2006) showed short-term clinically significant benefits. Some people (e.g., low risk) may require less care (e.g., advice for activity).
Implementation	*Indications:* • Provide interventions based on clinical presentation. Consider for people at medium-high risk of poor recovery. • For people at low risk (of poor outcome) consider unimodal and/or less dosage of care. *Considerations:* • Consider in relation to other recommended treatment interventions in these guidelines (e.g., psychologically informed exercise interventions). • Provide manual therapy (e.g., mobilisations) as an adjunct therapy, but only for short-periods of time (4-6 weeks, 1-2x/week), providing there is evidence of clinical benefit. • HCPs are trained to perform multimodal physical therapy.

	• Injured person's preference should determine modes chosen.

Please refer to T.4 in the Treatment Technical Report (Chapter 4) for further details.

12.9. Multidisciplinary: Multidisciplinary care

Question: Are multidisciplinary one-to-one interventions compared with usual care effective for the management of people with acute WAD?

A combination of interventions (e.g., education, physical therapy, psychological, medical) delivered by two or more HCPs (e.g., physician, psychologist, physiotherapist) compared with usual care (exercise/advice).

Recommendation: The guideline panel cannot recommend for or against multidisciplinary care for the management of people with acute WAD.

Panel vote summary: (8/9 89% neutral; 1/9 11% conditional for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There was one trial included for acute WAD (Jull 2013). • The evidence suggests that multidisciplinary care compared with usual care results in little to no difference in short- and long-term neck pain, neck disability, and psychological functioning (Jull 2013). Usual care in this context was at the discretion of the participants and generally involved general medical practitioners and physiotherapists. • Low certainty in the evidence for critical outcome effects as findings were from a single study with sample size (n=101) significantly below the threshold for precision. *Adverse effects:* • No adverse events were reported concerning physical therapy or psychological interventions. *Consistency:* • Recommended treatments for managing acute WAD in these guidelines are delivered by several HCPs, and people with acute WAD are likely to receive multi-profession care in practice. *Acceptability and feasibility:* • Multidisciplinary care involving medical, physical, and psychological treatment had high acceptability among injured people and no adverse effects reported.
Subgroup considerations	• Medium to high-risk people. Subjects in the study by Jull (2013) were stratified according to psychophysical measures suggestive of poor prognoses including NDI ≥30, Impact of Events Scale score ≥26, and sensory disturbances such as cold and pressure thresholds.
Implementation	*Indications:*

	• For people at medium/high risk of poor outcome and if there are clinically meaningful benefits in critical outcomes. *Dose:* • Provide for up to 3-months, where HCP's aim to develop self-efficacy in the person to self-manage their condition following treatment. *Considerations:* • Involve recommended treatment modalities outlined in these guidelines (education, physical therapy, psychological intervention). • Inter-professional communication is the core and critical component required to deliver effective multidisciplinary care. Following assessment, HCPs should initiate contact with other treating healthcare professionals if no communication has previously been established. Support for case conferencing (funding available through Medicare/insurers) should be considered to facilitate communication between professionals.

Please refer to T.23 in the Treatment Technical Report (Chapter 4) for further details.

12.10. Immobilisation: Intermittent immobilisation (soft collar)

Question: Is intermittent use of a cervical soft collar in addition to usual care effective for the management of people with acute WAD?

Use of cervical soft collar intermittently throughout the day with advice for active movements when collar is removed.

Recommendation: The guideline panel cannot recommend for or against intermittent use of a cervical soft collar in addition to usual care (advice and exercise) for the management of people with acute WAD.

(Panel vote summary: 8/10 80% neutral; 2/10 20% conditional for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were 8 studies included for acute WAD (Bonk 2000; Borchgrevink 1998; Crawford 2004; Dehner 2006; Kongsted 2007; Mealy 1986; Pennie & Agambar, 1990; Vassiliou 2006). • The evidence suggests that intermittent immobilisation of the neck with a soft collar in acute WAD results in little to no difference in short- and long-term neck pain and disability, and long-term psychological functioning. • Low to moderate certainty in the evidence of critical outcome effects. *Adverse effects:* • No adverse effects reported with intermittent soft collar use, and trivial adverse effects are expected.

	• Potential inactivity during a period of immobilisation, compared with physical activity, could result in small non-clinically significant increases in neck pain (Mealy et al., 1986). *Consistency:* • Active therapy is recommended for management of people with acute WAD (see sections: neck-specific exercises, psychologically informed exercise interventions, dizziness-specific exercises, specific-education). *Acceptability and feasibility:* • Can be provided in emergency departments or primary care settings.
Subgroup considerations	• There may be some instances where it is clinically indicated (e.g., high initial pain intensity) for a soft collar to be used for a short period of time in people with acute WAD.
Implementation	*Indications:* • There may be some instances where use of a soft collar is indicated (e.g., high initial pain). In these instances, use for a short period only (up to two weeks) and at intervals throughout the day. *Dose:* • Short period only (up to two weeks) and at intervals throughout the day. *Considerations:* • Early movement and return to usual activities are recommended as part of active treatment for the management of acute WAD, given the overall benefits of movement and physical activity over inactivity. • Contextual factors of the injured person such as pain, disability, and psychological distress if considering prescribing intermittent soft collar use. • HCPs should advise the injured person to mobilise the neck as tolerated when the soft collar is not worn.

Please refer to T.11 in the Treatment Technical Report (Chapter 4) for further details.

12.11. Medications: Amitriptyline

Question: Is amitriptyline compared with placebo effective for the management of people with acute WAD?

Amitriptyline is a tricyclic antidepressant used in low doses for the treatment of neuropathic pain and psychological distress.

Recommendation: The guideline panel cannot recommend for or against the use of amitriptyline for the management of people with acute WAD.

(Vote summary: 6/9 67% neutral; 3/9 33% conditional for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • No clinical trials included for acute WAD. Evidence relating to the use of amitriptyline for acute pain management and psychological distress was sourced from the Australian and New Zealand College of Anaesthetists and Faculty of Pain Medicine: Acute Pain Management Scientific Evidence (5th ed) (Schug et al., 2020). See "Absence of evidence procedures" (section 9.7.2) for further details. • Tricyclic antidepressants such as amitriptyline have been shown to be effective at reducing pain, improving sleep and QOL in pain conditions such as fibromyalgia, neuropathic pain, and chronic headaches. *Adverse effects:* • Varies based on potency. • Tricyclic antidepressants for fibromyalgia, no significant difference in adverse effects compared with placebo for dizziness/somnolence and weight gain, but increase dry mouth (Häuser et al., 2012). *Acceptability and feasibility:* • Effectiveness and acceptability (low dropout) demonstrated in other pain states (e.g., fibromyalgia). • Widely available and used in an Australian context.
Subgroup considerations	• People with suspected neuropathic/nociplastic pain and/or psychological distress who have not shown benefit with simple analgesics and NSAIDs.
Implementation	*Indications:* • If simple analgesics and NSAIDs are ineffective and the person is presenting with neuropathic/nociplastic pain and/or psychological distress, use of amitriptyline could be considered provided there is clinical benefit. *Dose:* • To minimise adverse effects, it is advisable to commence treatment with amitriptyline at the lowest dose possible (e.g., amitriptyline 5 to 10 mg at night) and titrate up to no more than 100 mg per day. *Considerations:* • In conjunction with recommended treatments, not as the primary treatment, and only prescribed for short periods of time (e.g., 4-6 weeks). • Inform person of known side-effects, including the risk of withdrawal symptoms. *Contraindications:* • Prior hypersensitization, concomitant use of monoamine oxidase inhibitors, acute recovery phase following myocardial infarction) and potential precautions (suicidality, anxiety and insomnia, activation of

	mania/hypomania and schizophrenia, cardiovascular disorders, hyperthyroid people, or those receiving thyroid medication, elective surgery, elevated or lowered blood sugar, impaired liver function).

Please refer to T.20 in the Treatment Technical Report (Chapter 4) for further details.

12.12. Medications: Pregabalin

Question: Is pregabalin compared with placebo effective for the management of people with acute WAD?
An oral anticonvulsant, analgesic, and anxiolytic medication used to manage neuropathic pain.
Recommendation: The guideline panel cannot recommend for or against the use of pregabalin for the management of people with acute WAD. (Panel vote summary: 8/8 100% neutral)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There was one trial included for acute WAD (Nikles 2021). • Pregabalin may result in clinically significant reductions in short-term neck pain in people with acute WAD and high pain intensity compared with placebo. • Very-low certainty in the evidence as the evidence is based on a small pilot trial with high loss to follow-up (unable to evaluate long-term outcomes). • Justification for the trial was to provide an alternative to more commonly prescribed opioids that have been used in people with WAD in practice. *Adverse effects:* • Known side effects associated with pregabalin use, including high prevalence of dizziness as a minor adverse effect in the pregabalin group compared with placebo group (Nikles 2021). *Acceptability and feasibility:* • Pregabalin group's adherence with medication was much higher than placebo group (73.6% vs 38.3%). • Medication in widespread use in an Australian context. • Use of pregabalin in WAD is not an accepted indication for the Pharmaceutical Benefits Scheme (neuropathic pain and not responding to other medication).
Subgroup considerations	• People with acute WAD who have high initial pain intensity (NRS≥5) early after whiplash injury (e.g., 48 hours post), and are suspected to have neuropathic pain.
Implementation	*Indications:*

	• People who have high initial pain intensity (NRS≥5) early after whiplash injury (e.g., 48 hours post) and are suspected to have neuropathic pain. *Considerations:* HCPs should • Prescribe for a short period of time only (5weeks). • Screen people for a history of drug misuse before prescribing and ongoing observation of the person for development of signs of misuse and dependence should be carried out. • Use in conjunction with recommended treatments and only if the person is showing clinically meaningful benefit in critical outcomes. • Inform person of known side-effects. *Contraindications:* • People with history of depression were not included in the study due to the risk of suicidal ideation (Nikles, 2021).

Please refer to T.21 in the Treatment Technical Report (Chapter 4) for further details.

12.13. Passive physical therapy: Massage

Question: Are massage techniques in addition to usual care effective for the management of people with acute WAD?

Massage techniques for musculoskeletal pain management.

Recommendation: The guideline panel cannot recommend for or against the use of massage techniques in addition to usual care for the management of people with acute WAD.

(Panel vote summary: 8/13 62% neutral; 3/13 23% conditional against; 2/13 15% conditional for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • No included studies for acute WAD. • Variable short-term improvements shown in other neck pain conditions. *Adverse effects:* • Some instances where massage could exacerbate symptoms in people with pain hypersensitivity (e.g., pressure hyperalgesia). *Consistency:* • Massage has been included in multimodal physical therapy clinical trials (see T.4 in Treatment Technical Report for details). • Emphasis on active therapies in other musculoskeletal condition guidelines (e.g., Low Back Pain Clinical Care Standard) over passive therapies like massage. *Acceptability and feasibility:*

	• Injured person's preference needs to be considered, but massage is generally accepted by people with musculoskeletal conditions. • Can be implemented as part of multimodal care by HCPs.
Subgroup considerations	• In some people with high pain sensitivity (hot/cold hyperalgesia, pressure hyperalgesia, allodynia) massage could have undesirable effects.
Implementation	*Indications:* • Not recommended as primary treatment but could be provided in conjunction with other recommended treatments provided there is clinical benefit. • More likely to be beneficial in the acute phase of whiplash injury for symptom management compared with the chronic phase. *Dose:* • Short-term treatment 1-2x/week for 4-6 weeks. *Considerations:* • Vascular structures and risks associated with pressure applied to these regions when performing massage to the cervical region. • More likely to be beneficial in the acute phase of whiplash injury for symptom management. • HCPs are able to provide massage techniques during multimodal care.

Please refer to T.10 in the Treatment Technical Report (Chapter 4) for further details.

12.14. Passive physical therapy: Acupuncture

Question: Are acupuncture techniques in addition to usual care effective for the management of people with acute WAD?

Needles to stimulate points in the body for pain management, with the possible addition of manual manipulation, heat, or electrical stimulation.

Recommendation: The guideline panel are unable to recommend for or against acupuncture techniques in addition to usual care for the management of people with acute WAD.

(Panel vote summary: 10/11 91% neutral; 1/11 9% conditional against)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There was one trial included for acute WAD (Kim 2020). • No significant short-term differences with motion style acupuncture in addition to integrative Korean medicine. The findings from this study (Kim 2020) in acute WAD were not applicable to an Australian context. • Unknown effects of acupuncture techniques in addition to usual care in an Australian context.

	Adverse effects: • There are undesirable effects associated with acupuncture techniques reported at low prevalence (e.g., localised bruising). • Low risk of significant harm (pneumothorax). *Acceptability and feasibility:* • Access may be reduced to acupuncture trained HCPs across Australia (e.g., regional/rural).
Subgroup considerations	• High pain sensitivity (hot/cold hyperalgesia, pressure hyperalgesia, allodynia) could be a contraindication to acupuncture techniques.
Implementation	*Indications:* • Not recommended as the primary treatment, but could be provided in conjunction with recommended treatments, provided there is clinical benefit. *Dose:* • Acupuncture techniques should only be used in the short-term (e.g., 6-12 sessions). *Considerations:* • Preference of the person with WAD. • HCPs should communicate risks: localised bruising and the low risk of significant harm (pneumothorax).

Please refer to T.13 in the Treatment Technical Report (Chapter 4) for further details.

12.15. Passive physical therapy: Manipulation (high velocity low amplitude)

Question: Is manipulation (high-velocity low amplitude thrust) of the spine compared with usual care effective for the management of people with acute WAD?

High velocity low amplitude (HVLA) thrust manipulation of the spine. The guideline panel agreed on providing two separate recommendations for cervical and thoracic manipulation of the spine.

Recommendation (thoracic): The guideline panel could not recommend for or against high-velocity low-amplitude manipulation of the thoracic spine for the management of people with acute WAD.

(Panel vote summary: 12/13 92% neutral; 1/13 8% conditional against)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Recommendation (cervical): The guideline panel suggest that healthcare professionals do not use high-velocity low-amplitude manipulation of the cervical spine for the management of people with acute WAD.

(Panel vote summary: 8/13 62% conditional against; 3/13 23% strong against; 2/13 15% neutral)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There was one trial included for acute WAD (Fernandez-de-las-Pen 2004). • Trivial non-clinically significant benefits shown in a single study in Spain comparing manipulation of the spine compared with multimodal care; differences in comparator intervention (includes ultrasound in cervical soft tissues, exercise, low energy high frequency pulsed electromagnetic therapy), which were not consistent with current usual care in an Australian context. • Very low certainty in the evidence for short-term neck pain effects. *Adverse effects:* • Very rare risk of significant adverse events (e.g., stroke and vertebral artery dissection).
Subgroup considerations	• WAD grade III (radiculopathy, decreased or absent tendon reflexes and/or weakness and sensory deficit) osteoporosis, vascular conditions (e.g., history of stroke), or dizziness may be a contraindication for manipulation.
Implementation	*Considerations (adapted from previous guidelines):* • Practitioners could provide thoracic spinal manipulation for the treatment of acute WAD. • HVLA manipulations should only be provided by registered health practitioners trained in the specific methods and in accordance with current professional standards. • Inform person that while significant adverse events (stroke and vertebral artery dissection) are very rare, some risk with manipulation may be present. *Dose:* • Manipulation could be provided for up to 4-6 weeks provided there is meaningful clinical benefit. • Spinal manipulation should not be used in isolation for the management of people with acute WAD, but as an adjunct to the recommended treatments.

Please refer to T.9 in the Treatment Technical Report (Chapter 4) for further details.

12.16. Medications: Opioids

Question: Are opioid analgesics compared with placebo effective for the management of people with acute WAD?

Oral opioid analgesics for the management of acute pain. Common types of opioids in an Australian context: fentanyl, morphine, oxycodone, methadone, tramadol, buprenorphine, tapentadol, hydromorphone, codeine.

Recommendation: The guideline panel suggest that healthcare professionals do not use opioid analgesics for the management of people with acute WAD. (Panel vote summary: 8/10 80% conditional against; 2/10 20% neutral)				
Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • No clinical trials included for acute WAD. Evidence relating to the use of opioids for acute pain management was sourced from the Australian and New Zealand College of Anaesthetists and Faculty of Pain Medicine: Acute Pain Management Scientific Evidence (5th ed) (Schug et al., 2020). See "Absence of evidence procedures" (section 9.7.2) for further details. • Some opioids have been shown to be effective for acute pain management: e.g., tramadol is an effective treatment for neuropathic pain. • Variable effectiveness as one opioid is not superior to others, but some opioids are better in some people. *Adverse effects:* • Clinically meaningful adverse effects (nausea, vomiting) of opioids are dose-related and in high doses opioids can induce hyperalgesia and/or acute tolerance.
Subgroup considerations	• People with very severe pain who have not shown benefit with simple analgesics, NSAIDs, or other medication (e.g., pregabalin).
Implementation	*Indications*: • If simple analgesics and NSAIDs are ineffective and pain is very severe, cautious use of low-potency opioids (e.g., tramadol) could be considered provided that there is clinical benefit. *Dose*: • If used, opioids should be only prescribed for short periods of time for severe pain that either is not responsive to other analgesics, or when other analgesics are contraindicated. *Considerations:* • Opioid types and potency need to be considered individually. • Communicate known side-effects, which appear to be dose related, to the injured person. *Contraindications:* • People with impaired liver or kidney function, or alcohol dependence, mild traumatic brain injury and other co-morbidities.

Please refer to T.22 in the Treatment Technical Report (Chapter 4) for further details.

12.17. Passive physical therapy: Electrotherapy

Question: Are electrotherapy techniques in addition to usual care effective for the management of people with acute WAD?

Mixed electrotherapy techniques:

- Ultra-reiz: also called ultra-stimulation current, is an interrupted direct current of low frequency applied via medium sized electrodes supported on a thick moist sponge. These electrodes are placed near the spinal column along the neck and upper back region.
- Transcutaneous electrical nerve stimulation (TENS): gentle electric current to stimulate nerves around the pain site.
- Low-energy high frequency pulsed electromagnetic therapy (PEMT).
- High powered laser therapy.
- Therapeutic Ultrasound: ultrasound energy applied to the skin to increase blood circulation to the injured tissue.

Recommendation: The guideline panel suggest that healthcare professionals do not use electrotherapy techniques in addition to usual care for the management of people with acute WAD.

(Panel vote summary: 9/11 82% conditional against; 2/11 strong against)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary*: • There were five included trials for acute WAD with mixed electrotherapy techniques (Conforti 2013; Foley-Nolan 1992; Hendriks 1996; Provinciali 1996; Ruiz-Molinero 2014). • Electrotherapy techniques may result in little to no effect on short-term neck pain in people with acute WAD in two of the five trials, two trials showed benefit of electrotherapy techniques, however, they were of high risk of bias and interventions/comparators were not consistent with usual care in an Australian context. • One trial showed a clinically significant difference in short- and long-term neck pain in favour of multimodal physical therapy compared with electrotherapy. *Consistency:* • Electrotherapy techniques are passive therapies that differ to recommendations of active modalities and could increase a person's reliance on passive therapy for pain management. • Serious indirectness noted with study designs (interventions/comparators), that may not be consistent with an Australian context. • No clinical trials performed in an Australian context, and it is not standard practice to teach electrotherapy techniques in tertiary education settings in Australia.

Please refer to T.12 in the Treatment Technical Report for further details.

12.18. Passive physical therapy: Needling techniques

Question: Are trigger point needling techniques in addition to usual care effective for the treatment of people with acute WAD?

Trigger point needling techniques differs from acupuncture techniques as the sites of treatment are targeted at myofascial trigger points.

Recommendation: The guideline panel suggests that healthcare professionals do not use trigger point needling techniques in addition to usual care for the management of people with acute WAD.

(Panel vote summary: 8/11 73% conditional against; 3/11 27% neutral)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification

Evidence summary:

- There were two trials included for acute WAD (Naranjo 2017; Tough 2010).
- Trigger point needling techniques in addition to usual care compared with sham needling compared with usual care result in little to no difference in short-term neck pain, neck disability, and psychological functioning in people with acute WAD.
- Overall, very low certainty in the evidence for trigger point needling techniques in addition to usual care have little to no difference on neck pain, neck disability, and psychological functioning in acute or chronic WAD.

Adverse effects:

- There are undesirable effects associated with trigger point needling techniques reported at low prevalence (e.g., localised bruising).
- There are rare adverse effects: e.g., infection, pneumothorax.
- In people with high pain sensitivity (hot/cold hyperalgesia, pressure hyperalgesia, allodynia) trigger point needling techniques may exacerbate pain.

Please refer to T.14 in the Treatment Technical Report (Chapter 4) for further details.

12.19. Injections: Botulinum toxin-A

Question: Are botulinum toxin-A injections compared with placebo injections effective for the management of people with acute WAD?

Botulinum toxin-A injections prevent the release of acetylcholine which is required for muscular contractions. The aim of these injections is to have analgesic effect by reducing muscular hyperactivity.

Recommendation: The guideline panel suggest that healthcare professionals do not use botulinum toxin-A injections for the management of people with acute WAD.

(Panel vote summary: 13/15 87% conditional against; 1/15 strong against; 1/15 neutral)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There was one trial included for acute WAD (Carroll, 2008). • The evidence suggests that botulinum toxin-A injections compared with placebo injections may result in little to no difference in short term neck pain, neck disability, and psychological functioning. Findings were based on a single study with small sample size. *Adverse effects:* • Significant side effects (e.g., weakness, vertigo, fever, infection risk). • May result in dependency on botulinum toxin-A injections as ongoing treatment. *Consistency:* • General effects of botulinum toxin-A injections for other conditions (e.g., neurological) are short term only. *Acceptability and feasibility:* • Moderate costs associated with treatment. • Only a select population would have access to treatment (e.g., in settings where professionals with specialised skills for these injections and where additional funding is available).

Please refer to T.15 in the Treatment Technical Report (Chapter 4) for further details.

12.20. Injections: Corticosteroid injection

Question: Are facet joint corticosteroid injections compared with placebo injections effective for the management of people with acute WAD?

Injection of a corticosteroid into a single cervical facet joint diagnosed as a source of pain following a nerve block protocol.

Recommendation: The guideline panel strongly recommend that healthcare professionals do not use facet joint corticosteroid injections for the management of people with acute WAD.

(Panel vote summary: 13/14 93% strong against; 1/14 7% conditional against)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were no included studies for acute WAD. • The effectiveness of corticosteroid injections for the management of acute WAD is unknown. • No benefit shown in chronic WAD when compared with local anaesthetic injections (Barnsley 1994).

	Adverse effects: • Low risk of severe adverse effects (e.g., vascular complications, spinal cord compression, infection). *Consistency:* • Effects are seen in the short-term only (weeks). *Acceptability and feasibility:* • Costly treatment. • Requires specialised skills (e.g., CT assistance for the injections). • Corticosteroid injections are only considered after the injured person has not shown significant improvement with usual care.

Please refer to T.16 in the Treatment Technical Report (Chapter 4) for further details.

12.21. Injections: Intravenous steroid injection

Question: Are facet joint corticosteroid injections compared with placebo injections effective for the management of acute WAD?

Intravenous (IV) steroid injections (e.g., hydrocortisone) are systemic, compared with the localised corticosteroid injection into a facet joint (see 9.20).

Recommendation: The guideline panel strongly recommend that healthcare professionals do not use intravenous steroid injections for the management of people with acute WAD.

(Panel vote summary: 12/15 80% strong against; 3/15 20% conditional against)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* There was one included study for acute WAD (Shaked 2021). • The evidence suggests that steroid intravenous injections do not reduce short-term neck pain (low certainty), neck disability (low certainty), and psychological functioning (very low certainty) compared with placebo injections in people with acute WAD. *Adverse effects:* • Steroid injections slow healing responses following acute injury. • Known side effects for steroids. • Infection risk with IV injection. *Acceptability and feasibility:* • Requires specialised expertise. • Consideration for other medications for pain management before IV steroid injections.

Please refer to T.16 in the Treatment Technical Report (Chapter 4) for further details.

12.22. Treatment for whiplash-associated headache

Question: Are treatments for WAD associated headache effective for the management of people with acute or chronic WAD?

No recommendation developed.

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	• In our systematic review of whiplash RCTs, no trials specifically aimed to change headache symptoms as part of the intervention. • Four studies evaluated headache intensity as a secondary outcome in response to multimodal physical therapy (Scholten-Peeters 2006), immobilisation with soft collar (Borchgrevink 1998; Kongsted 2007), and specific education (Kongsted 2008) interventions. No significant differences in between group headache intensity found in these studies. • The guideline panel note that as per the International Classification of Headache Disorders (3rd edition), the critical outcome measure for headache is the frequency of headache over the previous month. Frequency of headache was not measured in any of the included whiplash trials. • Interventions that target headache after whiplash might be an area for future research.
Implementation	• HCPs should review primary headache trials for evidence regarding headache management following traumatic injury.

12.23. References: Acute whiplash treatment

Ask, T., Strand, L. I., & Sture Skouen, J. (2009). The effect of two exercise regimes; motor control versus endurance/strength training for patients with whiplash-associated disorders: a randomized controlled pilot study. *Clinical rehabilitation, 23*(9), 812-823.

Barnsley, L., Lord, S. M., Wallis, B. J., & Bogduk, N. (1994). Lack of effect of intraarticular corticosteroids for chronic pain in the cervical zygapophyseal joints. *New England Journal of Medicine, 330*(15), 1047-1050.

Bonk, A. D., Ferrari, R., Giebel, G. D., Edelmann, M., & Huser, R. (2000). Prospective, randomized, controlled study of activity versus collar, and the natural history for whiplash injury, in Germany. *Journal of Musculoskeletal Pain, 8*(1-2), 123-132.

Borchgrevink, G. E., Kaasa, A., McDonagh, D., Stiles, T. C., Haraldseth, O., & Lereim, I. (1998). Acute treatment of whiplash neck sprain injuries: a randomized trial of treatment during the first 14 days after a car accident. *Spine, 23*(1), 25-31.

Bring, A., Åsenlöf, P., & Söderlund, A. (2016). What is the comparative effectiveness of current standard treatment, against an individually tailored behavioural programme delivered either on the Internet or face-to-face for people with acute whiplash associated disorder? A randomized controlled trial. *Clinical rehabilitation, 30*(5), 441-453.

Brison, R. J., Hartling, L., Dostaler, S., Leger, A., Rowe, B. H., Stiell, I., & Pickett, W. (2005). A randomized controlled trial of an educational intervention to prevent the chronic pain of whiplash associated disorders following rear-end motor vehicle collisions. *Spine, 30*(16), 1799-1807.

Bunketorp, L., Lindh, M., Carlsson, J., & Stener-Victorin, E. (2006). The effectiveness of a supervised physical training model tailored to the individual needs of patients with whiplash-associated disorders-a randomized controlled trial. *Clinical rehabilitation, 20*(3), 201-217.

Carroll, Á., Barnes, M., & Comiskey, C. (2008). A prospective randomized controlled study of the role of botulinum toxin in whiplash-associated disorder. *Clinical rehabilitation, 22*(6), 513-519.

Conforti, M., & Fachinetti, G. P. (2013). High power laser therapy treatment compared to simple segmental physical rehabilitation in whiplash injuries (1 and 2 grade of the Quebec Task Force classification) involving muscles and ligaments. *Muscles, ligaments and tendons journal, 3*(2), 106.

Côté, P., Boyle, E., Shearer, H. M., Stupar, M., Jacobs, C., Cassidy, J. D., Carette, S., Van Der Velde, G., Wong, J. J., & Hogg-Johnson, S. (2019). Is a government-regulated rehabilitation guideline more effective than general practitioner education or preferred-provider rehabilitation in promoting recovery from acute whiplash-associated disorders? A pragmatic randomised controlled trial. *BMJ open, 9*(1), e021283.

Crawford, J. R., Khan, R. J., & Varley, G. W. (2004). Early management and outcome following soft tissue injuries of the neck—a randomised controlled trial. *Injury, 35*(9), 891-895.

Dehner, C., Elbel, M., Strobel, P., Scheich, M., Schneider, F., Krischak, G., & Kramer, M. (2009). Grade II whiplash injuries to the neck: what is the benefit for patients treated by different physical therapy modalities? *Patient safety in surgery, 3*(1), 1-8.

Dehner, C., Hartwig, E., Strobel, P., Scheich, M., Schneider, F., Elbel, M., Kinzl, L., & Kramer, M. (2006). Comparison of the relative benefits of 2 versus 10 days of soft collar cervical immobilization after acute whiplash injury. *Archives of physical medicine and rehabilitation, 87*(11), 1423-1427.

Ekvall-Hansson, E., Månsson, N.-O., Ringsberg, K. A., & Håkansson, A. (2006). Dizziness among patients with whiplash-associated disorder: a randomized controlled trial. *Journal of Rehabilitation Medicine, 38*(6), 387-390.

Fernández-de-las-Peñas, C., Fernández-Carnero, J., Del Cerro, L. P., & Miangolarra-Page, J. (2004). Manipulative treatment vs. conventional physiotherapy treatment in whiplash injury: A randomized controlled trial. *Journal of Whiplash & Related Disorders, 3*(2), 73-90.

Ferrari, R., Rowe, B. H., Majumdar, S. R., Cassidy, J. D., Blitz, S., Wright, S. C., & Russell, A. S. (2005). Simple educational intervention to improve the recovery from acute whiplash: results of a randomized, controlled trial. *Academic Emergency Medicine, 12*(8), 699-706.

Fitz-Ritson, D. (1995, 1995/01//). Phasic exercises for cervical rehabilitation after "whiplash" trauma. *Journal of manipulative and physiological therapeutics, 18*(1), 21-24. http://europepmc.org/abstract/MED/7706955

Foley-Nolan, D., Moore, K., Codd, M., Barry, C., O'Connor, P., & Coughlan, R. (1992). Low energy high frequency pulsed electromagnetic therapy for acute whiplash injuries. A double blind randomized controlled study. *Scandinavian journal of rehabilitation medicine, 24*(1), 51-59.

Hendriks, O. (1996). Ultra-reiz current as an adjunct to standard physiotherapy treatment of the acute whiplash patient. *Physiotherapy Ireland, 17*, 3-7.

Jull, G., Kenardy, J., Hendrikz, J., Cohen, M., & Sterling, M. (2013). Management of acute whiplash: a randomized controlled trial of multidisciplinary stratified treatments. *Pain, 154*(9), 1798-1806.

Kim, D., Park, K.-S., Lee, J.-H., Ryu, W.-H., Moon, H., Park, J., Jeon, Y.-H., Seo, J.-Y., Moon, Y.-J., & Namgoong, J. (2020). Intensive motion style acupuncture treatment (MSAT) is effective for patients with acute whiplash injury: a randomized controlled trial. *Journal of clinical medicine, 9*(7), 2079.

Kongsted, A., Qerama, E., Kasch, H., Bach, F. W., Korsholm, L., Jensen, T. S., & Bendix, T. (2008). Education of patients after whiplash injury: is oral advice any better than a pamphlet? *Spine, 33*(22), E843-E848.

Kongsted, A., Qerama, E., Kasch, H., Bendix, T., Winther, F., Korsholm, L., & Jensen, T. S. (2007). Neck Collar,“Act-as-Usual” or Active Mobilization for Whiplash Injury?: A Randomized Parallel-Group Trial.

Lamb, S. E., Gates, S., Williams, M. A., Williamson, E. M., Mt-Isa, S., Withers, E. J., Castelnuovo, E., Smith, J., Ashby, D., & Cooke, M. W. (2012). Emergency department treatments and physiotherapy for acute whiplash: a pragmatic, two-step, randomised controlled trial. *The Lancet, 381*(9866), 546-556.

McKinney, L., Dornan, J., & Ryan, M. (1989). The role of physiotherapy in the management of acute neck sprains following road-traffic accidents. *Emergency Medicine Journal, 6*(1), 27-33.

Mealy, K., Brennan, H., & Fenelon, G. (1986). Early mobilization of acute whiplash injuries. *Br Med J (Clin Res Ed), 292*(6521), 656-657.

Naranjo, J. G., Rosa, S. B., Ferrer, J. L., Cañal, J. L., & Hernández, E. S. (2017). A novel approach in the treatment of acute whiplash syndrome: Ultrasound-guided needle percutaneous electrolysis. A randomized controlled trial. *Orthopaedics & Traumatology: Surgery & Research, 103*(8), 1229-1234.

Nikles, J., Keijzers, G., Mitchell, G., Farrell, S. F., Perez, S., Schug, S., Ware, R. S., McLean, S. A., Connelly, L. B., & Sterling, M. (2021). Pregabalin vs placebo to prevent chronic pain after whiplash injury in at-risk individuals: results of a feasibility study for a large randomised controlled trial. *Pain, 163*(2), e274-e284.

Oliveira, A., Gevirtz, R., & Hubbard, D. (2006). A psycho-educational video used in the emergency department provides effective treatment for whiplash injuries. *Spine, 31*(15), 1652-1657.

Pennie, B. H., & Agambar, L. J. (1990). Whiplash injuries. A trial of early management. *The Journal of Bone and Joint Surgery. British volume, 72*(2), 277-279.

Provinciali, L., Baroni, M., Illuminati, L., & Ceravolo, M. G. (1996). Multimodal treatment to prevent the late whiplash syndrome. *Scandinavian journal of rehabilitation medicine, 28*(2), 105-111.

Rebbeck, T., Maher, C. G., & Refshauge, K. M. (2006). Evaluating two implementation strategies for whiplash guidelines in physiotherapy: a cluster-randomised trial. *Australian Journal of Physiotherapy, 52*(3), 165.

Rosenfeld, M., Seferiadis, A., Carlsson, J., & Gunnarsson, R. (2003). Active intervention in patients with whiplash-associated disorders improves long-term prognosis: a randomized controlled clinical trial. *Spine, 28*(22), 2491-2498.

Ruiz-Molinero, C., Jimenez-Rejano, J. J., Chillon-Martinez, R., Suarez-Serrano, C., Rebollo-Roldan, J., & Perez-Cabezas, V. (2014). Efficacy of therapeutic ultrasound in pain and joint mobility in whiplash traumatic acute and subacute phases. *Ultrasound in medicine & biology, 40*(9), 2089-2095.

Rydman, E., Ottosson, C., Ponzer, S., Dahl, A., Eneqvist, T., Järnbert-Pettersson, H., & Kasina, P. (2020). Intervention with an educational video after a whiplash trauma–a randomised controlled clinical trial. *Scandinavian journal of pain, 20*(2), 273-281.

Scholten-Peeters, G. G., Neeleman-van der Steen, C. W., van der Windt, D. A., Hendriks, E. J., Verhagen, A. P., & Oostendorp, R. A. (2006). Education by general practitioners or education and exercises by physiotherapists for patients with whiplash-associated disorders? A randomized clinical trial.

Schug, S. A., Palmer, G. M., Scott, D. A., Alcock, M., Halliwell, R., & Mott, J. (2020). *Acute pain management: scientific evidence*. Australian and New Zealand College of Anaesthetists.

Shaked, G., Shaked, D., Sebbag, G., & Czeiger, D. (2021). The effect of steroid treatment on whiplash associated syndrome: a controlled randomized prospective trial. *European Journal of Trauma and Emergency Surgery, 47*(4), 1115-1122.

Silva Guerrero, A. V., Setchell, J., Maujean, A., & Sterling, M. (2022). "I've learned to look at things in a different way": exploring patients' perspectives on participation in physiotherapist delivered integrated stress inoculation training and exercise for acute whiplash. *Disability and rehabilitation, 44*(18), 5191-5198. https://doi.org/10.1080/09638288.2021.1931480

Söderlund, A., Olerud, C., & Lindberg, P. (2000). Acute whiplash-associated disorders (WAD): the effects of early mobilization and prognostic factors in long-term symptomatology. *Clinical rehabilitation, 14*(5), 457-467.

Sterling, M., Smeets, R., Keijzers, G., Warren, J., & Kenardy, J. (2019). Physiotherapist-delivered stress inoculation training integrated with exercise versus physiotherapy exercise alone for acute whiplash-associated disorder (StressModex): a randomised controlled trial of a combined psychological/physical intervention. *British Journal of Sports Medicine, 53*(19), 1240-1247.

Tough, E. A., White, A. R., Richards, S. H., & Campbell, J. L. (2010). Myofascial trigger point needling for whiplash associated pain–a feasibility study. *Manual therapy, 15*(6), 529-535.

Vassiliou, T., Kaluza, G., Putzke, C., Wulf, H., & Schnabel, M. (2006). Physical therapy and active exercises–An adequate treatment for prevention of late whiplash syndrome?: Randomized controlled trial in 200 patients. *Pain, 124*(1-2), 69-76.

Wiangkham, T., Duda, J., Haque, M. S., Price, J., & Rushton, A. (2019). A cluster randomised, double-blind pilot and feasibility trial of an active behavioural physiotherapy intervention for acute whiplash-associated disorder (WAD) II. *PLoS one, 14*(5), e0215803

13. Acute whiplash: Assessment consensus recommendations

13.1. Physical/musculoskeletal impairments: Cervical Range of Motion (CROM)

Clinical question: What physical and/or musculoskeletal impairments assist in the clinical assessment of people with acute WAD?

Cervical range of motion (CROM) refers to the amount (range) of movement a person can move their neck. Directions often measured are flexion (forward), extension (backward), rotation (turning) and lateral flexion (side bending).

Consensus Recommendation: There was strong guideline panel consensus that healthcare professionals assess cervical range of motion in people with acute WAD. *(Panel vote summary: 12/12 100% strong for)*

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • No evidence in assessment studies for ROM. *Consistency:* • Strong evidence in prognostic studies that poor CROM is associated with poor prognosis, hence assessment is recommended to determine prognosis. • CROM assessment is also important to classify the WAD Grade.
Implementation	*Indications:* • Assessing CROM is required to determine WAD Grade, prognosis and inform treatment direction. *How to assess:* • CROM can be measured in clinical settings using an inclinometer. Most reliable method is positioned in the midline of the forehead for lateral flexion or in the vertex of the head in the line with the nose for flexion and extension (see https://www.mywhiplash.com.au/node/160/#standard-assessment) • Normative age-related values are also found on MyWhiplashNavigator

Please refer to A.1 in the Assessment Technical Report (Chapter 2) for further details.

13.2. Pain sensitivity: Thermal hyperalgesia, pressure hyperalgesia, dynamic pain sensitivity, brachial plexus provocation test

Question: What pain sensitivity tests assist in the clinical assessment of people with acute WAD?

Pain sensitivity in this guideline refers to pain abnormal sensory processing (e.g., thermal hyperalgesia, pressure hyperalgesia pain) assessed by clinical tests, such as pressure pain tests and dynamic pain sensitivity test.

Consensus Recommendation: There was guideline panel consensus to suggest that healthcare professionals assess the following test(s): thermal hyperalgesia (cold pain thresholds, heat), pressure hyperalgesia (pressure pain threshold), dynamic pain sensitivity testing (CPM), and Brachial Plexus Provocation Test (BPPT).

(Panel vote summary: 11/12 (92%), conditional for 1/12 (8%) neutral)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • All cohorts evaluating pain sensitivity showed abnormal sensory in people with acute WAD. However, studies evaluated different constructions. Four independent cohort evaluated pressure pain threshold, 3 studies evaluated thermal hyperalgesia, 2 studies evaluated dynamic pain sensitivity, and 2 studies evaluated others' pain sensitivity. *Consistency:* • The findings are consistent were found across the included studies that suggest the presence of altered pain sensitivity in moderate-severe risk subgroups of people with acute WAD. • Findings for cold hyperalgesia were consistent with the Prognosis section of these guidelines, where assessment of cold hyperalgesia was recommended for determining those at risk of poor prognosis (see Prognosis section for pain sensitivity). *Balance of effects:* • Adverse effects for assessing pain sensitivity using these methods are likely limited in magnitude. *Acceptability and feasibility*: • Primary HCPs can administer clinical versions of pain sensitivity tests and conduct them as part of a routine consultation. These clinical tests are relatively low cost to administer.
Subgroup considerations	• Pain sensitivity assessments should be performed only for people at medium-to-high risk of poor recovery.
Implementation	*Indications:* • For people stratified as med/ high risk of poor outcome and / or when clinically indicated (e.g., widespread pain, reports of pain with non-noxious stimuli). *How to assess:* • Cold hyperalgesia: Ice Pain Test (Rebbeck et al., 2015). Perform with ice and ask a NRS rating for pain. NRS>5/10 for pain considered cold hyperalgesia (Maxwell & Sterling, 2013). • Pressure hyperalgesia: Best performed using a pressure algometer.

	• Brachial Plexus Provocation Test (BPPT)[1] is a clinical test to assess neural tissue sensitivity. The test can be modified to not go to end of range (i.e., avoid excessive overpressure). • Conditioned Pain Modulation (CPM): refer to the description of the test in the handout (Rebbeck et al. "How to assess for pain sensitisation in the clinic: neck and arm pain focus") presented on the following website http://www.specialistphysioeducation.net.au. *Considerations:* • Healthcare professionals should be cautious about carrying out a provocative pain sensitivity testing in people who present with widespread pain as some people may have a temporary increase in pain as a result of the assessment. *Contraindications:* • Cervical radiculopathy contraindicates provocative tests (upper limb neural tension test – brachial plexus). *What to do if test positive*: • Educate person on the purpose of the assessment and if positive on the assessment, take the opportunity to educate the person about pain hypersensitivity. • Use results to guide treatment – for example if positive some treatments may be contra-indicated (e.g., manual therapy), whilst others may be required (e.g., medication review / alternative medications - refer to pharmacological recommendations). • Referral to whiplash specialist for management. • Consider psychologically informed exercise interventions (see treatment recommendation).

Please refer to A.3 in the Assessment Technical Report (Chapter 2) for further details.

13.3. Additional symptoms: Jaw symptoms, upper limb disabilities, and sleep quality

Question: What additional symptoms assist in the clinical assessment of people with acute WAD?

Additional symptoms in this guideline refer to other symptoms (e.g., jaw symptoms, upper limb disabilities, and sleep quality) that people with whiplash might present other than the usual symptoms (i.e., neck pain, headache, dizziness).

Consensus Recommendation: There was guideline panel consensus to suggest that healthcare professionals assess the following additional symptoms in people with acute and chronic WAD.

(Panel vote summary: 10/12 (83%) condition for, 2/12 (17%) neutral for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:*

	• There were five studies (acute and chronic) and were all significant. However, there is only one study for each construct, and the findings are small. • The sleep study was in acute WAD. However, the recommendation in this guideline is the same for acute and chronic, as these additional symptoms are consistent across acute and chronic phases of WAD. *Consistency:* • Those symptoms are frequently reported in other musculoskeletal conditions, e.g., sleep disturbance. *Acceptability and feasibility:* • Assessing additional symptoms is usual practice for healthcare professionals to ask injured people about.
Implementation	• Assessing symptoms is part of routine history. HCPs are already recommended to assess pain intensity, neck disability, pain sites, number of symptoms and specific symptoms such as headache and dizziness. • HCPs should be aware that other areas that may be symptomatic are the aw and upper limb. Sleep quality/ disturbance is also recommended to be assessed. *How to assess:* • Sleep Quality: Pittsburgh Sleep Quality Index (PSQI) • Disability of the Arm Shoulder and Hand (DASH) to assess a person's ability to perform upper limb activities. *What to do:* • If sleep quality is impaired: It's important to help clients understand that sleep issues are common and manageable and that negative thoughts about sleep can worsen symptoms. Encourage small steps towards better sleep routines and check how sleep issues are affecting physical therapy. If sleep deprivation is severe, check their safety for certain activities (e.g., driving). Suggest they speak to their GP about sleep issues and consider seeing a psychologist for targeted support. Self-guided sleep resources can also be helpful as a starting point or while waiting for professional help.

Please refer to A.5 in the Assessment Technical Report (Chapter 2) for further details.

13.4. Physical/musculoskeletal impairments: Cervical muscle function and cervical muscle performance

Question: What physical and/or musculoskeletal clinical assessments assist in the clinical assessment of people with acute WAD?

Cervical muscle function refers to neck muscle endurance and muscle strength. Cervical muscle performance refers to muscle coordination and / or how much or little a muscle works (amplitude) when performing a task.

Consensus Recommendation: The guideline panel consensus was to not recommend either for or against assessing cervical muscle function and cervical performance in people with acute WAD. (Panel vote summary: Neutral 1/1 (9%) conditional for; 10/11 (91%) neutral)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were two studies (hence inconclusive). However, both found an impairment in people with WAD (in muscle performance and endurance, respectively). *Acceptability and feasibility:* • Assessment of muscle function/performance is commonly performed by HCPs and is expected by people as part of routine consultation.
Implementation	*Indications:* • Not recommended for people at low risk (of poor recovery) as they will recover well without these assessments. Consider assessing these factors in people at medium/ high risk of poor recovery when clinically indicated. • Clinical indications for assessing cervical muscle function may include when the person reports difficulty performing functional tasks requiring neck endurance (e.g., lifting head off bed, holding head up). Consumer panel members explained, "h*ead feels heavy".* • Clinical indications for assessing cervical (or axio-scapula) muscle performance may include when people report "muscle tightness or tension" in neck or axio-scapula muscles. Consumer panel members explained "*tight feeling in muscles in front of neck."* Considerations: • Healthcare professionals should explain the purpose of these assessments to the person. • Consider muscle performance tests before function (lower load before endurance) as it could be provocative. *How to assess:* • Examples of how to assess muscle performance and muscle endurance are provided in (Whiplash Navigator https://mywhiplash.com.au/). *What to do:* • If assessed to be impaired, this may require rehabilitation (see neck-specific exercises in treatment recommendations).

Please refer to A.1 in the Assessment Technical Report (Chapter 2) for further details.

13.5. Sensorimotor: Cervical joint position error, cervical movement sense, oculomotor disturbance, balance, and coordination test

Question: What sensorimotor impairments assist in the clinical assessment of people with acute WAD?

Sensorimotor impairment refers to impairment of the sensorimotor system. These include proprioceptive impairments such as Cervical joint position error (the ability to relocate the head / neck to a neutral position). Cervical movement sense assesses the ability to control the fine movement of the neck accurately. Oculomotor disturbance assesses the co-ordination between the eyes and the head/neck (e.g., the smooth pursuit neck torsion test (SPNT). Balance refers to general postural stability.

Consensus Recommendation: The guideline panel cannot reach consensus for or against assessing the following sensorimotor tests: Cervical joint position error, cervical movement sense, oculomotor disturbance, balance, and coordination test in people with acute WAD.

(Panel vote summary: 11/12 (92%), neutral 1/12 (8%) conditional for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were six studies. Five found a greater impairment for people with acute WAD. However, studies evaluated different constructs. • Evidence is limited, with only a few studies for those factors in people with acute WAD.
Subgroup considerations	• Do not assess these factors in people who are low risk (of poor outcome) as they will recover well without requiring more complicated assessments. • People at medium/high risk of poor outcome and/or those with dizziness are more likely to present with sensorimotor impairment
Implementation	*Indications:* • Consider assessing these factors in people at medium/ high risk of poor recovery if clinically indicated, such as when people report dizziness or impairment in balance. *Considerations:* • Some of the tests can provoke or increase symptoms. Avoid performing multiple tests on the same day to avoid symptom accumulation. HCPs are advised to prioritise the required tests based on clinical presentation. • Consider differential diagnosis of dizziness when interpreting tests (e.g., concussion, vestibular). • Training may be required to performing and interpreting tests. It is important to understand normative values and values that indicate

	impairment (e.g., error of > 4.5 degrees indicates impairment for cervical joint position error test). *How to assess:* • Resources on how to perform, normative values and threshold for cervical joint position error, cervical movement sense (CMS), smooth pursuit neck torsion test (SPNT), Balance – e.g., tandem step test) assessments are freely available from Whiplash Navigator: https://www.mywhiplash.com.au/content/higher-risk-assessments#sensorimotor-assessment *What to do:* • If the injured people are impaired – HCPs are recommended to rehabilitate the impairment and consider recommended treatments (e.g., dizziness specific exercise – see guideline Treatment section). Note that dizziness specific interventions included balance components. • Exercise needs to be safely performed (supervised) if at risk of falls (reduced balance). • Refer to a whiplash specialist if not confident in performing the above.

Please refer to A.2 in the Assessment Technical Report (Chapter 2) for further details.

13.6. Additional psychological factors: Fear avoidance and self-efficacy

Question: What additional psychological factors assist in the clinical assessment of people with acute WAD?

Additional psychological factors in this guideline refer to a person's avoiding movement or activities based on their fear (e.g., fear avoidance) and limited self-efficacy.

Consensus Recommendation: The guideline panel cannot reach consensus for or against assessing the following additional psychological factors: fear avoidance and self-efficacy in people with acute WAD.

(Panel vote summary: 12/12 (100%) strong for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • The two studies were significant. However, there is only one study for each construct, and the findings are therefore inconclusive. • Psychological factors are generally evaluated in a prognostic context and used to determine the probability of poor recovery, rather than to determine the differences between people with WAD and other groups (refer to Prognosis section in the guidelines). There is therefore limited evidence in the assessment component of the guideline.

	Consistency: • Inconclusive findings were shown for fear avoidance and self-efficacy for determining those at risk of poor prognosis (refer to Prognosis section in the guidelines).
Subgroup considerations	• People who are stratified as "low risk" of poor recovery are unlikely to present with psychological distress. These people are unlikely to require assessment of these factors. • However, people with acute WAD who are stratified a "medium/high risk" of poor recovery might present the need for assessing psychological factors, depending on a client's clinical presentation (refer to Prognosis section recommendations).
Implementation	*Indications:* • For people who are stratified as medium-high risk of poor prognosis. Consider if relevant to their clinical presentation. *How to assess:* • Fear avoidance using the TSK-17 and PFActS-C scale. • Pain Self Efficacy using the Pain Self Efficacy Questionnaire (PSEQ). *What to do:* • PSEQ scores 30-40 (amber) – consider specific concerns and obstacles that the person might have (Prof. Michael Nicholas, University of Sydney, author communication). • Manage the beliefs (fear avoidance and self-efficacy within management strategies). • Consider psychologically informed exercise (see treatment recommendations). • PSEQ scores of <30 indicates low confidence in the person's ability to resume functional activities while in pain. Consider multidisciplinary care (see treatment recommendations) to address obstacles. For context, mean PSEQ scores of people attending multidisciplinary pain clinics is ~21 (Prof Michael Nicholas, University of Sydney, author communication). • Pain self-efficacy can be used to measure outcome in chronic phase. https://www.mywhiplash.com.au/content/higher-risk-assessments#psychological-distress

Please refer to A.4 in the Assessment Technical Report (Chapter 2) for further details.

13.7. Pain sensitivity: Vibration hyperalgesia, nociceptive flexion reflex

Question: What pain sensitivity tests assist in the clinical assessment of people with acute WAD?

Pain sensitivity in this question refers to additional tests of sensory pain processing (e.g., vibration hyperalgesia and nociception flexion reflex).

Consensus Recommendation: There was guideline panel consensus to suggest that healthcare professionals do not assess the following test(s): vibration hyperalgesia (vibrometer), Nociceptive Flexion Reflex (NFR) in people with acute WAD.

(Panel vote summary: 9/12 (75%) conditionals against; 1/12(5%) strong against; 1/12 neutral (5%); 1/12 (5%) conditional for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification

Evidence summary:

- The were 2 independent cohort evaluating either vibration or nociceptive flexion reflex. Vibration and NFR thresholds were lower in WAD groups compared with controls. However, as these are single studies the evidence is inconclusive.

Acceptability and feasibility:

- NFR test is not feasible in clinical settings as it requires a High Voltage Constant Current Stimulator and EMG, and specialised training to administer.
- Assessment of vibration hyperalgesia may not be feasible in clinical settings as it requires a specialised vibrometer device.

Please refer to A.3 in the Assessment Technical Report (Chapter 2) for further details.

13.8. Advanced medical testing: Stress hormone and inflammatory biomarkers

Question: What advanced medical testing methods assist in the clinical assessment of people with acute WAD?

Advanced medical testing in this guideline refers to tests performed to evaluate stress hormones (e.g., cortisol concentration) and inflammatory biomarkers (e.g., TNF- α, serum IL-1β)

Consensus Recommendation: There was strong guideline panel consensus that primary healthcare practitioners do not assess the following in people with acute WAD.
(Panel vote summary: 11/12 (92%) strong against; 1/12 (8%) conditional against)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification

Evidence summary:

- One study evaluated the cortisol concentration, and three studies evaluated inflammatory biomarkers. However, inflammatory biomarkers vary across studies.
- These studies are explanatory studies and not diagnostic studies. Therefore, they would not help diagnose WAD conditions or the treatment direction.

Please refer to A.6 in the Assessment Technical Report (Chapter 2) for further details.

13.9. Advanced imaging: Magnetic Resonance Imaging (MRI) and Ultrasound (US) to assess changes in morphology

Question: What advanced imaging methods assist in the clinical assessment of people with acute WAD

Advanced Imaging in this guideline refers to techniques such as Magnetic Resonance Imaging, and diagnostic ultrasound, performed to evaluate morphological changes, such as muscle fat infiltration, muscle size and stiffness.

Consensus Recommendation: There was strong guideline panel consensus that primary healthcare practitioners do not use the following imaging techniques, Magnetic resonance Imaging (MRI) and Ultrasound (US) to assess changes in morphology – structure changes, muscle fat infiltration, muscle size, and muscle stiffness in people with acute WAD.

(Panel vote summary: 10/12 strong against (83%), 1/12 conditional against, 1/12 conditional for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were 4/6 independent studies showing association. However, there is only one study for each construction, except morphology–structures change with three studies but only two significant. Therefore, studies are largely inconclusive. • Studies are exploratory studies and not diagnostic studies. The imaging techniques do not assist in diagnosing WAD nor helping in treatment. *Acceptability and feasibility:* • The techniques and equipment are costly (e.g., MRI). • The analysis requires advanced neuroimaging expertise not readily available in the clinical setting.

Please refer to A.7 in the Assessment Technical Report (Chapter 2) for further details.

13.10. References: Acute whiplash assessment

Aljinovic, J., Barisic, I., Poljicanin, A., Kuzmicic, S., Vukojevic, K., Bokun, D. G., & Vlak, T. (2020). Can measuring passive neck muscle stiffness in whiplash injury patients help detect false whiplash claims? Wiener Klinische Wochenschrift, 132(17-18), 506-514. https://doi.org/10.1007/s00508-020-01631-y

Anderson, S. E., Boesch, C., Zimmermann, H., Busato, A., Hodler, J., Bingisser, R., Ulbrich, E. J., Nidecker, A., Buitrago-Tellez, C. H., Bonel, H. M., Heini, P., Schaeren, S., & Sturzenegger, M. (2012). Are there cervical spine findings at MR imaging that are specific to acute symptomatic whiplash injury? A prospective controlled study with four experienced blinded readers. Radiology, 262(2), 567-575. https://doi.org/http://dx.doi.org/10.1148/radiol.11102115

Bunketorp-Kall, L. S., Andersson, C., & Asker, B. (2007). The impact of subacute whiplash-associated disorders on functional self-efficacy: a cohort study. Int J Rehabil Res, 30(3), 221-226.

Chien, A., Eliav, E., & Sterling, M. (2008a). Hypoesthesia occurs in acute whiplash irrespective of pain and disability levels and the presence of sensory hypersensitivity. Clin J Pain, 24(9), 759-766. https://doi.org/https://dx.doi.org/10.1097/AJP.0b013e3181773b95

Chien, A., Eliav, E., & Sterling, M. (2010). The development of sensory hypoesthesia after whiplash injury. Clin J Pain, 26(8), 722-728. https://doi.org/https://dx.doi.org/10.1097/AJP.0b013e3181f096ac

Dehner, C., Heym, B., Maier, D., Sander, S., Arand, M., Elbel, M., Hartwig, E., & Kramer, M. (2008). Postural control deficit in acute QTF grade II whiplash injuries. Gait Posture, 28(1), 113-119.

Eklund, A., Wiesinger, B., Lampa, E., Osterlund, C., Wanman, A., & Haggman-Henrikson, B. (2020). Jaw-neck motor function in the acute stage after whiplash trauma. Journal of Oral Rehabilitation, 47(7), 834-842. https://doi.org/https://dx.doi.org/10.1111/joor.12981

Elliott, J., Pedler, A., Kenardy, J., Galloway, G., Jull, G., & Sterling, M. (2011). The Temporal Development of Fatty Infiltrates in the Neck Muscles Following Whiplash Injury: An Association with Pain and Posttraumatic Stress. PLoS one, 6(6). https://doi.org/10.1371/journal.pone.0021194

Erika Jasmin, U., Sandra, E., Boesch, C., Hodler, J., Busato, A., Schraner, C., Anderson, S. E., Bonel, H., Zimmermann, H., & Sturzenegger, M. (2011). Alterations of the Transverse Ligament: An MRI Study Comparing Patients With Acute Whiplash and Matched Control Subjects. American journal of roentgenology (1976), 197(4), 961-967. https://doi.org/10.2214/AJR.10.6321

Fernandez-Perez, A. M., Villaverde-Gutierrez, C., Mora-Sanchez, A., Alonso-Blanco, C., Sterling, M., & Fernandez-de-Las-Penas, C. (2012). Muscle trigger points, pressure pain threshold, and cervical range of motion in patients with high level of disability related to acute whiplash injury. J Orthop Sports Phys Ther, 42(7), 634-641. https://doi.org/https://dx.doi.org/10.2519/jospt.2012.4117

Kasch, H., Qerama, E., Bach, F. W., & Jensen, T. S. (2005). Reduced cold pressor pain tolerance in non-recovered whiplash patients: a 1-year prospective study. Eur J Pain, 9(5), 561-569. https://doi.org/10.1016/j.ejpain.2004.11.011

Kivioja, J., Ozenci, V., Rinaldi, L., Kouwenhoven, M., Lindgren, U., & Link, H. (2001). Systemic immune response in whiplash injury and ankle sprain: elevated IL-6 and IL-10. Clin Immunol, 101(1), 106-112. https://doi.org/10.1006/clim.2001.5086

Kivioja, J., Rinaldi, L., Ozenci, V., Kouwenhoven, M., Kostulas, N., Lindgren, U., & Link, H. (2001). Chemokines and their receptors in whiplash injury: elevated RANTES and CCR-5. J Clin Immunol, 21(4), 272-277. https://doi.org/10.1023/a:1010931309088

McLean, S. A., Diatchenko, L., Lee, Y. M., Swor, R. A., Domeier, R. M., Jones, J. S., Jones, C. W., Reed, C., Harris, R. E., Maixner, W., Clauw, D. J., & Liberzon, I. (2011). Catechol O-methyltransferase

haplotype predicts immediate musculoskeletal neck pain and psychological symptoms after motor vehicle collision. Journal of Pain, 12(1), 101-107. https://doi.org/10.1016/j.jpain.2010.05.008

Pajediene, E., Janusauskaite, J., Samusyte, G., Stasaitis, K., Petrikonis, K., & Bileviciute-Ljungar, I. (2015). Patterns of acute whiplash-associated disorder in the Lithuanian population after road traffic accidents. Journal of Rehabilitation Medicine, 47(1), 52-57. https://doi.org/https://dx.doi.org/10.2340/16501977-1892

Pedler, A., & Sterling, M. (2011). Assessing fear-avoidance beliefs in patients with whiplash-associated disorders: A comparison of 2 measures. Clinical Journal of Pain, 27(6), 502-507.

Rastovic, P., Definis Gojanovic, M., Berberovic, M., Pavlovic, M., Lesko, J., Galic, G., Pandza, M., & Gojanovic, M. D. (2017). Isometric muscle fatigue of the paravertebral and upper extremity muscles after whiplash injury. Annals of Saudi Medicine, 37(4), 297-307. https://doi.org/10.5144/0256-4947.2017.297

Shaked, D., Shaked, G., Sebbag, G., & Czeiger, D. (2020). Can cortisol levels predict the severity of acute whiplash-associated disorders? Eur J Trauma Emerg Surg, 46(2), 357-362. https://doi.org/10.1007/s00068-018-1028-2

Solarino, B., Coppola, F., Di Vella, G., Corsalini, M., & Quaranta, N. (2009). Vestibular evoked myogenic potentials (VEMPs) in whiplash injury: a prospective study. Acta Otolaryngol (Stockh), 129(9), 976-981. https://doi.org/https://dx.doi.org/10.1080/00016480802527552

Sterling, M. (2010). Differential development of sensory hypersensitivity and a measure of spinal cord hyperexcitability following whiplash injury. Pain (Amsterdam), 150(3), 501-506. https://doi.org/10.1016/j.pain.2010.06.003

Sterling, M., & Pedler, A. (2009). A neuropathic pain component is common in acute whiplash and associated with a more complex clinical presentation. Man Ther, 14(2), 173-179. https://doi.org/10.1016/j.math.2008.01.009

Sterling, M., Elliott, J. M., & Cabot, P. J. (2013). The Course of Serum Inflammatory Biomarkers Following Whiplash Injury and Their Relationship to Sensory and Muscle Measures: A Longitudinal Cohort Study. PLoS ONE [Electronic Resource], 8(10). https://doi.org/http://dx.doi.org/10.1371/journal.pone.0077903

Sterling, M., Jull, G., Vicenzino, B., & Kenardy, J. (2004). Characterization of acute whiplash-associated disorders. Spine (Phila Pa 1976), 29(2), 182-188. https://doi.org/10.1097/01.BRS.0000105535.12598.AE

Sterling, M., Jull, G., Vicenzino, B., Kenardy, J., & Darnell, R. (2003). Development of motor system dysfunction following whiplash injury. Pain, 103(1-2), 65-73. https://doi.org/10.1016/s0304-3959(02)00420-7

Stiebel-Kalish, H., Amitai, A., Mimouni, M., Bach, M., Saban, T., Cahn, M., & Gantz, L. (2018). The Discrepancy between Subjective and Objective Measures of Convergence Insufficiency in Whiplash-Associated Disorder versus Control Participants. Ophthalmology, 125(6), 924-928. https://doi.org/https://dx.doi.org/10.1016/j.ophtha.2017.11.030

Ulbrich, E. J., Anderson, S. E., Busato, A., Abderhalden, S., Boesch, C., Zimmermann, H., Heini, P., Hodler, J., & Sturzenegger, M. (2011). Cervical muscle area measurements in acute whiplash patients and controls. J Magn Reson Imaging, 33(3), 668-675. https://doi.org/https://dx.doi.org/10.1002/jmri.22446

Valenza, M. C., Valenza, G., Gonzalez-Jimenez, E., De-la-Llave-Rincon, A. I., Arroyo-Morales, M., & Fernandez-de-Las-Penas, C. (2012). Alteration in sleep quality in patients with mechanical

insidious neck pain and whiplash-associated neck pain. Am J Phys Med Rehabil, 91(7), 584-591. https://doi.org/https://dx.doi.org/10.1097/PHM.0b013e31823c757c

Vetti, N., Krakenes, J., Ask, T., Erdal, K. A., Torkildsen, M. D. N., Rorvik, J., Gilhus, N. E., & Espeland, A. (2011). Follow-Up MR Imaging of the Alar and Transverse Ligaments after Whiplash Injury: A Prospective Controlled Study. American Journal of Neuroradiology, 32(10), 1836-1841. https://doi.org/10.3174/ajnr.A2636

Vetti, N., Krakenes, J., Damsgaard, E., Rorvik, J., Gilhus, N. E., & Espeland, A. (2011). Magnetic resonance imaging of the alar and transverse ligaments in acute whiplash-associated disorders 1 and 2: a cross-sectional controlled study. Spine, 36(6), E434-440. https://doi.org/https://dx.doi.org/10.1097/BRS.0b013e3181da21a9

14. Recommendations for research: Acute whiplash

- Many prospective longitudinal cohort studies have been conducted to evaluate factors assessed in acute whiplash and their association with long-term prognosis. This has led to the development and validation of prognostic risk-assessment tools that have demonstrated validity for stratifying people with acute WAD into subgroups and determining those at higher risk of poor outcome. Research is now needed to evaluate the implementation of these tools and the effectiveness of the associated risk stratified interventions.
- Interventional clinical trials should evaluate critical outcomes for whiplash, including, neck pain, neck disability, psychological functioning, and perceived recovery. When designing trials, comparison to usual care in an Australian context should be considered (e.g., low risk care – advice and exercise).
- Further research into identifying people's access and acceptance of recommended care pathways across different cultural groups and settings (e.g., regional, remote) in an Australian context, including Aboriginal and Torres Strait Islander and Culturally and Linguistically Diverse peoples is required.
- There are some areas of diagnosis and treatment where there is very limited research evidence. Examples are the diagnosis and treatment of radiculopathy associated with WAD III.
- There is a very strong research base for similar conditions, particularly acute low back pain. Findings from that area of research could be tested in WAD.
- An approximate date for future update to these guidelines is in 2028. The resources required are substantial and consideration should be given to the potential sources of funding.

Draft Guidelines

Recommendations for the Management of People with Chronic Whiplash-Associated Disorders

State Insurance
Regulatory Authority

NSW GOVERNMENT

15. Chronic whiplash: Prognosis recommendations

15.1. Symptom factors (pain intensity, neck disability) and psychological factors (mood, perceived justice)

Question: What symptom and psychological factors are associated with poor outcome for people with chronic whiplash?

Symptom factors refer to subjective reports of people's experiences such as pain, headache, dizziness and how they feel these symptoms impact their ability to function.

Psychological factors refer to a person's distress (e.g., post-traumatic stress), mood (e.g., felling anxious, depressed, or angry) and their beliefs (e.g., recovery expectations, confidence, and perceived injustice).

Recommendation: The guideline panel suggest that healthcare professionals could consider assessing pain intensity (VAS) and neck–related disability (NDI), mood (depression/ anxiety), and perceived injustice when assessing someone with chronic whiplash for determining those at risk of ongoing poor outcome.

(Panel vote summary: 11/13 85% conditional for; 2/13 15% neutral)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • Evidence from the 5 studies was inconclusive, however initial pain and disability and mood could be considered as associated with ongoing pain, and perceived injustice with ongoing psychological distress. *Consistency:* • Consistent with acute whiplash and other musculoskeletal conditions. *Acceptability and feasibility:* • Is feasible for healthcare professionals to assess these factors.
Implementation	**Symptom factors: Pain intensity and neck disability** *How to measure and interpret:* • Measure pain intensity with a numerical rating scale (NRS). People with scores of ≥6/10 are considered to have moderate levels of pain. • Measure neck- related disability with the Neck Disability Index (NDI). People with scores of ≥> 15/50 (30%) are considered to have moderate -> severe disability. • If assessing the person for the first time after the injury in the chronic phase, then higher scores on these measures determine risk of ongoing poor outcome. *Considerations:* • Current guidelines suggest that these factors could be measured at 3-month intervals from the crash.

	• Elevated levels of pain, disability, or mood warrant referral to an expert if people are not recovering under standard recommended care. • HCP' should consider that continuing more of the same intervention if not resulting in improvement in pain or disability should flag the requirement for referral or the need for a different type of intervention (e.g., multidisciplinary care). • Tools available on MyWhiplashNavigator https://www.mywhiplash.com.au/sites/default/files/Visual%20Analogue%20Scale%20for%20pain%20%282%29_1.pdf https://www.mywhiplash.com.au/sites/default/files/Neck%20Disability%20Index%20(1).pdf **Psychological factors: Depression and Perceived Injustice** *How to measure and interpret:* • Measure depression with the DASS 21 • Measure Perceived Injustice with the Perceived injustice Questionnaire. *Considerations:* • Current guidelines suggest that these factors could be measured at 3-month intervals from the crash. • Moderate to severe scores on DASS21 warrant referral to an expert if people are not recovering under standard recommended care. • HCP' should consider that continuing more of the same intervention if not resulting in improvement in pain or disability should flag the requirement for referral or the need for a different type of intervention (e.g., multidisciplinary care). • DASS 21 available on MyWhiplashNavigator https://www.mywhiplash.com.au/content/higher-risk-assessments#psychological-distress • Perceived injustice questionnaire not available at time of writing guideline but can be added to MyWhiplashNavigator during implementation.

Please refer to P.11 in the Prognosis Technical Report (Chapter 3) for further details.

15.1.1. Physical impairment, compensation, and previous health factors

Question: What physical impairment, compensation and previous health factors are associated with poor outcome for people with chronic whiplash?

Physical impairment factors refer to common impairments people may experience after whiplash such as reduced range of neck motion, poor neck muscle strength, poor coordination or pain sensitivity. Compensation factors are primarily claim related factors (e.g., retaining a lawyer or

submitting a claim for compensation). Previous health refers to a person's health prior to the accident.

Recommendation: The guideline panel cannot recommend for or against measuring physical impairment, compensation, and previous health for the purpose of determining ongoing poor outcome in people with chronic whiplash.
(Panel vote summary: 12/13 92% neutral; 1/13 8% conditional for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • Evidence from the 5 studies was inconclusive; most factors were not associated with the outcome with some exceptions. *Consistency:* • Consistent with acute whiplash guideline. *Acceptability and feasibility:* • In light of other factors more likely to be associated, these factors would be considered less important (hence inefficient for or unnecessary for HCPs to assess).
Implementation	• HCPs may assess physical factors, compensation factors and previous health for other purposes in individual cases. For example, some assessment factors may be helpful to direct treatment (e.g., physical assessment) whilst others may be considered by people to be important in their recovery (e.g., previous health). In these individual circumstances clinical reasoning should prevail.

Please refer to P.11 in the Prognosis Technical Report (Chapter 3) for further details.

15.1.2. Sociodemographic and crash factors

Question: What sociodemographic and crash factors are associated with poor outcome for people with chronic whiplash?

Sociodemographic factors include people's personal details (e.g., age, gender), social circumstances (e.g., living situation, socioeconomic status, employment status and level of education). Crash factors include whether the person was a driver or passenger, the collision speed, and other circumstances regarding the crash.

Recommendation: The guideline panel suggest that sociodemographic and crash factors are not assessed for the purpose of determining ongoing poor outcome in people with chronic whiplash.
(Panel vote summary: 9/13 69% conditional against, 2/13 15% strong against, 2/13 neutral 15%, 1/13 7% strong for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • In the 5 studies, no associations were found between these factors and poor outcome. *Consistency:* • Consistent with acute whiplash guideline. *Acceptability and feasibility:* • In light of other factors more likely to be associated, these factors would be considered less important (hence inefficient for or unnecessary for HCPs to assess).
Implementation	• Not recommended to determine prognosis.

Please refer to P.11 in the Prognosis Technical Report (Chapter 3) for further details.

15.2. References: Chronic whiplash prognosis

Alalawi, A., Devecchi, V., Gallina, A., Luque-Suarez, A., & Falla, D. (2022). Assessment of neuromuscular and psychological function in people with recurrent neck pain during a period of remission: Cross-sectional and longitudinal analyses. *Journal of Clinical Medicine, 11*(7), 2042.

Alalawi, A., Evans, D. W., Liew, B., Peolsson, A., Heneghan, N., Rushton, A., . . . Falla, D. (2022). Does pain extent predict ongoing pain and disability in patients with chronic whiplash-associated disorders? *Journal of Clinical Medicine, 11*(3), 555.

Angst, F., Gantenbein, A. R., Lehmann, S., Gysi-Klaus, F., Aeschlimann, A., Michel, B. A., & Hegemann, F. (2014). Multidimensional associative factors for improvement in pain, function, and working capacity after rehabilitation of whiplash associated disorder: a prognostic, prospective outcome study. *BMC musculoskeletal disorders, 15*, 1-9.

Rebbeck, T., Sindhusake, D., Cameron, I., Rubin, G., Feyer, A., Walsh, J., . . . Schofield, W. (2006). A prospective cohort study of health outcomes following whiplash associated disorders in an Australian population. *Injury Prevention, 12*(2), 93-98.

Sullivan, M., Adams, H., Thibault, P., Moore, E., Carriere, J. S., & Larivière, C. (2017). Return to work helps maintain treatment gains in the rehabilitation of whiplash injury. *Pain, 158*(5), 980-987.

16. Chronic whiplash: Treatment recommendations

16.1. Advice: Specific educational information

Question: Are specific education interventions compared with general advice effective for the management of people with chronic WAD?

Refers to education provided to people with chronic WAD on the nature of their injury, self-management strategies, advice for activity/exercise, and prognosis.

Recommendation: The guideline panel suggest that specific education interventions, such as video-based educational resources, be used for the management of people with chronic WAD.

(Panel vote summary: 12/16 75% conditional for; 3/16 19% neutral; 1/16 6% strong for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were no clinical trials included for chronic WAD. • Oral advice interventions with healthcare professionals have shown some effectiveness for the management of chronic WAD compared with active interventions (e.g., see T.4 multimodal physical therapy in Treatment Technical Report). *Adverse effects:* • No expected adverse effects from a short educational intervention in the chronic phase following whiplash injury. *Consistency:* • Education is a key element for management of other musculoskeletal conditions. *Acceptability and feasibility:* • Specific educational information in addition to advice (e.g., 15-20min educational video) was acceptable to people in an acute WAD trial. • Development of video-based educational content is low cost and easily accessible if distributed online.
Implementation	*Include education on:* • Advice about activity and exercise. • How psychological distress influences pain and physical function. • Emphasis on how to manage chronic pain. • Emphasis on developing self-efficacy. *Considerations:* • Separate education in chronic vs acute WAD. • Appropriate stakeholder consultation when developing information videos.

Please refer to T.7 in the Treatment Technical Report for further details.

16.2. Physical therapy (Exercise): Neck-specific exercises

Question: Are neck-specific exercises compared with general activity and advice effective for the management of people with chronic WAD?

Neck specific exercises refer to low-load neck and shoulder exercises aimed at improving mobility, strength, endurance, and sensorimotor control of the head and neck.

Recommendation: The guideline panel suggests that healthcare professionals use neck-specific exercises for the management of people with acute WAD.

(Panel vote summary: 11/13 85% conditional for; 2/13 15% neutral)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification

Evidence summary:

- There was one clinical trial included for chronic WAD (Peolsson, 2016).
- Clinically significant overall benefits compared with control as no intervention. However, findings were from a single trial.
- Evidence certainty ranged from very low, to low, for short- and long-term critical outcomes.

Adverse effects:

- No adverse effects reported in included trial. Neck-specific exercises are low load and are unlikely to have significant adverse effects.

Consistency:

- Neck-specific exercises are generally included as part of psychologically informed exercise and multimodal physical therapy.
- Consistent with current recommended practice.

Acceptability and feasibility:

- Acceptable intervention to people in supervised and home-based settings.
- Intervention is feasible to implement in healthcare settings in Australia and is consistent with current recommended practice.

Implementation

Training:

- Required to effectively implement neck-specific exercises.
- Exercises are freely available on MyWhiplashNavigator (www.mywhiplash.com.au)

Dose:

- 1-2x/week for 6 weeks as supervised sessions.

Considerations:

	• Develop the injured person's skills to independently perform neck-specific exercises (e.g., home exercise programme). • HCPs require training to implement neck-specific exercises. • Evaluate critical outcomes regularly.

Please refer to T.1 in the Treatment Technical Report (Chapter 4) for further details.

16.3. Physical therapy (Exercise): Dizziness specific exercises

Question: Are dizziness-specific exercises effective for the management of people with chronic WAD and concurrent dizziness symptoms?

Dizziness-specific exercises includes vestibular, phasic, and sensorimotor exercises, for example: keeping eyes still on a target whilst the head moves, standing on foam and turning the head from side to side, walking on a slope and turning the head from side to side, standing on a trampoline and moving eyes from side to side.

Recommendation: The guideline panel suggest that healthcare professionals use dizziness-specific exercises (e.g., vestibular training, phasic head, and neck exercises) for the management of people with chronic WAD and dizziness symptoms. (Panel vote summary: 12/13 92% conditional for; 1/13 8% neutral)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were two included trials for chronic WAD (Ekvall-Hannsson 2006; Fitz-Ritson, 1995). The guideline panel agreed to include dizziness ability as a critical outcome for this question as it was specific to a subgroup of people with WAD and concurrent dizziness symptoms. • Dizziness-specific exercises resulted in reductions to dizziness disability and clinically significant reductions in neck disability in people with chronic WAD. • Very low certainty in the evidence for dizziness specific exercises for the management of people with chronic WAD, due to two studies with different primary outcomes and fair study quality. *Adverse effects:* • Dizziness-specific exercises are low load and are unlikely to have significant adverse effects. *Consistency:* • While these results were from two studies with small sample sizes and fair study quality (risk of bias present), dizziness specific exercises are prescribed for other dizziness-related conditions in both acute and chronic phases. *Acceptability and feasibility:* • People accept the delivery of exercise-based interventions by HCPs.

	• Dizziness-specific exercises can be prescribed as part of routine consultation.
Subgroup considerations	• People presenting with acute WAD and symptoms of dizziness, coordination deficits, and/or balance deficits.
Implementation	*Indications:* • For people presenting with symptoms of dizziness, coordination deficits, and/ or balance deficits coordination deficits, and/or balance deficits. • Provide intervention for short periods, and in conjunction with other recommended treatments. *Training:* • Provided HCP's have some training and access to information on these exercises. • Exercises are freely available on MyWhiplashNavigator (www.mywhiplash.com.au) *Dose:* • 1-2x/week for 6 weeks. • Consider feasible/acceptable dosage for the injured person. *Considerations:* • Differential diagnosis – e.g., mild traumatic brain injury. • Evaluate outcomes (dizziness-specific outcomes) and usual recommended outcomes regularly. • Consider referral (to whiplash or dizziness expert) if outside HCP expertise.

Please refer to T.3 in the Treatment Technical Report (Chapter 4) for further details.

16.4. Physical therapy (Exercise): Psychologically informed exercise

Question: Are psychologically informed exercise interventions compared with usual care (advice/exercise) effective for the management of people with chronic WAD?

Psychologically informed exercise interventions are implemented by HCPs (e.g., physiotherapist) and target early stress symptoms using cognitive behavioural approaches in addition to exercise.

Recommendation: The guideline panel suggest that healthcare professionals use psychologically informed exercise interventions for the management of people with chronic WAD.

(Panel vote summary: 9/13 69% conditional for; 4/13 31% strong for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:*

	• There were three chronic WAD trials included (Ludvigsson 2015; Soderlund 2001; Stewart 2007). • Psychologically informed exercise interventions compared with exercise and advice likely results in small-to-moderate reductions in short- and long-term neck disability, and improvements in short-term psychological functioning. • Greater proportion of long-term responders [defined by: Neck Disability Index (NDI, cut off change of ≥5/50), Visual Analogue Scale Bothersomeness (VAS-B, ≥50% reduction), Current Pain Visual Analogue Scale (P-VAS, ≥50% reduction)] in intervention compared with control (54% vs 21%) (Ludvigsson, 2015). *Adverse effects:* • Undesirable effects are trivial and similar in frequency to exercise and advice. Intervention is acceptable to the injured person as shown in acute whiplash qualitative study and supported by high follow up rate in chronic trials. *Consistency:* • Neck specific exercises (see 13.2) are included in psychologically informed exercise interventions and are recommended for the management of people with chronic WAD. *Acceptability and feasibility:* • Most injured people found the psychological techniques in the study by Sterling (2019) to be helpful in managing stress and pain, coping with their injury, and returning to function (Silva-Guerrero, 2022). • More training may be required for HCPs to implement these techniques when managing people with psychological distress and moderate-severe disability in chronic phase.
Subgroup considerations	• Sterling (2019): stress inoculation intervention is more appropriate for moderate-severe disability subgroups (elevated pain and hyperarousal symptoms). • Stewart (2007): participants with high levels of pain intensity and disability were associated with greater short- and long-term treatment effects compared with lower pain and disability.
Implementation	*Indications:* • More appropriate for those with psychological distress and moderate-severe neck pain/ disability in the chronic phase. *Training:* • Additional formal training required (feasible given HCP's require continuing professional development (CPD) points for registration. • Where and how to access training will be a point for implementation (e.g., online modules).

	Dose: • 2x/week for 6 weeks. • Consider acceptable dosage for the person. *Considerations:* • Exercise interventions were delivered by HCP's (e.g., physiotherapists). Psychologically informed interventions (e.g., cognitive behavioural therapy, stress management skill development) were used. • HCP's require formal training in psychological interventions by a psychologist. • Evaluate outcomes regularly. • Non-responders who are exhibiting high distress should be referred (whiplash specialist +/- psychologist).

Please refer to T.2 in the Treatment Technical Report (Chapter 4) for further details.

16.5. Physical therapy: Multimodal physical therapy

Question: Is multimodal physical therapy (e.g., exercise and manual therapy, and another treatment modality) compared with single interventions (e.g., advice for activity) effective for the management of people with chronic WAD?

Multimodal physical therapy was defined as an intervention consisting of exercise and manual therapy, and another treatment modality (e.g., education, psychological, electrotherapy).

Recommendation: The guideline panel suggest that healthcare professionals use multimodal physical therapy consisting of exercise and manual therapy and one or more other treatment modalities (e.g., education, psychological support) for the management of people with chronic WAD.

(Panel vote summary: 9/12 75% conditional for; 2/12 17% neutral; 1/12 8% strong for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were three chronic WAD trials included (Michaleff 2014; Soderlund 2001; Jull 2007). • Small short-term benefits in neck pain, with trivial adverse effects, when compared with advice for activity. • Overall certainty of evidence was very low, however, certainty of critical outcomes ranged from very low to moderate for chronic WAD trials. *Adverse effects:* • Trivial adverse effects associated with the interventions. *Acceptability and feasibility:*

	• Injured people accept the delivery of this intervention by HCPs for the management of whiplash injury and other musculoskeletal conditions in an Australian context.
Implementation	*Indications:* • Multimodal physical therapy can't be seen in isolation to other recommended treatments. When considered in relation to other treatment interventions, HCP's delivering exercise interventions have been shown to be effective (e.g., psychologically informed exercise approaches, neck-specific exercise). *Dose:* • 1 session/week for 10 weeks (3 months), however, consider who may require more/less sessions based on a stratified care approach (e.g., moderate/severe disability subgroup in chronic WAD). *Considerations:* • Should focus on active physical therapy and psychological support in the chronic phase of whiplash injury. • HCP's may provide manual therapy (e.g., mobilisations) as an adjunct therapy but only for very short periods of time during this phase, providing there is evidence of clinical benefit. *Outcomes:* • HCPs should consider key outcomes of self-management and self-confidence (efficacy) in people with chronic WAD, rather than just changes to neck pain and disability. • HCPs could consider interdisciplinary care.

Please refer to T.4 in the Treatment Technical Report (Chapter 4) for further details.

16.6. Psychological: Trauma focused cognitive behavioural therapy

Question: Is trauma focused cognitive behavioural therapy in addition to usual care effective for the management of people with chronic WAD and post-traumatic stress disorder?

Cognitive behavioural therapy (CBT) delivered by a psychologist for people with chronic WAD and post-traumatic stress disorder (PTSD) with elements such as psychoeducation, exposure, cognitive restructuring, anxiety management, and relapse prevention.

Recommendation: The guideline panel suggests that healthcare professionals (psychologists) use trauma-focused cognitive behavioural therapy for the management of people with chronic WAD and diagnosed motor vehicle collision-related post-traumatic stress disorder.

(Panel vote summary: 13/16 81% conditional for; 3/16 19% neutral)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were three included trials for chronic WAD (Andersen 2021; Andersen 2022; Dunne 2012). • Cognitive behavioural therapy in addition to usual care may result in clinically significant reductions in short-term post-traumatic stress in people with chronic WAD and post-traumatic stress disorder. Little to no difference in other outcomes was observed, however, the comparison intervention in the study by Andersen 2021 was psychologically informed exercise and not usual care (exercise/advice). • Certainty in the evidence ranged from very low to moderate for critical outcome effects. *Adverse effects:* • No adverse effects reported in the included studies. • There could be an increase in psychological distress, but the intervention is conducted by a psychologist who is trained to manage this. *Consistency:* • This evidence is considered in conjunction with the broader evidence for the effectiveness of CBT to manage PTSD in general. *Acceptability and feasibility:* • Psychological intervention for people with PTSD is accepted and currently performed in an Australian context. • Feasibility depends on availability of psychologists to provide 10 sessions.
Subgroup considerations	• Chronic WAD grade II-III and diagnostic criteria (DSM-5) for current MVC-related PTSD.
Implementation	*Indications:* • People with full diagnostic criteria for MVC-related PTSD are not met until at least six months after the trauma. However, choice to provide the intervention should be based on the persons individual clinical presentation. The intervention therefore could be provided earlier, based on persons levels of distress and loss of function. *Dose:* • Australian psychologists are mental health professionals trained in CBT techniques. In the studies, the intervention was provided 1x/week for 10 weeks. Appropriate dosage should be considered in accordance with the Clinical Framework for the Delivery of Health Services (https://www.tac.vic.gov.au/providers/working-with-the-tac/clinical-framework). *Considerations:*

	• HCPs are recommended to use the PCL-5 to screen for post-traumatic stress symptoms in the sub-acute phase (>1month). Scores of 31-33 or higher suggests that the person may benefit from PTSD treatment and is considered as a threshold for referral to psychologists. More information on the checklist for the DSM-5 (the PCL-5) can be found on the US Depart of Veterans Affairs National Centre for PTSD website (https://www.ptsd.va.gov) • However, HCPs should consider the individual elements in the tool and severity of symptoms when determining whether or not to refer. • Psychologists are recommended to use the DSM-5 to diagnose PTSD.

Please refer to T.5 in the Treatment Technical Report (Chapter 4) for further details.

16.7. HCP education: HCP implementation strategy

Question: Are implementation strategies involving education compared with dissemination of clinical practice guidelines effective for the management of people with chronic WAD?

Intervention consisted of dissemination of whiplash guidelines, initial education by opinion leaders one-day workshop, and follow-up educational outreach session approximately 6 months after.

Recommendation: The guideline panel suggest that implementation strategies for healthcare professionals, involving education on clinical practice recommendations and their implementation, be used for the management of people with chronic WAD.

(Panel vote summary: 8/14 57% conditional for; 4/14 29% strong for; 2/14 14% neutral)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There was one trial included for acute WAD (Rebbeck 2006). The guideline panel agreed to include HCP specific outcomes as a critical outcome for this question as it was specific to educating HCPs who manage people with WAD and holds implications for implementation of these guidelines. • Significant improvements in HCP knowledge and implementation of clinical practice guidelines recommendations with an implementation education session. • Little to no difference on the injured person's short- and long-term neck disability was found between groups which may have been due to high quality of treatment prescription at baseline by both groups (e.g., most physiotherapists prescribed exercise in-line with guidelines recommendations before, during, and after the trial in both groups). • Certainty of evidence ranged from very low for the person's neck disability outcomes, to low certainty for HCP outcomes. *Adverse effects:* • No adverse effects reported.

	• HCP implementation sessions were developed based on guidelines recommendations and therefore unlikely to have undesirable effects on people if implemented effectively. *Acceptability and feasibility:* • HCPs would need to be prepared to undertake the training. • Possible online modules/online delivered educational sessions. *Cost-effectiveness:* • Cost-effective per-person compared with dissemination of guidelines, however, costs associated with development and delivery of educational workshop.
Subgroup considerations	• Education would be tailored to included specific subgroup recommendations that are presented in these guidelines.
Implementation	*Indications:* • For HCP's who are less familiar or unclear about evidence-based interventions for whiplash injury. *Dose:* • Interactive education provided by opinion leaders (over 1-2 day workshops) resulted in change in PHCP behaviour to be more consistent with guidelines. *Considerations:* • Feasible as HCPs require CPD for registration. • Time and costs associated with developing and delivering clinical education sessions. • Possible future modes of delivery could include online delivery. • Tailor to HCPs impacted by these guidelines.

Please refer to T.8 in the Treatment Technical Report (Chapter 4) for further details.

16.8. Multidisciplinary: Multidisciplinary care

Question: Are multidisciplinary one-to-one interventions compared with usual care effective for the management of people with chronic WAD?*

*The panel agreed to comment on multidisciplinary pain clinics in the implementation considerations of this clinical question, given that no evidence was identified for multidisciplinary pain clinics for the management of WAD.

A combination of interventions (e.g., education, physical therapy, psychological, medical) delivered by two or more HCPs (e.g., physician, psychologist, physiotherapist) compared with usual care (exercise/advice).

Recommendation: The guideline panel suggests that multidisciplinary care could be used for the management of people with chronic WAD. (Panel vote summary: 9/9 100% conditional for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There was one trial included for chronic WAD (Wicksell 2008). • The evidence suggests that multidisciplinary care compared with usual care results in clinically significant reductions in short-term neck disability, and short- and long-term depression, but the evidence is very uncertain as this it was from a single pilot trial (n=21). Usual care in this context was at the discretion of the participants and generally involved general medical practitioners and physical therapy. • Small sample size from a single pilot trial (n=21) which is significantly below the threshold for precision (very low certainty in the evidence). *Adverse effects:* • No adverse events were reported concerning physical therapy or psychological interventions. *Consistency*: • People with chronic WAD are already classified as medium-high risk and are likely presenting with pain, physical, and psychological issues. • Recommended treatments for managing chronic WAD in these guidelines are delivered by several HCPs, and people with chronic WAD are likely to receive multi-profession care in practice. *Acceptability and feasibility:* • Multidisciplinary care involving medical, physical, and psychological treatment had high acceptability among injured people and no adverse effects reported.
Subgroup considerations	• Moderate-severe disability and psychological distress subgroup of people with chronic WAD.
Implementation	*Indications*: • Multidisciplinary care should be considered for the management of people with chronic WAD if they present with pain, physical, and psychological issues and have not responded to other recommended treatments. *Dose*: • Multidisciplinary care should be provided for a period up to 3-6-months (providing there are treatment benefits around self-efficacy, including evidence of activity and participation). • Treatment should be tapered (reduced dosage over time) as self-efficacy develops. *Considerations*:

	• Interprofessional communication is critical for effective multidisciplinary collaborative care. Following initial assessment, primary HCPs should initiate contact with other treating healthcare professionals if no prior communication has been established. *Outcomes*: • HCPs should aim to develop self-efficacy in people with chronic whiplash to enable self-management. Meaningful change in self-efficacy is likely to be achieved before clinically meaningful benefits in neck pain or disability.
Multidisciplinary chronic pain clinics	• Multidisciplinary chronic pain clinics (one location) are effective interventions in other types of musculoskeletal pain (not including radicular pain), where there is a clear biopsychosocial approach with coordination between at least two treating health professionals providing physical, psychological, and medical therapies (not including interventional pain management techniques). Other inclusion factors to consider are the presence of significant pain and disability. As there is no clear recommendation for the duration and intensity of this treatment, it should be provided within the Clinical Framework for Delivery of Health Services when treating people injured in MVCs (https://www.tac.vic.gov.au/providers/working-with-the-tac/clinical-framework).

Please refer to T.23 in the Treatment Technical Report (Chapter 4) for further details.

16.9. Medications: Simple analgesics

Question: Are simple analgesics (e.g., paracetamol) compared with placebo effective for the management of people with chronic WAD?

Simple oral analgesics such as paracetamol for pain management in chronic whiplash.

Recommendation: The guideline panel cannot recommend for or against the use of simple analgesics for the management of people of chronic WAD.

(Panel vote summary: 8/9 89% neutral; 1/9 11% conditional for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • No clinical trials included for chronic WAD. Evidence relating to the use of simple analgesics for chronic pain management was sourced from the National Institute for Health and Care Excellence's consultation on the Chronic Pain Assessment and Management Guidelines (NICE, 2021). See "Absence of evidence procedures" (section 9.7.2) for further details. • No clinical trials in chronic WAD and no evidence identified within the NICE Guidelines for the effectiveness of managing chronic pain (NICE, 2021).

	Adverse effects: • Can be implemented safely if dosage recommendations are followed, as there are known significant dose related adverse effects, and if not used by people with known contraindicated conditions. *Acceptability and feasibility:* • Widely available and used in Australia, acceptable for people for pain management.

Implementation	*Indications:*
	• Simple analgesics could be used in conjunction with an active biopsychosocial approach in the chronic phase of whiplash injury.
	Dose:
	• Calculate total paracetamol dosage that person is currently taking and ensure that it falls within guidelines (given known dose related side-effects).
	Considerations:
	• Inform person of known dose-related side-effects.
	• Inform person that paracetamol might be present in mixed oral medications (over the counter or prescribed). For example, cold and flu medication.
	• Outside Australia paracetamol has different names (e.g., acetaminophen).
	• If a person with chronic WAD is already using simple analgesia (e.g., paracetamol) for pain management, HCPs should review the prescribing and consider the following actions:
	  ○ Explain the lack of evidence for these medicines for managing chronic pain.
	  ○ Develop a shared plan in conjunction with the injured person for usage of simple analgesia if there are clinically meaningful benefits at a safe dosage.
	  ○ Explain the risks of continuing if they report little benefit or adverse effects and encourage and support them to reduce and stop the medicine if possible.
	Contraindications:
	• People with allergy to paracetamol.
	• Have already taken the recommended dose within a 24-hour period.
	• People with liver, kidney conditions, alcohol problems or if severely underweight.

Please refer to T.18 in the Treatment Technical Report (Chapter 4) for further details.

16.10. Medications: Nonsteroidal anti-inflammatory drugs (NSAIDs)

Question: Are non-steroidal anti-inflammatory drugs compared with placebo effective for the management of people with chronic WAD?

Oral NSAIDs for pain management in chronic whiplash.

Recommendation: The guideline panel cannot recommend for or against the use of non-steroidal anti-inflammatory drugs for the management of chronic WAD.

(Panel vote summary: 8/9 89% neutral; 1/9 11% conditional for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • No clinical trials included for acute WAD. Evidence relating to the use of NSAIDs for chronic pain management was sourced from the National Institute for Health and Care Excellence's consultation on the Chronic Pain Assessment and Management Guidelines (NICE, 2021). See "Absence of evidence procedures" (section 9.7.2) for further details. • No clinical trials in chronic WAD. • Evidence suggested that short-term use of NSAIDs made no difference to pain or psychological distress in people with chronic pain (NICE, 2021). • A small amount of evidence suggested that NSAIDs reduced physical function, compared with placebo in people with chronic pain (NICE, 2021). *Adverse effects:* • Common side effects after taking NSAIDs include nausea, heartburn, and indigestion. • Known dose-related adverse effects associated with NSAIDs and lack of evidence of short-term or long-term effectiveness for chronic pain management. *Acceptability and feasibility:* • Available over the counter at low cost in multiple forms (e.g., tablet).

Implementation	*Indications:*
	• HCPs should avoid initiating the use of NSAIDs for the management of chronic WAD if the person is not currently using NSAIDs. If a person with chronic WAD has had no benefit with simple analgesics or is already taking NSAIDs, HCPs should review the prescribing of NSAIDs and consider the following actions:
	  ○ Explain the lack of evidence for these medicines for chronic pain management.
	  ○ Develop a shared plan in conjunction with the injured person for usage of NSAIDs, if there are clinically meaningful benefits at a safe dosage.

	○ Explain the risks of continuing if they report little benefit or adverse effects and encourage and support them to reduce and stop the medicine, if possible, in conjunction with an active and biopsychosocial treatment approach. ○ In the event of a flare up NSAIDs could be prescribed for a short period of time only. *Contraindications:* • People allergic or hypersensitive to NSAIDs • Pregnancy or planning a pregnancy. • People with kidney or liver conditions • People with have a gastrointestinal (gut) ulcer or bleeding. • People with a NSAID-exacerbated respiratory disease. • Care should be taken when prescribing NSAIDs to older adults with hypertension and/or heart disease.

Please refer to T.18 in the Treatment Technical Report (Chapter 4) for further details.

16.11. Medications: Amitriptyline

Question: Is amitriptyline compared with placebo effective for the management of people with chronic WAD?

Amitriptyline is a tricyclic antidepressant used in low doses for the treatment of neuropathic pain and psychological distress.

Recommendation: The guideline panel cannot recommend for or against the use of amitriptyline for the management of people with chronic WAD.

(Vote summary: 6/9 67% neutral; 3/9 33% conditional for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • No clinical trials included for chronic WAD. Evidence relating to the use of amitriptyline for acute pain management and psychological distress was sourced from the United Kingdom National Institute for Health and Care Excellence's Chronic Pain Assessment and Management Guidelines (NICE, 2021). See "Absence of evidence procedures" (section 9.7.2) for further details. • Tricyclic antidepressants such as amitriptyline have been shown to be effective at reducing pain, improving sleep and QOL in pain conditions such as fibromyalgia, neuropathic pain, and chronic headaches. *Adverse effects:* • Varies based on potency. • Risk of withdrawal symptoms when deprescribing antidepressants (NICE, 2021).

	Acceptability and feasibility: • Effectiveness and acceptability (low dropout) demonstrated in other pain states (e.g., fibromyalgia). • Widely available and used in an Australian context.
Subgroup considerations	• People with suspected neuropathic/nociplastic pain and/or psychological distress who have not shown benefit with simple analgesics and NSAIDs.
Implementation	*Indications:* • If simple analgesics and NSAIDs are ineffective and the injured person is presenting with neuropathic/nociplastic pain and/or psychological distress, use of amitriptyline could be considered provided there is clinical benefit. *Dose:* • To minimise adverse effects, it is advisable to commence treatment with amitriptyline at the lowest dose possible (e.g., amitriptyline 5 to 10 mg at night) and titrate up to no more than 100 mg per day. *Considerations:* • In conjunction with recommended treatments, not as the primary treatment, and only prescribed for short periods of time (e.g., 4-6 weeks). • Inform person of known side-effects, including the risk of withdrawal symptoms. *Contraindications:* • Prior hypersensitization, concomitant use of monoamine oxidase inhibitors, acute recovery phase following myocardial infarction) and potential precautions (suicidality, anxiety and insomnia, activation of mania/hypomania and schizophrenia, cardiovascular disorders, hyperthyroid people, or those receiving thyroid medication, elective surgery, elevated or lowered blood sugar, impaired liver function).

Please refer to T.20 in the Treatment Technical Report (Chapter 4) for further details.

16.12. Medications: Pregabalin

Question: Is pregabalin compared with placebo effective for the management of chronic WAD?
An oral anticonvulsant, analgesic, and anxiolytic medication used to manage neuropathic pain.
Recommendation: The guideline panel cannot recommend for or against the use of pregabalin for the management of people with chronic WAD. (Panel vote summary: 9/9 100% neutral)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were no trials included for chronic WAD. • Pregabalin may result in clinically significant reductions in short-term neck pain in people with acute WAD (Nikles 2021) and high pain intensity compared with placebo. • Unknown effects in chronic WAD. *Adverse effects:* • Known side effects associated with pregabalin use. *Acceptability and feasibility:* • Medication in widespread use in an Australian context. • Use of pregabalin in WAD is not an accepted indication for the Pharmaceutical Benefits Scheme (neuropathic pain and not responding to other medication).

Implementation	*Indications:*
	• If a person with chronic WAD has had no benefit with simple analgesics or NSAIDs, and are suspected to have neuropathic pain, pregabalin could be considered.
	Considerations:
	• HCPs should
	  ○ Explain the lack of evidence for these medicines chronic non-neuropathic pain management.
	  ○ Prescribe for a short period of time only (5 weeks).
	  ○ Explain the risks of continuing if they report little benefit or adverse effects and encourage and support them to reduce and stop the medicine if possible.
	  ○ Used in conjunction with an active and biopsychosocial treatment approach.
	  ○ Prescribe according to principles described in Clinical Framework for Delivery of Health Services.
	  ○ Evaluate outcomes.

Please refer to T.21 in the Treatment Technical Report (Chapter 4) for further details.

16.13. Psychological: Exposure therapy

Question: Is exposure therapy for fear of neck movement in addition to usual care effective for the management of subacute/chronic WAD?

Exposure therapy is a type of psychological therapy that involves systematic exposure to the feared stimuli over time with the aim of reducing the person's fearful reaction to the stimulus (e.g., neck movement).

Recommendation: The guideline panel cannot recommend for or against exposure therapy for managing fear of neck movement in people with subacute or chronic WAD.

(Panel vote summary: 8/15 53% neutral; 7/15 47% conditional for – no strong opposition for neutral recommendation)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There was one included trial for people with subacute/chronic WAD (>1-month post-injury) (Robinson 2013). • Exposure therapy may result in moderate reductions in short-term neck pain, neck disability, and psychological functioning compared with advice. • Low certainty in the evidence, with findings from a single study. *Adverse effects:* • There may be instances where exposure to movements, images, and/or discussion of the incident could incite further psychological distress. *Consistency*: • Prolonged exposure therapy and narrative exposure therapy are recommended treatments for managing PTSD in the Australian PTSD Guidelines (Phoenix Australia: https://www.phoenixaustralia.org/australian-guidelines-for-ptsd/). *Acceptability and feasibility:* • A person's understanding and commitment will influence acceptability.
Subgroup considerations	• People with moderate pain intensity and/or significant fear of neck-specific movements.
Implementation	*Indications:* • People with moderate pain intensity (VAS ≥4/10) and or significant fear of neck-specific movements (defined as fear ratings of at least 4/10 on 3 or more of the Pictorial Fear of Activities Scale (PFActS-C). • Provide from sub-acute phase onwards (1-month post-injury). *Dose:* • 3 sessions were used in the included study, however, consider feasible/acceptable dosage for the injured person. *Considerations:* • Persons understanding and commitment needs to be considered. • This therapy technique requires full involvement and information about risks/ benefits, where the person should drive the need. • Evaluate outcomes regularly.

	Contraindications: • Significant life event occurring.

Please refer to T.6 in the Treatment Technical Report (Chapter 4) for further details.

16.14. Passive physical therapy: Massage

Question: Are massage techniques in addition to usual care effective for the management of people with chronic WAD?

Massage techniques for musculoskeletal pain management.

Recommendation: The guideline panel cannot recommend for or against the use of massage techniques in addition to usual care for the management of people with chronic WAD.

(Panel vote summary: 8/13 62% neutral; 3/13 23% conditional against; 2/13 15% conditional for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • No included studies for chronic WAD. • Variable short-term improvements shown in other neck pain conditions. *Adverse effects:* • Some instances where massage could exacerbate symptoms in people with pain hypersensitivity (e.g., pressure hyperalgesia). *Consistency:* • Massage has been included in multimodal physical therapy clinical trials (see T.4 in Treatment Technical Report for details). • Emphasis on active therapies in other musculoskeletal condition guidelines (e.g., Low Back Pain Clinical Care Standard) over passive therapies like massage. *Acceptability and feasibility:* • Injured person's preference needs to be considered, but massage is generally accepted by people with musculoskeletal conditions. • Can be implemented as part of multimodal care by HCPs.
Subgroup considerations	• In some people with high pain sensitivity (hot/cold hyperalgesia, pressure hyperalgesia, allodynia) massage could have undesirable effects.
Implementation	*Indications:* • Not recommended as primary treatment but could be provided in conjunction with other recommended treatments provided there is clinical benefit. • More likely to be beneficial in the acute phase of whiplash injury for symptom management compared with the chronic phase.

	Dose: • Short-term treatment 1-2x/week for 4-6 weeks. *Considerations:* • Vascular structures and risks associated with pressure applied to these regions when performing massage to the cervical region. • More likely to be beneficial in the acute phase of whiplash injury for symptom management. • HCPs are able to provide massage techniques during multimodal care.

Please refer to T.10 in the Treatment Technical Report (Chapter 4) for further details.

16.15. Passive physical therapy: Acupuncture

Question: Are acupuncture techniques in addition to usual care effective for the treatment of chronic WAD?

Needles to stimulate points in the body for pain management, with the possible addition of manual manipulation, heat, or electrical stimulation.

Recommendation: The guideline panel are unable to recommend for or against acupuncture techniques in addition to usual care for the management of people with chronic WAD.

(Panel vote summary: 12/12 100% neutral)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were two trials included for chronic WAD (Cameron 2011; Kwak 2012). Compared electroacupuncture to sham acupuncture (Cameron 2011) and acupuncture in addition to usual care (Kwak 2012). • Acupuncture techniques resulted in non-clinically (moderate) significant reductions in neck pain (short- and long-term) and little to no differences in neck disability and psychological functioning. *Adverse effects:* • There are undesirable effects associated with acupuncture techniques reported at low prevalence (e.g., localised bruising). • Low risk of significant harm (pneumothorax). • Can create reliance on passive treatment in the chronic phase of the condition which is not conducive to promoting self-efficacy. *Consistency*: • Passive treatment in the chronic phase of the condition differs from recommendations of an active and biopsychosocial approach to management of whiplash injury in this phase. *Acceptability and feasibility:*

	• Access may be reduced to acupuncture trained HCPs across Australia (e.g., regional/rural).
Subgroup considerations	• High pain sensitivity (hot/cold hyperalgesia, pressure hyperalgesia, allodynia) could be a contraindication to acupuncture techniques.
Implementation	*Indications:* • Providing passive treatment in the chronic phase of WAD differs from recommendations of an active and bio-psychosocial approach to management in this phase. • Not recommended as the primary treatment, but could be provided in conjunction with recommended treatments, provided there is clinical benefit. *Dose:* • Acupuncture techniques should only be used in the short-term (e.g., 6-12 sessions). *Considerations:* • Preference of the person with WAD. • PHCPs should communicate risks: localised bruising and the low risk of significant harm (pneumothorax).

Please refer to T.13 in the Treatment Technical Report (Chapter 4) for further details.

16.16. Surgery: Spinal surgery for cervical radiculopathy

Question: Is spinal surgery compared with non-surgical treatment effective for the management of people with WAD with radiculopathy?

Systematic review of surgery (plasma decompression/nucleoplasty or anterior cervical decompression with fusion, ADCF) versus conservative care for neck pain involving people with chronic neck pain and evidence of myelopathy or radiculopathy (van-Middelkoop et al., 2013). Van-Middelkoop et al. (2013) used the GRADE process to evaluate certainty of evidence for several outcomes, including short- and long-term pain (considers neck/arm) in radiculopathy people. Six studies, four of which were case-controlled trials, were identified which examined surgery versus non-surgical interventions in people with radiculopathy. Exclusion of developing spinal cord injury (myelopathy).

Recommendation: The guideline panel cannot recommend for or against the use of surgery of the cervical spine for the management of people with chronic WAD and radiculopathy.

(Panel vote summary: 7/8 88% neutral; 1/8 12% conditional against)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • No clinical trials evaluating the effectiveness of spinal surgery compared with non-surgical treatment for the management of chronic

	WAD and radiculopathy. Cervical surgery is generally only considered during the chronic phase of whiplash injury and in the presence of neurological symptoms. • Radiculopathy is suspected in a small subgroup of people with WAD (less than 5%). See section 10.2 for information on screening for cervical radiculopathy (WAD III). • (Low certainty evidence) Cervical decompression surgery compared with non-surgical intervention has been shown to be effective at reducing short- and long-term pain in people with chronic neck pain with radiculopathy. • (Very low certainty evidence) No differences between decompression with cervical fusion and non-surgical intervention (including physiotherapy) in short- and long-term pain in people with chronic neck pain with radiculopathy. *Adverse effects:* • Known significant adverse risks with cervical surgery (e.g., infection, vascular/neural damage). *Acceptability and feasibility:* • Requests for surgery for radiculopathy following whiplash injury would be considered within existing frameworks for evaluating requests for spinal surgery.
Subgroup considerations	• People with WAD grade III and in accordance with the *indications* listed below.
Implementation	*Indications:* • Spinal surgery (e.g., decompression) could be considered in rare cases of WAD III when a period of conservative treatment was found to be ineffective, and the person has persistent high intensity pain (e.g., mean pain ≥6/10, neck/arm) and evidence of radiculopathy (see screening for radiculopathy, WAD grade III, in the Diagnosis section 10.2) present for more than 1-month. • Note: Radiculopathy is suspected in a small subgroup of people with WAD (less than 5%). *Considerations:* • Communicate known adverse effects/risk associated with cervical spinal surgery. • Recommendations are applicable for radiculopathy, not radicular pain, meaning there is objective neurological abnormality.

Please refer to T.25 in the Treatment Technical Report (Chapter 4) for further details.

16.17. Medications: Opioids

Question: Are opioid analgesics compared with placebo effective for the management of people with chronic WAD?

Oral opioid analgesics for the management of acute pain. Common types of opioids in an Australian context: fentanyl, morphine, oxycodone, methadone, tramadol, buprenorphine, tapentadol, hydromorphone, codeine.

Recommendation: The guideline panel suggest that healthcare professionals do not use opioid analgesics for the management of people with chronic WAD.
(Panel vote summary: 7/10 70% conditional against; 2/10 20% neutral; 1/10 10% strong against)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • No clinical trials included for chronic WAD. Evidence relating to the use of opioids for chronic pain management was sourced from the United Kingdom National Institute for Health and Care Excellence's Chronic Pain Assessment and Management Guidelines (NICE, 2021). See "Absence of evidence procedures" (section 9.7.2) for further details. • The evidence of long-term harm, along with lack of evidence on effectiveness of opioids, persuaded the committee to recommend against starting opioid treatment for people with chronic pain (NICE, 2021).
Subgroup considerations	• People with very severe pain who have not shown benefit with simple analgesics, NSAIDs, or other medication (e.g., pregabalin).
Implementation	*Indications*: • If simple analgesics and NSAIDs are ineffective and pain is very severe, cautious use of low-potency opioids (e.g., tramadol) could be considered provided that there is clinical benefit. *Dose*: • If used, opioids should be only prescribed for short periods of time for severe pain that either is not responsive to other analgesics, or when other analgesics are contraindicated. *Considerations:* • Opioid types and potency need to be considered individually. • Communicate known side-effects, which appear to be dose related, to the injured person. *Contraindications:* • People with impaired liver or kidney function, or alcohol dependence, TBI/other comorbidities/injury.

Please refer to T.22 in the Treatment Technical Report (Chapter 4) for further details.

16.18. Passive physical therapy: Electrotherapy

Question: Are electrotherapy techniques in addition to usual care effective for the management of chronic WAD?

Mixed electrotherapy techniques:

- Ultra-reiz: also called ultra-stimulation current, is an interrupted direct current of low frequency applied via medium sized electrodes supported on a thick moist sponge. These electrodes are placed near the spinal column along the neck and upper back region.
- Transcutaneous electrical nerve stimulation (TENS): gentle electric current to stimulate nerves around the pain site.
- Low-energy high frequency pulsed electromagnetic therapy (PEMT).
- High powered laser therapy.
- Therapeutic Ultrasound: ultrasound energy applied to the skin to increase blood circulation to the injured tissue.

Recommendation: The guideline panel suggest that healthcare professionals do not use electrotherapy techniques in addition to usual care for the management of people with chronic WAD.

(Panel vote summary: 9/11 82% conditional against; 2/11 strong against)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were no included trials for chronic WAD. *Consistency:* • Not consistent with recommended active biopsychosocial approach to chronic WAD. • See justification for electrotherapy techniques for people with acute WAD (section 12.17).

Please refer to T.12 in the Treatment Technical Report (Chapter 4) for further details.

16.19. Passive physical therapy: Manipulation (high velocity low amplitude)

Question: Is manipulation (high-velocity low amplitude thrust) of the spine compared with usual care effective for the treatment of chronic WAD?

High velocity low amplitude (HVLA) thrust manipulation of the spine. The guideline panel agreed on providing one recommendation for cervical and thoracic manipulation of the spine for chronic WAD.

Recommendation (cervical/thoracic): The guideline panel suggest that primary healthcare professionals do not use high-velocity low-amplitude manipulation of the spine for the management of people with chronic WAD.

(Panel vote summary: 8/13 62% conditional against; 3/13 23% strong against; 2/13 15% neutral)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • No clinical trials for the use of manipulation techniques of the spine for the management of chronic WAD. *Consistency:* • May increase dependency on passive care in the chronic phase. • Passive treatment in the chronic phase of the condition differs from recommendations of an active and biopsychosocial approach to management of whiplash injury in this phase. *Adverse effects:* • Very rare risk of significant adverse events (e.g., stroke and vertebral artery dissection).

Please refer to T.9 in the Treatment Technical Report (Chapter 4) for further details.

16.20. Passive physical therapy: Needling techniques

Question: Are trigger point needling techniques in addition to usual care effective for the treatment of chronic WAD?

Trigger point needling techniques differs from acupuncture techniques as the sites of treatment are targeted at myofascial trigger points.

Recommendation: The guideline panel suggests that healthcare professionals do not use trigger point needling techniques in addition to usual care for the management of people with chronic WAD.

(Panel vote summary: 8/11 73% conditional against; 3/11 27% neutral)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There was one clinical trial included for chronic WAD (Sterling 2015). • Trigger point needling techniques compared with sham needling results in small non-clinically significant reductions in long-term neck disability and little to no difference in remaining short- and long-term critical outcomes (very low certainty in the evidence). *Adverse effects:* • There are undesirable effects associated with trigger point needling techniques reported at low prevalence (e.g., localised bruising). • There are rare adverse effects: e.g., infection, pneumothorax.

	• In people with high pain sensitivity (hot/cold hyperalgesia, pressure hyperalgesia, allodynia) trigger point needling techniques may exacerbate pain. *Consistency:* • Passive treatment in the chronic phase of the condition differs from recommendations of an active and biopsychosocial approach to management of whiplash injury in this phase.

Please refer to T.14 in the Treatment Technical Report (Chapter 4) for further details.

16.21. Medical procedure: Radiofrequency neurotomy

Question: Is a radiofrequency neurotomy compared with placebo treatment effective for the management of cervical facet joint pain in people with chronic WAD?

Radiofrequency neurotomy is a medical procedure using radio waves to heat the nerve (medial branch of cervical dorsal ramus) supplying a facet joint diagnosed as the source of pain in the spine to disrupt signaling and manage pain.

Recommendation: The guideline panel suggest that healthcare professionals not use radiofrequency neurotomy (RFN) for the management of people with chronic WAD. (Panel vote summary: 9/11 82% conditional against; 2/11 18% strong against)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There is one trial included for chronic WAD (Lord 1996). • Clinically significant long-term reductions in neck pain. • Very low certainty in the evidence as findings were based on a small pilot trial (n=24) that has not been replicated. Inadequate reporting of neck pain point estimates to evaluate short- and long-term effects of the intervention. • Treatment effects wear off. *Adverse effects:* • Proportion of participants had a return of their accustomed pain in the period immediately after the operation. • Known risks associated with the procedure: Low risk of significant harm, associated with insertion of probe near vascular and neural structures. Infection risk associated with injection. *Acceptability and feasibility:* • Large costs associated with the treatment. • Not all patients accept a medical procedure for treatment. • Highly specialised procedure, requiring a guided injection. Public pain services and private centres perform the procedure.

Please refer to T.24 in the Treatment Technical Report (Chapter 4) for further details.

16.22. Injections: Corticosteroid injection

Question: Are facet joint corticosteroid injections compared with placebo injections effective for the management of chronic WAD?

Injection of a corticosteroid into a single cervical facet joint diagnosed as a source of pain following a nerve block protocol.

Recommendation: The guideline panel strongly recommend that healthcare professionals do not use facet joint corticosteroid injections for the management of people with chronic WAD.

(Panel vote summary: 10/15 67% strong against; 5/15 33% conditional against)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There was one included study for chronic WAD (Barnsley 1994). • No benefit shown in chronic WAD when compared with local anaesthetic injections, where pain increased in a short period of time (days) after an initial reduction in pain levels. • Very low certainty in the evidence, as findings were from a single study with small sample size (n=41). *Adverse effects:* • Low risk of severe adverse effects (e.g., vascular complications, spinal cord compression, infection). *Consistency:* • Effects are seen in the short-term only (weeks). *Acceptability and feasibility:* • Costly treatment. • Requires specialised skills (e.g., CT assistance for the injections). • Corticosteroid injections are only considered after the injured person has not shown significant improvement with usual care.

Please refer to T.16 in the Treatment Technical Report (Chapter 4) for further details.

16.23. Injections: Botulinum toxin-A

Question: Are botulinum toxin-A injections compared with placebo injections effective for the management of chronic WAD?

Botulinum toxin-A injections prevent the release of acetylcholine which is required for muscular contractions. The aim of these injections is to have analgesic effect by reducing muscular hyperactivity.

Recommendation: The guideline panel strongly recommend that healthcare professionals do not use botulinum toxin-A injections for the management of people with chronic WAD.

(Panel vote summary: 10/14 71% strong against; 4/14 29% conditional against)				
Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were three trials included for chronic WAD (Braker 2008; Freund 2002; Padberg 2007). • The evidence suggests that botulinum toxin-A injections compared with placebo injections may result in little to no difference in short term neck pain, neck disability, and psychological functioning in people with chronic WAD. • Very low to low certainty in the evidence for critical outcome effects. *Adverse effects:* • Significant side effects (e.g., weakness, vertigo, fever, infection risk). • May result in dependency on botulinum toxin-A injections as ongoing treatment. • Significantly higher rate of side effects in treatment (40%) vs control injections (0%) such as weakness, vertigo, fever, and/or shivering (Braker 2008). *Consistency:* • General effects of botulinum toxin-A injections for other conditions (e.g., neurological) are short term only. • Differs from recommendations of an active and biopsychosocial approach to management of whiplash injury in this phase. *Acceptability and feasibility:* • Moderate costs associated with treatment. • Only a select population would have access to treatment (e.g., in settings where professionals with specialised skills for these injections and where additional funding is available).

Please refer to T.15 in the Treatment Technical Report (Chapter 4) for further details.

16.24. Injections: Intravenous steroid injection

Question: Are facet joint corticosteroid injections compared with placebo injections effective for the management of chronic WAD?

Intravenous (IV) steroid injections (e.g., hydrocortisone) are systemic, compared with the localised corticosteroid injection into a facet joint (see 13.18).

Recommendation: The guideline panel strongly recommend that healthcare professionals do not use intravenous steroid injections for the management of people with chronic WAD.

(Panel vote summary: 9/15 60% strong against; 6/15 40% conditional against)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were no included studies for chronic WAD. • The evidence suggests that steroid intravenous injections do not reduce short-term neck pain (low certainty), neck disability (low certainty), and psychological functioning (very low certainty) compared with placebo injections in people with acute WAD. *Adverse effects:* • Steroid injections slow healing responses following acute injury. • Known side effects for steroids. • Infection risk with IV injection. *Consistency:* • Can develop a person's reliance on steroid injections for pain management. *Acceptability and feasibility:* • Requires specialised expertise, where referral to a tertiary care setting for IV injection is not feasible. • Consideration for other medications for pain management before IV steroid injections.

Please refer to T.16 in the Treatment Technical Report (Chapter 4) for further details.

16.25. Treatment for whiplash-associated headache

Question: Are treatments for WAD associated headache effective for the management of people with acute or chronic WAD?

No recommendation developed.

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	• In our systematic review of whiplash RCTs, no trials specifically aimed to change headache symptoms as part of the intervention. • Four studies evaluated headache intensity as a secondary outcome in response to multimodal physical therapy (Scholten-Peeters 2006), immobilisation with soft collar (Borchgrevink 1998; Kongsted 2007), and specific education (Kongsted 2008) interventions. No significant differences in between group headache intensity found in these studies. • The guideline panel note that as per the International Classification of Headache Disorders (3rd edition), the critical outcome measure for headache is the frequency of headache over the previous month.

	Frequency of headache was not measured in any of the included whiplash trials. • Interventions that target headache after whiplash might be an area for future research.
Implementation	• HCPs should review primary headache trials for evidence regarding headache management following traumatic injury.

16.26. References: Chronic whiplash treatment

Andersen, T. E., Ravn, S. L., Armfield, N., Maujean, A., Requena, S. S., & Sterling, M. (2021). Trauma-focused cognitive behavioural therapy and exercise for chronic whiplash with comorbid posttraumatic stress disorder: a randomised controlled trial. *Pain, 162*(4), 1221-1232.

Andersen, T. E., Ravn, S. L., Mejldal, A., & Roessler, K. K. (2022). Values-based cognitive behavioural therapy for the prevention of chronic whiplash associated disorders: A randomized controlled trial. *European Journal of Pain*, *26*(6), 1256-1268.

Barnsley, L., Lord, S. M., Wallis, B. J., & Bogduk, N. (1994). Lack of effect of intraarticular corticosteroids for chronic pain in the cervical zygapophyseal joints. *New England Journal of Medicine, 330*(15), 1047-1050.

Braker, C., Yariv, S., Adler, R., Badarny, S., & Eisenberg, E. (2008). The analgesic effect of botulinum-toxin A on postwhiplash neck pain. *The Clinical journal of pain, 24*(1), 5-10.

Cameron, I. D., Wang, E., & Sindhusake, D. (2011). A randomized trial comparing acupuncture and simulated acupuncture for subacute and chronic whiplash. *Spine, 36*(26), E1659-E1665.

Dunne, R. L., Kenardy, J., & Sterling, M. (2012). A randomized controlled trial of cognitive-behavioral therapy for the treatment of PTSD in the context of chronic whiplash. *The Clinical journal of pain*, *28*(9), 755-765.

Ekvall-Hansson, E., Månsson, N.-O., Ringsberg, K. A., & Håkansson, A. (2006). Dizziness among patients with whiplash-associated disorder: a randomized controlled trial. *Journal of Rehabilitation Medicine, 38*(6), 387-390.

Fitz-Ritson, D. (1995, 1995/01//). Phasic exercises for cervical rehabilitation after "whiplash" trauma. *Journal of manipulative and physiological therapeutics, 18*(1), 21-24. http://europepmc.org/abstract/MED/7706955

Freund, B. J., & Schwartz, M. (2002). Use of botulinum toxin in chronic whiplash-associated disorder. *The Clinical journal of pain, 18*(6), S163-S168.

Jull, G., Sterling, M., Kenardy, J., & Beller, E. (2007). Does the presence of sensory hypersensitivity influence outcomes of physical rehabilitation for chronic whiplash?–A preliminary RCT. *Pain, 129*(1-2), 28-34.

Kwak, H.-Y., Kim, J.-I., Park, J.-M., Lee, S.-H., Yu, H.-S., Lee, J.-D., Cho, K.-H., Katai, S., Tsukayama, H., & Kimura, T. (2012). Acupuncture for Whiplash-associated disorder: a randomized, waiting-list controlled, pilot trial. *European Journal of Integrative Medicine, 4*(2), e151-e158.

Lord, S. M., Barnsley, L., Wallis, B. J., McDonald, G. J., & Bogduk, N. (1996). Percutaneous radio-frequency neurotomy for chronic cervical zygapophyseal-joint pain. *New England Journal of Medicine, 335*(23), 1721-1726.

Ludvigsson, M. L., Peterson, G., O'Leary, S., Dedering, Å., & Peolsson, A. (2015). The effect of neck-specific exercise with, or without a behavioral approach, on pain, disability, and self-efficacy in chronic whiplash-associated disorders: a randomized clinical trial. *The Clinical journal of pain, 31*(4), 294.

Michaleff, Z. A., Maher, C. G., Lin, C.-W. C., Rebbeck, T., Jull, G., Latimer, J., Connelly, L., & Sterling, M. (2014). Comprehensive physiotherapy exercise programme or advice for chronic whiplash (PROMISE): a pragmatic randomised controlled trial. *The Lancet, 384*(9938), 133-141.

NICE. (2021). *Chronic pain (primary and secondary) in over 16s: assessment of all chronic pain and management of chronic primary pain*. National Institute for Health and Care Excellence, United Kingdom.

Nikles, J., Keijzers, G., Mitchell, G., Farrell, S. F., Perez, S., Schug, S., Ware, R. S., McLean, S. A., Connelly, L. B., & Sterling, M. (2021). Pregabalin vs placebo to prevent chronic pain after whiplash injury in at-risk individuals: results of a feasibility study for a large randomised controlled trial. *Pain, 163*(2), e274-e284.

Padberg, M., de Bruijn, S., & Tavy, D. (2007). Neck pain in chronic whiplash syndrome treated with botulinum toxin. A double-blind, placebo-controlled clinical trial. *Journal of neurology, 254*, 290-295.

Peolsson, A., Ludvigsson, M. L., Tigerfors, A.-M., & Peterson, G. (2016). Effects of neck-specific exercises compared to waiting list for individuals with chronic whiplash-associated disorders: a

prospective, randomized controlled study. *Archives of physical medicine and rehabilitation, 97*(2), 189-195.

Rebbeck, T., Maher, C. G., & Refshauge, K. M. (2006). Evaluating two implementation strategies for whiplash guidelines in physiotherapy: a cluster-randomised trial. *Australian Journal of Physiotherapy, 52*(3), 165.

Robinson, J. P., Theodore, B. R., Dansie, E. J., Wilson, H. D., & Turk, D. C. (2013). The role of fear of movement in subacute whiplash-associated disorders grades I and II. *Pain*, *154*(3), 393-401.

Silva Guerrero, A. V., Setchell, J., Maujean, A., & Sterling, M. (2022). "I've learned to look at things in a different way": exploring patients' perspectives on participation in physiotherapist delivered integrated stress inoculation training and exercise for acute whiplash. *Disability and rehabilitation, 44*(18), 5191-5198.

https://doi.org/10.1080/09638288.2021.1931480

Söderlund, A., & Lindberg, P. (2001). Cognitive behavioural components in physiotherapy management of chronic whiplash associated disorders (WAD)-a randomised group study. *Physiotherapy Theory and Practice, 17*(4), 229-238.

Sterling, M., Vicenzino, B., Souvlis, T., & Connelly, L. B. (2015). Dry-needling and exercise for chronic whiplash-associated disorders: a randomized single-blind placebo-controlled trial. *Pain, 156*(4), 635-643.

Stewart, M. J., Maher, C. G., Refshauge, K. M., Herbert, R. D., Bogduk, N., & Nicholas, M. (2007). Randomized controlled trial of exercise for chronic whiplash-associated disorders. *Pain, 128*(1-2), 59-68.

van Middelkoop, M., Rubinstein, S. M., Ostelo, R., van Tulder, M. W., Peul, W., Koes, B. W., & Verhagen, A. P. (2013, 2013/01/01). Surgery versus conservative care for neck pain: a systematic review. *European Spine Journal, 22*(1), 87-95.

https://doi.org/10.1007/s00586-012-2553-z

Vassiliou, T., Kaluza, G., Putzke, C., Wulf, H., & Schnabel, M. (2006). Physical therapy and active exercises–An adequate treatment for prevention of late whiplash syndrome?: Randomized controlled trial in 200 patients. *Pain, 124*(1-2), 69-76.

Wicksell, R. K., Ahlqvist, J., Bring, A., Melin, L., & Olsson, G. L. (2008). Can exposure and acceptance strategies improve functioning and life satisfaction in people with chronic pain and Whiplash-Associated Disorders (WAD)? A randomized controlled trial. *Cognitive behaviour therapy, 37*(3), 169-182.

17.Chronic whiplash: Assessment consensus recommendations

17.1. Physical/musculoskeletal impairments: Cervical Range of Motion (CROM)

Question: What physical and/or musculoskeletal impairments assist in the clinical assessment of people with chronic WAD?

Cervical range of motion (CROM) refers to the amount (range) of movement a person can move their neck. Directions often measured are flexion (forward), extension (backward), rotation (turning) and lateral flexion (side bending).

Consensus Recommendation: There was strong guideline panel consensus that healthcare professionals assess the following: cervical range of motion in people with chronic WAD.

(Panel vote summary: 11/11 100% strong for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were six studies, all significant, therefore strong evidence, that people with chronic WAD have poorer (significantly less) cervical ROM than controls or people with other neck pain conditions. • Cervical ROM assessment is also important to determine the grade of WAD and to evaluate treatment effectiveness. *Consistency:* • Findings are consistent with previous guidelines. *Acceptability and feasibility:* • Assessing Cervical ROM is feasible to be performed by in a clinical setting by all primary HCP's. *Balance of effects:* • Trivial adverse effects with ROM assessment.
Implementation	*Indications*: • Assessing CROM is required to determine WAD Grade and inform treatment direction. *How to assess:* • ROM can be measured in clinical settings using an inclinometer. Most reliable method is positioned in the midline of the forehead for lateral flexion or in the vortex of the head in the line with the nose for flexion and extension. • Normative age-related values are found on MyWhiplashNavigator • Resources on how to perform CROM are freely available from Whiplash Navigator https://www.mywhiplash.com.au/node/160/#standard-assessment

Please refer to A.1 in the Assessment Technical Report (Chapter 2) for further details.

17.2. Physical/musculoskeletal impairments: Cervical muscle function

Question: What physical and/or musculoskeletal impairment assist in the clinical assessment of people with chronic WAD.

Cervical muscle function refers to neck muscle endurance and muscle strength.

Consensus Recommendation: There was guideline panel consensus to suggest that healthcare professionals assess the following: cervical muscle function in people with chronic WAD.

(Panel vote summary: 12/12 100% conditional for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • Moderate evidence, with all six studies significant for muscle function impairment in people with chronic WAD compared to the control groups. • More common for muscle function to be impaired in the chronic phase of people with WAD. • Assessment of muscle function can be used to evaluate the effectiveness of treatment.
Sub-groups consideration	• HCPs could consider assessing these factors when clinically indicated (e.g., person reports difficulty performing functional tasks requiring neck endurance (lifting head off bed, holding head up).
Implementation	*Indications*: • HCPs indications for assessing cervical muscle function may include when the person reports difficulty performing functional tasks requiring neck endurance (lifting head off bed, holding head up). *How to assess:* • Examples of how to assess muscle performance and muscle endurance are provided. https://www.mywhiplash.com.au/content/higher-risk-assessments#motor-assessment *What to do:* • If assessed to be impaired, this may require rehabilitation (see neck-specific exercises in treatment recommendations).

Please refer A.1 in the Assessment Technical Report (Chapter 2) for further details.

17.3. Pain sensitivity: Thermal hyperalgesia (CPT, heat), pressure hyperalgesia (PPT), and Brachial Plexus Provocation Test (BPPT)

Question: What pain sensitivity impairments assist in the clinical assessment of people with chronic WAD?

Pain sensitivity in this guideline refers to pain abnormal sensory pain processing (e.g., pressure hyperalgesia) assessed by clinical tests.

Consensus Recommendation: Are you for or against healthcare professionals assessing the following pain sensitivity tests in people with chronic whiplash: thermal hyperalgesia, pressure hyperalgesia, brachial plexus provocation test?

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were 10/11 and 11/11 (strong evidence) independent cohorts for pressure and thermal hyperalgesia in people with chronic WAD, respectively, where people with WAD were significantly different from control group. And 3/3 independent cohorts positive for Brachial Plexus Provocation Test. • Consistent findings were found across the included studies that suggest the presence of altered pain sensitivity in people with chronic WAD. *Balance of effects:* • Adverse effects for assessing pain sensitivity using these methods are likely trivial in magnitude. *Acceptability and feasibility:* • These clinical tests are relatively low cost to administer.
Sub-group considerations	• Strong evidence for pressure and thermal hyperalgesia, where people with WAD were significantly different from control group
Implementation	*Indications:* • Pain sensitivity assessment should be performed if clinically indicated (e.g., widespread pain, reports of pain with non-noxious stimuli). *How to assess:* • Cold hyperalgesia[1]: Ice Pain Test (Rebbeck et al., 2015). Perform with ice and ask a NRS rating for pain. NRS>5/10 for pain considered cold hyperalgesia (Maxwell & Sterling, 2013). • Pressure hyperalgesia1: Best performed using a pressure algometer. • Brachial Plexus Provocation Test (BPPT)[1] is a clinical test to assess neural tissue sensitivity. The test can be modified to not go to end of range (i.e., avoid excessive overpressure).

	Considerations: • Healthcare professionals should be cautious about carrying out a provocative pain sensitivity testing in people who present with widespread pain as some people may have a temporary increase in pain as a result of the assessment. *Contraindications:* • Cervical radiculopathy contraindicates provocative tests (upper limb neural tension test – brachial plexus).

Please refer to A.3 in the Assessment Technical Report (Chapter 2) for further details.

17.4. Additional psychological factors: depression

Question: What additional psychological factors assist in the clinical assessment of people with chronic WAD?

Additional psychological factors in this guideline refer to depression.

Consensus Recommendation: There was guideline panel consensus to suggest that Healthcare professionals assess the following depressive symptoms in people with chronic WAD.

(Panel vote summary: 11/12 (92%) conditional for, 1/12 (8%) neutral)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were significant differences in diagnosis of depression in chronic WAD compared with a control group in a single study. *Consistency:* • Screening for a probable major depressive disorder in people with acute WAD was recommended in the prognosis section of these guidelines.
Implementation	• Please refer to the prognosis section for psychological factors.

Please refer to A.4 in the Assessment Technical Report (Chapter 2) for further details.

17.5. Additional symptoms: Jaw symptoms, upper limb disabilities, and sleep quality

Question: What additional symptoms assist in the clinical assessment of people with chronic WAD?

Additional symptoms in this guideline refer to other symptoms that people with whiplash might present other than the usual symptoms (e.g., jaw symptoms, upper limb disabilities)

Consensus Recommendation: There was guideline panel consensus to suggest that healthcare professionals assess the following additional symptoms in people with acute and chronic WAD. (Panel vote summary: 10/12 (83%) conditional for, 2/12 (17%) neutral for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification

Evidence summary:

- There were five studies (acute and chronic), and all were significant. However, and all were significant. However, there is only one study for each construct, and the findings are small.
- The sleep study was in acute WAD. However, the recommendation in this guideline is the same for acute and chronic, as these additional symptoms are consistent in the acute and chronic phase of WAD.

Consistency:

- Those symptoms are frequently reported in other musculoskeletal conditions, e.g., sleep disturbance.

Acceptability and feasibility:

- Assessing additional symptoms is usual practice for healthcare professionals to ask injured people about.

Implementation

- Assessing symptoms is part of routine history. HCPs are already recommended to assess pain intensity, neck disability, pain sites, number of symptoms and specific symptoms such as headache and dizziness.
- HCPs should be aware that other areas that may be symptomatic are the aw and upper limb. Sleep quality/ disturbance is also recommended to be assessed.

How to assess:

- Sleep Quality: Pittsburgh Sleep Quality Index (PSQI)
- Disability of the Arm Shoulder and Hand (DASH) to assess a person's ability to perform upper limb activities.

What to do:

- If sleep quality is impaired: It's important to help clients understand that sleep issues are common and manageable and that negative thoughts about sleep can worsen symptoms. Encourage small steps towards better sleep routines and check how sleep issues are affecting physical therapy. If sleep deprivation is severe, check their safety for certain activities (e.g., driving). Suggest they speak to their GP about sleep issues and consider seeing a psychologist for targeted support. Self-guided sleep resources can also be helpful as a starting point or while waiting for professional help.

Please refer to A.5 in the Assessment Technical Report (Chapter 2) for further details.

17.6. Sensorimotor: Cervical joint position error, cervical movement sense, oculomotor disturbance, balance, and coordination test

Question: What sensorimotor impairments assist in the clinical assessment of people with chronic WAD?

In this guideline sensorimotor refers to tests that assess alteration to the sensorimotor control. Cervical joint position error assesses the ability to relocate the head to a neutral head posture. Cervical movement sense assesses the ability to control the fine movement of the neck accurately. Oculomotor disturbance assesses oculomotor disturbance, including the smooth pursuit neck torsion test (SPNT). Balance refers to general postural stability. Coordination tests the ability of coordinate movements.

Consensus Recommendation: There was guideline panel consensus to suggest that Healthcare professionals assess the following: cervical joint position error, cervical movement sense, oculomotor disturbance and balance in people with chronic WAD.

(Panel vote summary: 11/12 conditional for (92%), 1/12 (8%) neutral)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were 6/8, 4/5, 8/9 and 10/10 studies that showed people with chronic WAD have impairments in cervical joint position error, cervical movement sense, oculomotor disturbance and balance, respectively. • Moderate evidence showing that people with chronic WAD have impairments in cervical joint position error, cervical movement sense, oculomotor disturbance and balance. *Consistency:* • Findings are consistent with previous guidelines. *Acceptability and feasibility:* • All factors can be clinically assessed. • Results of tests can be used to reassess effectiveness of treatment.
Implementation	*Indications:* • Whilst many people with chronic WAD people may demonstrate impairment, primary HCPs should consider individual presentation (e.g., people with dizziness). *Considerations*: • Consider these and other tests to differentiate other sources of symptoms (e.g., due to mild traumatic brain injury/ concussion or vestibular causes) • Be aware that some of the tests can provoke or increase symptoms. Avoid performing multiple tests on the same day to avoid symptom accumulation. Prioritise test based on clinical presentation.

	How to assess: • Training is required to performing and interpret tests. It is important to understand normative values and values that indicate impairment (e.g., error of > 4.5 degrees indicates impairment for cervical joint position error test) • Resources on how to perform, normative values and threshold for cervical joint position error, cervical movement sense (CMS), smooth pursuit neck torsion test (SPNT), Balance – tandem step test) assessments are freely available from Whiplash Navigator https://www.mywhiplash.com.au/content/higher-risk-assessments#sensorimotor-assessment *What to do:* • If people are impaired primary HCPs are recommended to rehabilitate the impairment and may be directed to recommended treatments (e.g., dizziness specific exercise – see guideline treatment section) • Referral to whiplash expert +/- psychologist (consideration differential diagnoses).

Please refer to A.2 in the Assessment Technical Report (Chapter 2) for further details.

17.7. Physical/musculoskeletal impairments: cervical muscle performance

Question: What physical and/or musculoskeletal impairment assist in the clinical assessment of people with chronic WAD?

Cervical muscle performance refers to muscle coordination and / or how much or little a muscle works (amplitude) when performing a task.

Consensus Recommendation: The guideline panel cannot reach consensus for or against assessing the following: cervical muscle performance in people with chronic WAD.

(Panel vote summary: 10/11 91% neutral; 1/11 9% conditional for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • The evidence for impairments in muscle performance is inconclusive. • There were 5/6 studies showing impairment impairments in muscle performance. However, there are different tests evaluated, hence heterogeneity in studies (e.g., scapular tilt, onset of muscle activation, abnormal trapezius activation pattern).
Implementation	*Indications*: • People with chronic whiplash may require an assessment of muscle performance if clinically indicated. For example, report of “muscle

	tightness or tension" in neck or axio-scapula muscles that require re-training. Muscle performance may vary in people with chronic WAD. *How to assess:* • Examples of how to assess muscle performance (e.g., cranio-cervical flexion test) are provided in Whiplash Navigator https://www.mywhiplash.com.au/content/higher-risk-assessments#motor-assessment *What to do:* • If assessed to be impaired, this may require rehabilitation (see neck-specific exercise in treatment recommendations).

Please refer to A.1 in the Assessment Technical Report (Chapter 2) for further details.

17.8. Pain sensitivity: dynamic pain sensitivity test

Question: What pain sensitivity impairments assist in the clinical assessment of people with chronic WAD?

Pain sensitivity in this guideline refers to abnormal pain sensory processing assessed by clinical tests (e.g., dynamic pain sensitivity test)

Consensus Recommendation: The guideline panel cannot reach consensus for or against assessing the following test(s): dynamic pain sensitivity testing (CPM) in people with chronic WAD.
(Panel vote summary: 11/12 (92%) neutral, 1 conditional (8%) for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were 2/4 studies significant for CPM, therefore, inconsistent evidence. However, consistent findings were found across the included studies that suggest the presence of altered pain sensitivity in Chronic WAD. *Balance of effects:* • Adverse effects for assessing pain sensitivity using these methods are likely trivial in magnitude.
Sub-group considerations	• More severe or likely in those with moderate to severe disability.
Implementation	*Indications:* • People with widespread pain, including nociplastic pain type. *How to assess:* • Conditioned Pain Modulation (CPM): refer to the description of the test in the handout (Rebbeck et al. "How to assess for pain sensitisation in

	the clinic: neck and arm pain focus") presented on the following website http://www.specialistphysioeducation.net.au. *Considerations:* • Healthcare professionals should be cautious about carrying out a provocative pain sensitivity testing in people who present with widespread pain as some people may have a temporary increase in pain as a result of the assessment. *What to do if test positive:* • Educate person on the purpose of the assessment and if positive on the assessment, take the opportunity to educate the person about pain hypersensitivity. • Use results to guide treatment – for example if positive some treatments may be contra-indicated (e.g., manual therapy), whilst others may be required (e.g., medication review / stronger medications. Treatments recommended for medium/high risk group should be considered (see treatment section) • Online resources[1] are available for primary HCPs to become familiar with how to do this, however some may require training to effectively implement and interpret the findings from these tests. • More details on how to perform these tests are on MyWhiplashNavigator (www.mywhiplash.com.au)

Please refer to A.3 in the Assessment Technical Report (Chapter 2) for further details.

17.9. Sensorimotor: Coordination and proprioception (others)

Question: What sensorimotor impairments assist in the clinical assessment of people with acute WAD?

In this guideline sensorimotor impairment refers to tests that assess alteration to sensorimotor control.

Consensus Recommendation: The guideline panel cannot reach consensus for or against assessing the following: coordination and proprioception in people with chronic WAD.
(Panel vote summary: 10/12 neutral (83%), 2/12 conditional (17%) for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were only 2/2 and 2/3 studies significant for coordination and other proprioception factors, respectively, showing limited evidence.
Implementation	*Indications:* • We do not recommend as assessing upper limb coordination or other proprioceptive tests routinely. There may however be individual

	circumstances when assessment is indicated (e.g., person reporting upper limb incoordination or differences in laterality perception. *Considerations:* • Primary HCPs should be aware that some people with WAD may be hypervigilant, hence assessment of laterality may be contraindicated. *What to do:* • If people are impaired primary HCPs are recommended to rehabilitate the impairment

Please refer to A.2 in the Assessment Technical Report (Chapter 2) for further details.

17.10. Additional psychological factors: Psychological distress symptoms and perceived cognitive deficits.

Question: What additional psychological factors assist in the clinical assessment of people with chronic WAD?

Additional psychological factors in this guideline include psychological constructs that can be readily assessed.

Consensus Recommendation: The guideline panel cannot reach consensus for or against assessing the following: psychological distress symptoms and perceived cognitive deficits in people with chronic WAD.
(Panel vote summary: 12/12 (100% neutral for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were 2/3 studies significant. However, only two studies evaluating perceived cognitive deficit and one psychological distress symptoms. • Psychological factors are usually used in term of prognostic context and to assist healthcare professionals to determine the probably of poor recovery rather than to determine differences between groups (refer to prognostic section in the guideline).
Implementation	*Indications:* • Healthcare professionals might consider to additionally assess perceived cognitive deficit associated with depression if clinically indicated (e.g., if the person reports cognitive deficits). In these instances, recommendations are to use the – the Perceived Deficits Questionnaire Depression (PDQ-D) or 5-item version PDQ-D-5. • Link: https://workingwithdepression.psychiatry.ubc.ca/leaps/perceived-deficits-questionnaire-pdq/

Please refer to A.4 in the Assessment Technical Report (Chapter 2) for further details.

17.11. Pain sensitivity: Vibration hyperalgesia, nociceptive flexion reflex

Question: What pain sensitivity impairments assist in the clinical assessment of people with chronic WAD?

Pain sensitivity in this guideline refers to pain abnormal sensory pain processing (e.g., vibration hyperalgesia) assessed by clinical tests.

Consensus Recommendation: There was guideline panel consensus to suggest that healthcare professionals do not assess the following test(s): Nociceptive Flexion Reflex (NFR) and vibration hyperalgesia in people with chronic WAD.
(Panel vote summary: 11/11 conditional against (100%)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were only 1/2 and 2/3 studies significant for Vibration and NFR thresholds, respectively. • Vibration and NFR thresholds were shown to be inconsistent in WAD groups compared with controls, however, these findings were from few studies. *Acceptability and feasibility:* • NFR test is not feasible in clinical settings as it requires a High Voltage Constant Current Stimulator and EMG, and specialised training to administer. • Assessment of vibration hyperalgesia may not be feasible in clinical settings as it requires a specialised vibrometer device.

Please refer to A.3 in the Assessment Technical Report (Chapter 2) for further details.

17.12. Advanced medical testing: Stress hormone and inflammatory biomarkers, blood flow, skin biopsy and genetic markers

Question: What advanced medical testing methods assist in the clinical assessment of people with acute WAD?

Advanced medical testing in this guideline refers to tests performed to evaluate stress hormone (e.g., cortisol concentration), inflammatory biomarkers (e.g., TNF- α, serum IL-1β), cerebral blood flow, skin biopsy and genetic markers.

Consensus Recommendation: The panel recommends not assessing any stress hormone, inflammatory biomarkers, blood flow, skin biopsy, or genetic markers.
(Panel vote summary: 11/12 92% strong against; 1/112 8% strong for)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • Although most chronic studies, 5/6 studies showed significance when comparing WAD to control groups, what they assessed, and the technique used varies across all studies. • Studies are exploratory, and not diagnostic, in nature. • Only a few studies assess people with WAD compared to the control group. • Saliva and blood tests are generally available. However, PET, SPECT, genetic assessment, and skin biopsy are less accessible and costlier and require specialised equipment and training.

Please refer to A.6 in the Assessment Technical Report (Chapter 2) for further details.

17.13. Imaging

What imaging methods assist in the clinical assessment of people with acute WAD?

Imaging in this question refers to a technique (e.g., Magnetic Resonance imaging, ultrasound) performed to evaluate morphology changes, muscle fat infiltration, muscle size, stiffness and others (e.g., brain).

Consensus Recommendation: There was strong guideline panel consensus that primary healthcare practitioners do not assess the following techniques Magnetic resonance imaging (MRI) and Ultrasound (US) to assess changes in WAD Morphology – structure changes, muscle fat infiltration, muscle size, muscle morphology, metabolites measured by MRS, Brain, and nerve mobility and others in people with chronic WAD.

(Panel vote summary: 10/10 (100%) strong against)

Strong against	Conditional against	Neither for/against	Conditional for	Strong for

Justification	*Evidence summary:* • There were 12/22 independent studies showing differences and therefore are largely inconclusive for morphology – structure changes muscle size, muscle morphology, metabolites measured by MRS, brain, and nerve mobility. The exception of evidence was for muscle fat infiltration with 6/6 studies showing increased muscle fat infiltration in people with WAD compared to control group. • Studies are exploratory studies and not diagnostic studies. Therefore, the imaging techniques do not assist in diagnosing WAD nor helping in treatment. *Acceptability and feasibility:* • The techniques and equipment are very costly (e.g., MRI). • The analysis requires advanced neuroimaging expertise not readily available in the clinical setting.

Please refer to A.7 in the Assessment Technical Report (Chapter 2) for further details.

17.14. References: Chronic whiplash assessment

Abbott, R., Pedler, A., Sterling, M., Hides, J., Murphey, T., Hoggarth, M., & Elliott, J. (2015). The geography of fatty infiltrates within the cervical multifidus and semispinalis cervicis in individuals with chronic whiplash-associated disorders. Journal of Orthopaedic & Sports Physical Therapy, 45(4), 281-288. https://doi.org/https://dx.doi.org/10.2519/jospt.2015.5719

Abbott, R., Peolsson, A., West, J., Elliott, J. M., Aslund, U., Karlsson, A., & Leinhard, O. D. (2018). The qualitative grading of muscle fat infiltration in whiplash using fat and water magnetic resonance imaging. Spine Journal: Official Journal of the North American Spine Society, 18(5), 717-725. https://doi.org/https://dx.doi.org/10.1016/j.spinee.2017.08.233

Anstey, R., Kongsted, A., Kamper, S., & Hancock, M. (2016). Are people with whiplash-associated neck pain different from people with nonspecific neck pain? Journal of Orthopaedic and Sports Physical Therapy, 46(10), 894-890.

Antonaci, F., Bulgheroni, M., Ghirmai, S., Lanfranchi, S., Dalla Toffola, E., Sandrini, G., & Nappi, G. (2002). 3D kinematic analysis and clinical evaluation of neck movements in patients with whiplash injury. Cephalalgia, 22(7), 533-542. https://doi.org/10.1046/j.1468-2982.2002.00405.x

Armstrong, B. S., McNair, P. J., & Williams, M. (2005). Head and neck position sense in whiplash patients and healthy individuals and the effect of the cranio-cervical flexion action. Clin Biomech (Bristol, Avon), 20(7), 675-684. https://doi.org/10.1016/j.clinbiomech.2005.03.009

Astrup, J., Johansen, A.-M., Gyntelberg, F., Lei, A., & Marott, J. L. (2021). Impaired neck motor control in chronic whiplash and tension-type headache. Acta Neurologica Scandinavica, 144(4), 394-399. https://doi.org/http://dx.doi.org/10.1111/ane.13473

Banic, B., Petersen-Felix, S., Andersen, O. K., Radanov, B. P., Villiger, P. M., Arendt-Nielsen, L., & Curatolo, M. (2004). Evidence for spinal cord hypersensitivity in chronic pain after whiplash injury and in fibromyalgia. Pain, 107(1-2), 7-15. https://doi.org/10.1016/j.pain.2003.05.001

Baydal-Bertomeu, J. M., Page, A. F., Belda-Lois, J. M., Garrido-Jaen, D., & Prat, J. M. (2011). Neck motion patterns in whiplash-associated disorders: quantifying variability and spontaneity of movement. Clin Biomech, 26(1), 29-34. https://doi.org/https://dx.doi.org/10.1016/j.clinbiomech.2010.08.008

Beeckmans, K., Crunelle, C., Van Ingelgom, S., Michiels, K., Dierckx, E., Vancoillie, P., Hauman, H., & Sabbe, B. (2017). Persistent cognitive deficits after whiplash injury: a comparative study with mild traumatic brain injury patients and healthy volunteers. Acta Neurologica Belgica, 117(2), 493-500. https://doi.org/https://dx.doi.org/10.1007/s13760-017-0745-3

Bexander, C. S. M., & Hodges, P. W. (2012). Cervico-ocular coordination during neck rotation is distorted in people with whiplash-associated disorders. Experimental Brain Research, 217(1), 67-77. https://doi.org/10.1007/s00221-011-2973-8

Borsbo, B., Liedberg, G. M., Wallin, M., & Gerdle, B. (2012). Subgroups based on thermal and pressure pain thresholds in women with chronic whiplash display differences in clinical presentation - an explorative study. Journal of pain research, 5, 511-521. https://doi.org/https://dx.doi.org/10.2147/JPR.S37062

Cagnie, B., Dolphens, M., Peeters, I., Achten, E., Cambier, D., & Danneels, L. (2010). Use of muscle functional magnetic resonance imaging to compare cervical flexor activity between patients with whiplash-associated disorders and people who are healthy. Phys Ther, 90(8), 1157-1164. https://doi.org/https://dx.doi.org/10.2522/ptj.20090351

Castaldo, M., Catena, A., Fernandez-de-Las-Penas, C., & Arendt-Nielsen, L. (2019). Widespread Pressure Pain Hypersensitivity, Health History, and Trigger Points in Patients with Chronic Neck Pain: A

Preliminary Study. Pain medicine, 20(12), 2516-2527. https://doi.org/https://dx.doi.org/10.1093/pm/pnz035

Chien, A., & Sterling, M. (2010). Sensory hypoaesthesia is a feature of chronic whiplash but not chronic idiopathic neck pain. Manual Ther, 15(1), 48-53. https://doi.org/https://dx.doi.org/10.1016/j.math.2009.05.012

Chien, A., Eliav, E., & Sterling, M. (2008b). Whiplash (grade II) and cervical radiculopathy share a similar sensory presentation: an investigation using quantitative sensory testing. Clin J Pain, 24(7), 595-603. https://doi.org/https://dx.doi.org/10.1097/AJP.0b013e31816ed4fc

Chien, A., Eliav, E., & Sterling, M. (2009). Hypoaesthesia occurs with sensory hypersensitivity in chronic whiplash--further evidence of a neuropathic condition. Manual Ther, 14(2), 138-146. https://doi.org/https://dx.doi.org/10.1016/j.math.2007.12.004

Coppieters, I., Cagnie, B., De Pauw, R., Danneels, L., Ickmans, K., & Meeus, M. (2016). Differences between traumatic and non-traumatic chronic neck pain patients: The role of central pain modulation, cognitive functioning and psychosocial characteristics. Manual therapy, 25, e71. https://doi.org/http://dx.doi.org/10.1016/j.math.2016.05.112

Coppieters, I., Cagnie, B., V, R., Meeus, M., & Timmers, I. (2021). Enhanced amygdala-frontal operculum functional connectivity during rest in women with chronic neck pain: Associations with impaired conditioned pain modulation. NeuroImage Clinical, 30, 102638. https://doi.org/https://dx.doi.org/10.1016/j.nicl.2021.102638

Coppieters, I., De Pauw, R., Caeyenberghs, K., Danneels, L., Kregel, J., Pattyn, A., Meeus, M., & Cagnie, B. (2017). Decreased Regional Grey Matter Volume in Women with Chronic Whiplash-Associated Disorders: Relationships with Cognitive Deficits and Disturbed Pain Processing. Pain physician, 20(7), E1025-E1051.

Coppieters, I., De Pauw, R., Caeyenberghs, K., Lenoir, D., DeBlaere, K., Genbrugge, E., Meeus, M., & Cagnie, B. (2018). Differences in white matter structure and cortical thickness between patients with traumatic and idiopathic chronic neck pain: Associations with cognition and pain modulation? Human Brain Mapping, 39(4), 1721-1742. https://doi.org/https://dx.doi.org/10.1002/hbm.23947

Coppieters, I., Ickmans, K., Cagnie, B., Nijs, J., De Pauw, R., Noten, S., & Meeus, M. (2015). Cognitive performance is related to central sensitization and health-related quality of life in patients with chronic whiplash-associated disorders and fibromyalgia. Pain physician, 18(3), E389-E402. http://www.painphysicianjournal.com/2015/may/2015;18;E389-E401.pdf

Cote, J. N., Patenaude, I., St-Onge, N., & Fung, J. (2009). Whiplash-associated disorders affect postural reactions to antero-posterior support surface translations during sitting. Gait Posture, 29(4), 603-611. https://doi.org/https://dx.doi.org/10.1016/j.gaitpost.2008.12.014

Daenen, L., Nijs, J., Cras, P., Wouters, K., & Roussel, N. (2014). Changes in Pain Modulation Occur Soon After Whiplash Trauma but are not Related to Altered Perception of Distorted Visual Feedback. Pain Practice, 14(7), 588-598. https://doi.org/https://dx.doi.org/10.1111/papr.12113

Daenen, L., Nijs, J., Roussel, N., Wouters, K., & Cras, P. (2012). Altered perception of distorted visual feedback occurs soon after whiplash injury: an experimental study of central nervous system processing. Pain physician, 15(5), 405-413.

Daenen, L., Nijs, J., Roussel, N., Wouters, K., Van, L. M., & Cras, P. (2012). Sensorimotor incongruence exacerbates symptoms in patients with chronic whiplash associated disorders: An experimental study. Rheumatology, 51(8), 1492-1499.

Dall'Alba, P. T., Sterling, M. M., Treleaven, J. M., Edwards, S. L., & Jull, G. A. (2001). Cervical range of motion discriminates between asymptomatic persons and those with whiplash. Spine (Phila Pa 1976), 26(19), 2090-2094. https://doi.org/10.1097/00007632-200110010-00009

De Pauw, R., Coppieters, I., Palmans, T., Danneels, L., Meeus, M., & Cagnie, B. (2018). Motor impairment in patients with chronic neck pain: does the traumatic event play a significant role? A case-control study. Spine Journal: Official Journal of the North American Spine Society, 18(8), 1406-1416. https://doi.org/https://dx.doi.org/10.1016/j.spinee.2018.01.009

Descarreaux, M., Mayrand, N., & Raymond, J. (2007). Neuromuscular control of the head in an isometric force reproduction task: comparison of whiplash subjects and healthy controls. Spine J, 7(6), 647-653.

Don, S., De, K. M., Voogt, L., Ickmans, K., Daenen, L., & Nijs, J. (2017). The effect of visual feedback of the neck during movement in people with, chronic whiplash-associated disorders: An experimental study. Journal of Orthopaedic and Sports Physical Therapy, 47(3), 190-199.

Dullerud, R., Gjertsen, O., & Server, A. (2010). Magnetic resonance imaging of ligaments and membranes in the craniocervical junction in whiplash-associated injury and in healthy control subjects. Acta Radiologica, 51(2), 207-212. https://doi.org/10.3109/02841850903321617

Elliott, J. M., O'Leary, S., Sterling, M., Hendrikz, J., Pedler, A., & Jull, G. (2010). Magnetic Resonance Imaging Findings of Fatty Infiltrate in the Cervical Flexors in Chronic Whiplash. Spine, 35(9), 948-954. https://doi.org/10.1097/BRS.0b013e3181bb0e55

Elliott, J. M., Pedler, A. R., Cowin, G., Sterling, M., & McMahon, K. (2012). Spinal cord metabolism and muscle water diffusion in whiplash. Spinal Cord, 50(6), 474-476. https://doi.org/http://dx.doi.org/10.1038/sc.2011.17

Elliott, J. M., Pedler, A. R., Jull, G. A., Van Wyk, L., Galloway, G. G., & Oleary, S. P. (2014). Differential changes in muscle composition exist in traumatic and nontraumatic neck pain. Spine (03622436), 39(1), 39-47. https://doi.org/10.1097/BRS.0000000000000033

Elliott, J., Jull, G., Noteboom, J. T., Darnell, R., Galloway, G., & Gibbon, W. W. (2006). Fatty infiltration in the cervical extensor muscles in persistent whiplash-associated disorders: a magnetic resonance imaging analysis. Spine (Phila Pa 1976), 31(22), E847-855. https://doi.org/10.1097/01.brs.0000240841.07050.34

Elliott, J., Jull, G., Noteboom, J., & Galloway, G. (2008). MRI study of the cross-sectional area for the cervical extensor musculature in patients with persistent whiplash associated disorders. Manual therapy, 13(3), 258-265.

Elliott, J., Sterling, M., Noteboom, J. T., Darnell, R., Galloway, G., & Jull, G. (2008). Fatty infiltrate in the cervical extensor muscles is not a feature of chronic, insidious-onset neck pain. Clinical Radiology, 63(6), 681-687. https://doi.org/10.1016/j.crad.2007.11.011

Ernst, M., Williams, L., Werner, I., Crawford, R., & Treleaven, J. (2019). Clinical assessment of cervical movement sense in those with neck pain compared to asymptomatic individuals. Musculoskeletal Science and Practice, 43, 64-69.

Ettlin, T., Schuster, C., Stoffel, R., Bruderlin, A., & Kischka, U. (2008). A distinct pattern of myofascial findings in patients after whiplash injury. Arch Phys Med Rehabil, 89(7), 1290-1293. https://doi.org/https://dx.doi.org/10.1016/j.apmr.2007.11.041

F Scott, F., Sterling, M., Irving-Rodgers, H., Schmid, A. B., & Irving-Rodgers, H. (2020). Small fibre pathology in chronic whiplash-associated disorder: A cross-sectional study. European Journal of Pain, 24(6), 1045-1057. https://doi.org/10.1002/ejp.1549

Farooq, M. (2012). Effects of whipash injury on median nerve mobility: A comparative study. Journal of Physiotherapy & Sports Medicine, 1(2), 115-130.

Farrell, S. F., Cowin, G. J., Pedler, A., Durbridge, G., de Zoete, R. M. J., & Sterling, M. (2021). Magnetic Resonance Spectroscopy Assessment of Brain Metabolite Concentrations in Individuals With Chronic Whiplash-associated Disorder: A Cross-sectional Study. Clinical Journal of Pain, 37(1), 28-37. https://doi.org/https://dx.doi.org/10.1097/AJP.0000000000000890

Farrell, S. F., Cowin, G., Pedler, A., Durbridge, G., & Sterline, M. (2020). Spinal cord injury is not a feature of chronic whiplash-associated disorder: a magnetic resonance spectroscopy study. European Spine Journal, 29(6), 1212-1218. https://doi.org/10.1007/s00586-020-06407-6

Farrell, S., Osmotherly, P., Cornwall, J., Lau, P., & Rivett, D. (2016). Morphology of cervical spine meniscoids in individuals with chronic whiplash-associated disorder: A case-control study. Journal of Orthopaedic and Sports Physical Therapy, 46(10), 902-910.

Feipel, V., Salvia, P., Klein, H., & Rooze, M. (2006). Head repositioning accuracy in patients with whiplash-associated disorders. Spine (Phila Pa 1976), 31(2), E51-58. https://doi.org/10.1097/01.brs.0000194786.63690.54

Field, S., Treleaven, J., & Jull, G. (2008). Standing balance: A comparison between idiopathic and whiplash-induced neck pain. Manual therapy, 13(3), 183-191. https://doi.org/10.1016/j.math.2006.12.005

Findling, O., Schuster, C., Sellner, J., Ettlin, T., & Allum, J. H. (2011). Trunk sway in patients with and without, mild traumatic brain injury after whiplash injury. Gait Posture, 34(4), 473-478. https://doi.org/https://dx.doi.org/10.1016/j.gaitpost.2011.06.021

Frydas, D., Rushton, A., Wright, C., Kontakiotis, N., Mystrakis, A., & Heneghan, N. (2014). Discriminative validity of sensory evaluation in a whiplash-associated disorder II population. International Journal of Therapy & Rehabilitation, 21(10), 460-467.

Gaab, J., Baumann, S., Budnoik, A., Gmunder, H., Hottinger, N., & Ehlert, U. (2005). Reduced reactivity and enhanced negative feedback sensitivity of the hypothalamus-pituitary-adrenal axis in chronic whiplash-associated disorder. Pain, 119(1-3), 219-224. https://doi.org/10.1016/j.pain.2005.10.001

Gandelman-Marton, R., Arlazoroff, A., & Dvir, Z. (2016). Postural stability in patients with different types of head and neck trauma in comparison to healthy subjects. Brain Injury, 30(13-14), 1612-1616.
Greening, J., Dilley, A., & Lynn, B. (2005). In vivo study of nerve movement and mechanosensitivity of the median nerve in whiplash and non-specific arm pain patients. Pain, 115(3), 248-253. https://doi.org/10.1016/j.pain.2005.02.023

Grip, H., Ohberg, F., Wiklund, U., Sterner, Y., Karlsson, J. S., & Gerdle, B. (2003). Classification of neck movement patterns related to whiplash-associated disorders using neural networks. IEEE Trans Inf Technol Biomed, 7(4), 412-418. https://doi.org/10.1109/titb.2003.821322

Grip, H., Sundelin, G., Gerdle, B., & Karlsson, J. S. (2007). Variations in the axis of motion during head repositioning--a comparison of subjects with whiplash-associated disorders or non-specific neck pain and healthy controls. Clin Biomech, 22(8), 865-873.

Grip, H., Sundelin, G., Gerdle, B., & Stefan Karlsson, J. (2008). Cervical helical axis characteristics and its center of rotation during active head and upper arm movements-comparisons of whiplash-associated disorders, non-specific neck pain and asymptomatic individuals. Journal of Biomechanics, 41(13), 2799-2805.

Gronqvist, J., Haggman-Henrikson, B., & Eriksson, P. O. (2008). Impaired jaw function and eating difficulties in whiplash-associated disorders. Swed Dent J, 32(4), 171-177.

Grushka, M., Ching, V. W., Epstein, J. B., & Gorsky, M. (2007). Radiographic and clinical features of temporomandibular dysfunction in patients following indirect trauma: A retrospective study. Oral Surgery Oral Medicine Oral Pathology Oral Radiology and Endodontology, 104(6), 772-780. https://doi.org/10.1016/j.tripleo.2007.02.025

Haggman-Henrikson, B., Gronqvist, J., & Eriksson, P. O. (2011). Frequent jaw-face pain in chronic Whiplash-Associated Disorders. Swed Dent J, 35(3), 123-131.

Haggman-Henrikson, B., Lampa, E., & Nordh, E. (2013). Altered thermal sensitivity in facial skin in chronic whiplash-associated disorders. International Journal of Oral Science, 5(3), 150-154. https://doi.org/https://dx.doi.org/10.1038/ijos.2013.42

Helgadottir, H., Kristjansson, E., Einarsson, E., Karduna, A., & Jonsson, H. (2011). Altered activity of the serratus anterior during unilateral arm elevation in patients with cervical disorders. Journal of Electromyography and Kinesiology, 21(6), 947-953. https://doi.org/10.1016/j.jelekin.2011.07.007

Helgadottir, H., Kristjansson, E., Mottram, S., Karduna, A. R., & Jonsson, H., Jr. (2010). Altered scapular orientation during arm elevation in patients with insidious onset neck pain and whiplash-associated disorder. J Orthop Sports Phys Ther, 40(12), 784-791. https://doi.org/https://dx.doi.org/10.2519/jospt.2010.3405

Helgadottir, H., Kristjansson, E., Mottram, S., Karduna, A., & Jonsson, H. (2011). Altered Alignment of the Shoulder Girdle and Cervical Spine in Patients With Insidious Onset Neck Pain and Whiplash-Associated Disorder. Journal of Applied Biomechanics, 27(3), 181-191. https://doi.org/10.1123/jab.27.3.181

Janssen, M., Ischebeck, B. K., de Vries, J., Kleinrensink, G.-J., Frens, M. A., & van der Geest, J. N. (2015). Smooth Pursuit Eye Movement Deficits in Patients With Whiplash and Neck Pain are Modulated by Target Predictability. Spine (03622436), 40(19), E1052-E1057. https://doi.org/10.1097/BRS.0000000000001016

Juul-Kristensen, B., Clausen, B., Ris, I., Jensen, R. V., Steffensen, R. F., Chreiteh, S. S., Jørgensen, M. B., & Søgaard, K. (2013). INCREASED NECK MUSCLE ACTIVITY AND IMPAIRED BALANCE AMONG FEMALES WITH WHIPLASH-RELATED CHRONIC NECK PAIN: A CROS S-SECTIONAL STUDY. Journal of Rehabilitation Medicine (Stiftelsen Rehabiliteringsinformation), 45(4), 376-384. https://doi.org/10.2340/16501977-1120

Kaale, B. R., Krakenes, J., Albrektsen, G., & Wester, K. (2005a). Head position and impact direction in whiplash injuries: associations with MRI-verified lesions of ligaments and membranes in the upper cervical spine. Journal of Neurotrauma, 22(11), 1294-1302. https://doi.org/10.1089/neu.2005.22.1294

Kaale, B. R., Krakenes, J., Albrektsen, G., & Wester, K. (2005b). Whiplash-associated disorders impairment rating: neck disability index score according to severity of MRI findings of ligaments and membranes in the upper cervical spine. Journal of Neurotrauma, 22(4), 466-475. https://doi.org/10.1089/neu.2005.22.466

Kaale, B. R., Krakenes, J., Albrektsen, G., & Wester, K. (2007). Active range of motion as an indicator for ligament and membrane lesions in the upper cervical spine after a whiplash trauma. J Neurotrauma, 24(4), 713-721.

Karlsson, A., Dahlqvist Leinhard, O., ÅSlund, U., West, J., Romu, T., Smedby, Ö., Zsigmond, P., & Peolsson, A. (2016). An Investigation of Fat Infiltration of the Multifidus Muscle in Patients With Severe Neck Symptoms Associated With Chronic Whiplash-Associated Disorder. Journal of Orthopaedic & Sports Physical Therapy, 46(10), 886-893. https://doi.org/10.2519/jospt.2016.6553

Karlsson, A., Peolsson, A., Elliott, J., Romu, T., Ljunggren, H., Borga, M., & Dahlqvist Leinhard, O. (2019). The relation between local and distal muscle fat infiltration in chronic whiplash using magnetic

resonance imaging. PLoS ONE [Electronic Resource], 14(12), e0226037. https://doi.org/https://dx.doi.org/10.1371/journal.pone.0226037

Kelders, W. P., Kleinrensink, G. J., van der Geest, J. N., Schipper, I. B., Feenstra, L., De Zeeuw, C. I., & Frens, M. A. (2005). The cervico-ocular reflex is increased in whiplash injury patients. Journal of Neurotrauma, 22(1), 133-137. https://doi.org/10.1089/neu.2005.22.133

Kivioja, J., Sjalin, M., & Lindgren, U. (2004). Psychiatric morbidity in patients with chronic whiplash-associated disorder. Spine (Phila Pa 1976), 29(11), 1235-1239. https://doi.org/10.1097/00007632-200406010-00013

Knackstedt, H., Kråkenes, J., Bansevicius, D., & Russell, M. (2012). Magnetic resonance imaging of craniovertebral structures: clinical significance in cervicogenic headaches. Journal of Headache & Pain, 13(1), 39-44. https://doi.org/10.1007/s10194-011-0387-4

Kongsted, A., Jorgensen, L. V., Bendix, T., Korsholm, L., & Leboeuf-Yde, C. (2007). Are smooth pursuit eye movements altered in chronic whiplash-associated disorders? A cross-sectional study. Clin Rehabil, 21(11), 1038-1049.

Krakenes, J., Kaale, B. R., Nordli, H., Moen, G., Rorvik, J., & Gilhus, N. E. (2003). MR analysis of the transverse ligament in the late stage of whiplash injury. Acta Radiol, 44(6), 637-644. https://doi.org/10.1046/j.1600-0455.2003.00134.x

Kristjansson, E., & Jonsson, H., Jr. (2002). Is the sagittal configuration of the cervical spine changed in women with chronic whiplash syndrome? A comparative computer-assisted radiographic assessment. Journal of Manipulative & Physiological Therapeutics, 25(9), 550-555. https://doi.org/10.1067/mmt.2002.128371

Kumbhare, D. A., Balsor, B., Parkinson, W. L., Harding Bsckin, P., Bedard, M., Papaioannou, A., & Adachi, J. D. (2005). Measurement of cervical flexor endurance following whiplash. Disability & Rehabilitation, 27(14), 801-807. https://doi.org/10.1080/09638280400020615

Lee, Y. H., Lee, K. M., Auh, Q. S., & Hong, J. P. (2018). Magnetic resonance imaging-based prediction of the relationship between whiplash injury and temporomandibular disorders. Frontiers in Neurology, 8(JAN). https://doi.org/http://dx.doi.org/10.3389/fneur.2017.00725

Lemming, D., Graven-Nielsen, T., Sorensen, J., Arendt-Nielsen, L., & Gerdle, B. (2012). Widespread pain hypersensitivity and facilitated temporal summation of deep tissue pain in whiplash associated disorder: an explorative study of women. Journal of Rehabilitation Medicine, 44(8), 648-657. https://doi.org/https://dx.doi.org/10.2340/16501977-1006

Lenoir, D., Willaert, W., Ickmans, K., Bernaers, L., Nijs, J., Malfliet, A., Danneels, L., Leysen, L., De Pauw, R., Cagnie, B., Coppieters, I., & Meeus, M. (2022). Are Reports of Pain, Disability, Quality of Life, Psychological Factors, and Central Sensitization Related to Outcomes of Quantitative Sensory Testing in Patients Suffering from Chronic Whiplash Associated Disorders? Clinical Journal of Pain, 38(3), 159-172. https://doi.org/https://dx.doi.org/10.1097/AJP.0000000000001013

Lindgren, K. A., Kettunen, J. A., Paatelma, M., & Mikkonen, R. H. (2009). Dynamic kine magnetic resonance imaging in whiplash patients and in age- and sex-matched controls. Pain Res Manag, 14(6), 427-432.

Linnman, C., Appel, L., Fredrikson, M., Gordh, T., Soderlund, A., Langstrom, B., & Engler, H. (2011). Elevated [11C]-D-deprenyl uptake in chronic Whiplash Associated Disorder suggests persistent musculoskeletal inflammation. PLoS one, 6(4), e19182. https://doi.org/https://dx.doi.org/10.1371/journal.pone.0019182

Linnman, C., Appel, L., Soderlund, A., Frans, O., Engler, H., Furmark, T., Gordh, T., Langstrom, B., & Fredrikson, M. (2009). Chronic whiplash symptoms are related to altered regional cerebral blood

flow in the resting state. Eur J Pain, 13(1), 65-70. https://doi.org/https://dx.doi.org/10.1016/j.ejpain.2008.03.001

Madeleine, P., Nielsen, M., & Arendt-Nielsen, L. (2011). Characterization of postural control deficit in whiplash patients by means of linear and nonlinear analyses - A pilot study. J Electromyogr Kinesiol, 21(2), 291-297. https://doi.org/https://dx.doi.org/10.1016/j.jelekin.2010.05.006

Malik, A. A., Robinson, S., Khan, W. S., Dillon, B., & Lovell, M. E. (2017). Assessment of Range of Movement, Pain and Disability Following a Whiplash Injury. The open orthopaedics journal, 11, 541-545. https://doi.org/https://dx.doi.org/10.2174/1874325001711010541

Matsumoto, M., Ichihara, D., Okada, E., Chiba, K., Toyama, Y., Fujiwara, H., Momoshima, S., Nishiwaki, Y., & Takahata, T. (2012). Cross-sectional area of the posterior extensor muscles of the cervical spine in whiplash injury patients versus healthy volunteers--10 year follow-up MR study. Injury, 43(6), 912-916. https://doi.org/https://dx.doi.org/10.1016/j.injury.2012.01.017

Matsumoto, M., Okada, E., Ichihara, D., Chiba, K., Toyama, Y., Fujiwara, H., Momoshima, S., Nishiwaki, Y., Hashimoto, T., Inoue, T., Watanabe, M., & Takahata, T. (2010). Prospective ten-year follow-up study comparing patients with whiplash-associated disorders and asymptomatic subjects using magnetic resonance imaging. Spine, 35(18), 1684-1690. https://doi.org/https://dx.doi.org/10.1097/BRS.0b013e3181c9a8c7

Michele, S., Julia, T., Sandra, E., & Gwendolen, J. (2002). Pressure Pain Thresholds in Chronic Whiplash Associated Disorder: Further Evidence of Altered Central Pain Processing. Journal of Musculoskeletal Pain, 10:3, 69-81. https://doi.org/10.1300/J094v10n03_05

Moog M, Q. J., Hall T, Zusman M. (2002). The late whiplash syndrome: a psychophysical study. Euro J Pain 2002;6:283-294. Eur J Pain, 7(6), 561-562; author reply 563. https://doi.org/10.1016/S1090-3801(03)00034-X

Myran, R., Kvistad, K. A., Nygaard, O. P., Andresen, H., Folvik, M., & Zwart, J. A. (2008). Magnetic resonance imaging assessment of the alar ligaments in whiplash injuries: a case-control study. Spine, 33(18), 2012-2016. https://doi.org/https://dx.doi.org/10.1097/BRS.0b013e31817bb0bd

Myran, R., Zwart, J. A., Kvistad, K. A., Folvik, M., Lydersen, S., Ro, M., Woodhouse, A., & Nygaard, O. P. (2011). Clinical characteristics, pain, and disability in relation to alar ligament MRI findings. Spine, 36(13), E862-867.

https://doi.org/https://dx.doi.org/10.1097/BRS.0b013e3181ff1dde

Nederhand, M. J., MJ, I. J., Hermens, H. J., Baten, C. T., & Zilvold, G. (2000). Cervical muscle dysfunction in the chronic whiplash associated disorder grade II (WAD-II). Spine (Phila Pa 1976), 25(15), 1938-1943. https://doi.org/10.1097/00007632-200008010-00012

Ng, T. S., Pedler, A., Vicenzino, B., & Sterling, M. (2014). Less efficacious conditioned pain modulation and sensory hypersensitivity in chronic whiplash-associated disorders in Singapore. Clinical Journal of Pain, 30(5), 436-442. https://doi.org/https://dx.doi.org/10.1097/AJP.0b013e3182a03940

Ohberg, F., Grip, H., Wiklund, U., Sterner, Y., Karlsson, J. S., & Gerdle, B. (2003). Chronic whiplash associated disorders and neck movement measurements: an instantaneous helical axis approach. IEEE Trans Inf Technol Biomed, 7(4), 274-282. https://doi.org/10.1109/titb.2003.821328

Patijn, J., Wilmink, J., ter Linden, F. H., & Kingma, H. (2001). CT study of craniovertebral rotation in whiplash injury. Eur Spine J, 10(1), 38-43. https://doi.org/10.1007/s005860000212

Pearson, I., Reichert, A., De Serres, S. J., Dumas, J. P., & Cote, J. N. (2009). Maximal voluntary isometric neck strength deficits in adults with whiplash-associated disorders and association with pain and fear of movement. J Orthop Sports Phys Ther, 39(3), 179-187. https://doi.org/https://dx.doi.org/10.2519/jospt.2009.2950

Pedler, A., & Sterling, M. (2013). Patients with chronic whiplash can be subgrouped on the basis of symptoms of sensory hypersensitivity and posttraumatic stress. Pain, 154(9), 1640-1648. https://doi.org/10.1016/j.pain.2013.05.005

Peolsson, A., Ludvigsson, M., Wibault, J., Dedering, A., & Peterson, G. (2014). Function in patients with cervical radiculopathy or chronic whiplash-associated disorders compared with healthy volunteers. Journal of manipulative and physiological therapeutics, 37(4), 211-218.

Peolsson, A., Peterson, G., Trygg, J., & Nilsson, D. (2016). Multivariate analysis of ultrasound-recorded dorsal strain sequences: Investigation of dynamic neck extensions in women with chronic whiplash associated disorders. Scientific Reports, 6, 30415. https://doi.org/https://dx.doi.org/10.1038/srep30415

Peterson, G., Nilsson, D., Peterson, S., Dedering, A., Trygg, J., Wallman, T., & Peolsson, A. (2016). Changes in Dorsal Neck Muscle Function in Individuals with Chronic Whiplash-Associated Disorders: A Real-Time Ultrasound Case-Control Study. Ultrasound in medicine & biology, 42(5), 1090-1102. https://doi.org/https://dx.doi.org/10.1016/j.ultrasmedbio.2015.12.022

Prushansky, T., Dvir, Z., Pevzner, E., & Gordon, C. R. (2004). Electro-oculographic measures in patients with chronic whiplash and healthy subjects: a comparative study. J Neurol Neurosurg Psychiatry, 75(11), 1642-1644. https://doi.org/10.1136/jnnp.2003.031278

Radanov, B. P., Mannion, A. F., & Ballinari, P. (2011). Are symptoms of late whiplash specific? A comparison of SCL-90-R symptom profiles of patients with late whiplash and patients with chronic pain due to other types of trauma. J Rheumatol, 38(6), 1086-1094. https://doi.org/https://dx.doi.org/10.3899/jrheum.101112

Rahnama, L., Peterson, G., Kazemnejad, A., Trygg, J., & Peolsson, A. (2018). Alterations in the Mechanical Response of Deep Dorsal Neck Muscles in Individuals Experiencing Whiplash-Associated Disorders Compared to Healthy Controls: An Ultrasound Study. American Journal of Physical Medicine & Rehabilitation, 97(2), 75-82. https://doi.org/10.1097/PHM.0000000000000845

Richter, H. O., Roijezon, U., Bjorklund, M., & Djupsjobacka, M. (2010). Long-term adaptation to neck/shoulder pain and perceptual performance in a hand laterality motor imagery test. Perception, 39(1), 119-130. https://doi.org/10.1068/p6418

Roijezon, U., Bjorklund, M., & Djupsjobacka, M. (2011). The slow and fast components of postural sway in chronic neck pain. Manual Ther, 16(3), 273-278. https://doi.org/https://dx.doi.org/10.1016/j.math.2010.11.008

Sandlund, J., Djupsjobacka, M., Ryhed, B., Hamberg, J., & Bjorklund, M. (2006). Predictive and discriminative value of shoulder proprioception tests for patients with whiplash-associated disorders. Journal of Rehabilitation Medicine, 38(1), 44-49. https://doi.org/10.1080/16501970510042847

Sandlund, J., Roijezon, U., Bjorklund, M., & Djupsjobacka, M. (2008). Acuity of goal-directed arm movements to visible targets in chronic neck pain. J Rehabil Med, 40(5), 366-374. https://doi.org/https://dx.doi.org/10.2340/16501977-0175

Scott, D., Jull, G., & Sterling, M. (2005). Widespread sensory hypersensitivity is a feature of chronic whiplash-associated disorder but not chronic idiopathic neck pain. Clin J Pain, 21(2), 175-181. https://doi.org/10.1097/00002508-200503000-00009

See, K., & Treleaven, J. (2015). Identifying upper limb disability in patients with persistent whiplash. Manual therapy, 20(3), 487-493.

Sjolander, P., Michaelson, P., Jaric, S., & Djupsjobacka, M. (2008). Sensorimotor disturbances in chronic neck pain--range of motion, peak velocity, smoothness of movement, and repositioning acuity. Manual Ther, 13(2), 122-131.

Stenneberg, M. S., Scholten-Peeters, G. G. M., den Uil, C. S., Wildeman, M. E., van Trijffel, E., & de Bie, R. A. (2022). Clinical characteristics differ between patients with non-traumatic neck pain, patients with whiplash-associated disorders, and pain-free individuals. Physiother Theory Pract, 38(13), 2592-2602. https://doi.org/10.1080/09593985.2021.1962464

Sterling, M., Hodkinson, E., Pettiford, C., Souvlis, T., & Curatolo, M. (2008). Psychologic factors are related to some sensory pain thresholds but not nociceptic flexion reflex threshold in chronic whiplash. Clinical Journal of Pain, 24(2), 124-130. https://doi.org/10.1097/ajp.0b013e31815ca293

Sterling, M., Jull, G., Vicenzino, B., & Kenardy, J. (2003). Sensory hypersensitivity occurs soon after whiplash injury and is associated with poor recovery. Pain, 104(3), 509-517. https://doi.org/10.1016/S0304-3959(03)00078-2

Sterling, M., Treleaven, J., & Jull, G. (2002). Responses to a clinical test of mechanical provocation of nerve tissue in whiplash associated disorder. Man Ther, 7(2), 89-94. https://doi.org/10.1054/math.2002.0443

Stokell, R., Yu, A., Williams, K., & Treleaven, J. (2011). Dynamic and functional balance tasks in subjects with persistent whiplash: A pilot trial. Manual therapy, 16(4), 394-398.

Sturzenegger, M., Radanov, B. P., Winter, P., Simko, M., Farra, A. D., & Di Stefano, G. (2008). MRI-based brain volumetry in chronic whiplash patients: no evidence for traumatic brain injury. Acta Neurol Scand, 117(1), 49-54.

Sullivan, M. J., Hall, E., Bartolacci, R., Sullivan, M. E., & Adams, H. (2002). Perceived cognitive deficits, emotional distress and disability following whiplash injury. Pain Research & Management, 7(3), 120-126. https://doi.org/10.1155/2002/502984

Sundstrom, T., Guez, M., Hildingsson, C., Toolanen, G., Nyberg, L., & Riklund, K. (2006). Altered cerebral blood flow in chronic neck pain patients but not in whiplash patients: a 99mTc-HMPAO rCBF study. Eur Spine J, 15(8), 1189-1195. https://doi.org/10.1007/s00586-005-0040-5

Tjell, C., Tenenbaum, A., & Sandström, S. (2002). Smooth pursuit neck torsion test -- a specific test for whiplash associated disorders? Journal of Whiplash & Related Disorders, 1(2), 9-24. https://doi.org/10.1300/j180v01n02_02

Treleaven, J., & Takasaki, H. (2015). High variability of the subjective visual vertical test of vertical perception, in some people with neck pain - Should this be a standard measure of cervical proprioception? Manual therapy, 20(1), 183-188. https://doi.org/https://dx.doi.org/10.1016/j.math.2014.08.005

Treleaven, J., Jull, G., & Grip, H. (2011). Head eye co-ordination and gaze stability in subjects with persistent whiplash associated disorders. Manual Ther, 16(3), 252-257. https://doi.org/https://dx.doi.org/10.1016/j.math.2010.11.002

Treleaven, J., Jull, G., & LowChoy, N. (2005a). Smooth pursuit neck torsion test in whiplash-associated disorders: relationship to self-reports of neck pain and disability, dizziness and anxiety. Journal of Rehabilitation Medicine, 37(4), 219-223. https://doi.org/10.1080/16501970410024299

Treleaven, J., Jull, G., & Lowchoy, N. (2005b). Standing balance in persistent whiplash: a comparison between subjects with and without dizziness. Journal of Rehabilitation Medicine, 37(4), 224-229. https://doi.org/10.1080/16501970510027989

Treleaven, J., Jull, G., & Sterling, M. (2003). Dizziness and unsteadiness following whiplash injury: characteristic features and relationship with cervical joint position error. Journal of Rehabilitation Medicine, 35(1), 36-43. https://doi.org/10.1080/16501970306109

Treleaven, J., LowChoy, N., Darnell, R., Panizza, B., Brown-Rothwell, D., & Jull, G. (2008). Comparison of sensorimotor disturbance between subjects with persistent whiplash-associated disorder and subjects with vestibular pathology associated with acoustic neuroma. Arch Phys Med Rehabil, 89(3), 522-530. https://doi.org/https://dx.doi.org/10.1016/j.apmr.2007.11.002

Uremovic, M., Cvijetic, S., Pasic, M. B., Seric, V., Vidrih, B., & Demarin, V. (2007). Impairment of proprioception after whiplash injury. Coll Antropol, 31(3), 823-827.

Valera-Calero, J. A., Al-Buqain-Ortega, A., Arias-Buria, J. L., Fernandez-de-Las-Penas, C., Varol, U., & Ortega-Santiago, R. (2021). Echo-intensity, fatty infiltration, and morphology ultrasound imaging assessment in healthy and whiplash associated disorders populations: an observational study. Eur Spine J, 30(10), 3059-3067. https://doi.org/https://dx.doi.org/10.1007/s00586-021-06915-z

Van Looveren, E., Cagnie, B., Coppieters, I., Meeus, M., & De Pauw, R. (2021). Changes in Muscle Morphology in Female Chronic Neck Pain Patients Using Magnetic Resonance Imaging. Spine, 46(10), 638-648. https://doi.org/http://dx.doi.org/10.1097/BRS.0000000000003856

Vangronsveld, K., Van Damme, S., Peters, M., Vlaeyen, J., Goossens, M., & Crombez, G. (2007). An experimental investigation on attentional interference by threatening fixations of the neck in patients with chronic whiplash syndrome. Pain, 127(1-2), 121-128. H

Vikne, H., Bakke, E. S., Liestol, K., Engen, S. R., & Vollestad, N. (2013). Muscle activity and head kinematics in unconstrained movements in subjects with chronic neck pain; cervical motor dysfunction or low exertion motor output? BMC Musculoskeletal Disorders, 14, 314. https://doi.org/https://dx.doi.org/10.1186/1471-2474-14-314

Voerman, G. E., Vollenbroek-Hutten, M. M., & Hermens, H. J. (2007). Upper trapezius muscle activation patterns in neck-shoulder pain patients and healthy controls. Eur J Appl Physiol, 102(1), 1-9.

Wallin, M. K., & Raak, R. I. (2008). Quality of life in subgroups of individuals with whiplash-associated disorders. Eur J Pain, 12(7), 842-849. https://doi.org/https://dx.doi.org/10.1016/j.ejpain.2007.12.008

Wallin, M., Liedberg, G., Borsbo, B., & Gerdle, B. (2012). Thermal detection and pain thresholds but not pressure pain thresholds are correlated with psychological factors in women with chronic whiplash-associated pain. Clinical Journal of Pain, 28(3), 211-221. https://doi.org/https://dx.doi.org/10.1097/AJP.0b013e318226c3fd

Watson, D. H., & Drummond, P. D. (2016). The Role of the Trigemino Cervical Complex in Chronic Whiplash Associated Headache: A Cross Sectional Study. Headache, 56(6), 961-975. https://doi.org/http://dx.doi.org/10.1111/head.12805

Woodhouse, A., & Vasseljen, O. (2008). Altered motor control patterns in whiplash and chronic neck pain. BMC Musculoskeletal Disorders, 9. https://doi.org/10.1186/1471-2474-9-90

Woodhouse, A., Liljeback, P., & Vasseljen, O. (2010). REDUCED HEAD STEADINESS IN WHIPLASH COMPARED WITH NON-TRAUMATIC NECK PAIN. Journal of Rehabilitation Medicine, 42(1), 35-41. https://doi.org/10.2340/16501977-0484

Woodhouse, A., Stavdahl, O., & Vasseljen, O. (2010). Irregular head movement patterns in whiplash patients during a trajectory task. Experimental Brain Research, 201(2), 261-270. https://doi.org/10.1007/s00221-009-2033-9

Yu, L. J., Stokell, R., & Treleaven, J. (2011). The effect of neck torsion on postural stability in subjects with persistent whiplash. Manual Ther, 16(4), 339-343. https://doi.org/https://dx.doi.org/10.1016/j.math.2010.12.006

18. Recommendations for research: Chronic whiplash

- Limited prospective longitudinal cohort studies have been conducted to evaluate factors assessed in chronic whiplash and their association with long-term prognosis. Prognostic risk-assessment tools that have demonstrated validity for stratifying people with acute WAD should be investigated in chronic WAD populations to assess their validity.
- Interventional clinical trials in chronic WAD populations should evaluate critical outcomes for whiplash, including, neck pain, neck disability, psychological functioning, and perceived recovery. When designing trials, comparison to usual care in an Australian context should be considered.
- Further research into identifying people's access and acceptance of recommended care pathways in chronic WAD across different cultural groups and settings (e.g., regional, remote) in an Australian context, including Aboriginal and Torres Strait Islander and Culturally and Linguistically Diverse peoples is required.
- There is a very strong research base for similar conditions, particularly chronic low back pain. Findings from that area of research could be tested in chronic WAD.
- An approximate date for future update to these guidelines is in 2028. The resources required are substantial and consideration should be given to the potential sources of funding.

19. List of tables

20. List of figures

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