

Electronic Annex 2d

Comparison of the WHIM, CRS-R and SMART tools

Table 1 Comparison of the WHIM, CSR-R and SMART tools

Features	WHIM Wessex Head Injury Matrix	CRS JFK Coma Recovery Scale – Revised	SMART profile Sensory Modality Assessment and Rehabilitation Technique Version 3
Overview of cost, validity, content and features according to recommendations for neurobehavioural assessments			
Type of tool and unique features	Hierarchical observational assessment tool of 62 behavioural items ranging from coma to emergence from PTA. Evaluation of responses to both: > naturally occurring stimuli and > stimuli presented by assessor.	Clinical assessment of PDOC across six modalities providing total and subscores.	Comprehensive clinical assessment providing complete profile of PDOC clients including family and team perspectives. Investigative element supports detailed evaluation of specific observed responses based on clinical reasoning. Supports development of a bespoke intervention and/or management plan.
What will the assessment tell you?	Overview of number, type of behaviours observed and the highest-level behaviour seen. Published analysis has categorised behaviours into those compatible with VS, MCS-, MCS+. ¹ Trajectory over repeated assessments.	Sensory, motor, communication and arousal scores. Indicative diagnosis either VS and MCS. ² Now categorisable into MCS- and MCS+. Trajectory over repeated assessments. ^{3,4}	Behaviours at rest, type and frequency of responses per modality. Indicative diagnosis (VS, MCS-, MCS+), for both motor and functional communication. Trajectory over sessions and repeated assessment, impact of prerequisites to diagnosis. Clinical intervention and management plan. Detailed report provided.
Recommended number/timing of assessments	RCP guidelines recommend at least 10 WHIMs as part of formal PDOC assessment.	RCP guidelines recommend at least 10 CRS-Rs as part of formal PDOC assessment.	Detailed SMART evaluation requires 10 assessments recorded over 2–3 weeks. Thereafter, specific intervention based on clinical reasoning.

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	<p>Recommended for ongoing monitoring in the post-acute care setting.</p> <p>This is not onerous as the observations can be recorded as part of the therapy session or while delivering care.</p>	<p>(US originators recommend a minimum of six assessments for indicative diagnosis).</p> <p>Thereafter as required in context of review assessment.</p>	
<p>Family/friends/team involvement in process</p> <p>Eg interviewed face to face, by phone, observed responses jointly reviewed with assessor, compared directly to assessment findings.</p>	<p>Can be recorded by family (ideally on separate WHIM recording sheets.</p> <p>Although not formally validated, can be recorded by interview of family/carers to ascertain which behaviours they have noticed.</p>	<p>None required.</p> <p>But phone CRS-R now available for recording through interview with family and carers.⁵</p>	<p>Yes – integral part of assessment.</p> <p>Family/friends/team are met and interviewed and any relevant responses observed jointly with assessor to verify.</p> <p>Report actively reviews any similarities or differences between findings versus formal assessment and defines future intervention.</p>
<p>Key content and unique feature of techniques</p>	<p>Use of personally meaningful stimuli which some patients are more likely to respond to.</p> <p>Tool was developed on the basis of <i>in vivo</i> observations of patients emerging from acute DOC as opposed to deciding in advance what it was thought would be significant and testing for this.</p>	<p>Addresses auditory, visual, motor oromotor/verbal function, communication and arousal.</p> <p>Now widely used and recommended as an international common language by for PDOC evaluation by the International Brain Injury Association DOC Special Interest Group.⁶</p>	<p>Techniques addressing visual, auditory tactile, olfactory and gustatory responses.</p> <p>Core, advanced, functional exploration and emergence techniques.</p> <p>Explores cause and effect, use of auditory feedback switch, utilises a range of visual auditory and tactile cues and techniques to accommodate any sensory deficits such as hearing or vision and not disadvantage individuals.</p>

Features	WHIM Wessex Head Injury Matrix	CRS JFK Coma Recovery Scale – Revised	SMART profile Sensory Modality Assessment and Rehabilitation Technique Version 3
			Recording of more than 60 possible types of behaviours.
Operational aspects			
Assessor experience	Can only be purchased by qualified healthcare professional.	No requirement for professional qualification.	Clear prerequisites for experience and skills meeting RCP guidelines before attendance on course permitted.
Assessor training required	Not mandatory, but recommended. Regular 1-day training courses are available in the UK.	Not mandatory, but recommended. Free training CD provided by originators. Regular 1-day training courses are available in the UK. ^a	Yes – mandatory. A range of training options is available from the originators. SMART training offers wider competencies for understanding and assessing PDOC and is one way of guaranteeing that clinicians meet the RCP requirements for specialist PDOC assessors.
Cost of manual	Manual £59 inc. VAT. Scoring sheets (15 assessments each) pack of 25 @£55.80 inc. VAT (ie £2.23 for 15 assessments).	Free download.	Free download manual, forms and stimuli cards. £40 cost for auditory feedback switch.
Cost of training	Optional. 1-day course available. ^a	Optional. One-day course available. ^a	Mandatory. Course cost dependent upon mode of delivery, see RHN website (from £100–£750). Free mentorship.

^a For example, the PDOC training course at Northwick Park Hospital includes tuition for the WHIM and the CRS-R in one day (£125)

Prolonged disorders of consciousness

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			Some free places available for national PDOC units on each course.

Time per assessment	Per session as clinically required – usually 20–30 minutes.	30–40 minutes.	30–40 minutes.
Tool validity⁸	Moderate reservations.	Minimal reservations.	Moderate reservations regarding lack of Rasch analysis.
Tool changes since Seel <i>et al</i> 2010⁸ recommendations	Some items known to be out of order. Research ongoing to investigate the hierarchy.	Validation in different languages – French, Italian, Spanish, Russian.	Rasch analysis completed (2016). ⁷ Version 3 (2018) meeting Seel <i>et al</i> (2010) criteria. ⁸

DOC = disorders of consciousness; MCS = minimally conscious state; PDOC = prolonged disorders of consciousness; PTA = post-traumatic amnesia; RHN = Royal Hospital for Neuro-disability; VS = vegetative state

Table 2 Summary of tool content: Sensory components included within the assessments

Technique / responses observed	WHIM	CRS-R	SMART
Pupil response	No	Yes	Yes
Eye movement	Yes	Yes	Yes
Motor behaviours recorded, ie leg flexion	No	1 min Not recorded	Yes listed 10 min x 10
Arousal protocol	No	Yes	Yes
Visual responses			
Pupil response to light	No	Yes	Yes
Blink to light	No	No	Yes
Visual response to threat	No	Yes Centre field	Yes Centre field and each quadrant
Visual focusing auditory instruction	Yes?	Yes	Yes
Visual tracking auditory instruction	Yes	Mirror Bright object	Yes Toothbrush Photograph Mirror (T)
Tracks assessor	Yes	No	Yes
Visual focusing written instruction	No	No	Yes
Visual tracking written instruction	No	No	Yes
Follows written instruction	No	No	Yes 3-6
AF switch press written instruction	No	No	Yes
Yes /No switch written instruction	No	No	Yes
Visual discrimination: Verbal instruction	Yes Object, picture Yes/No cards (all not mandatory)	Yes Object	Yes/No Cards Colour Cards
Location of stimuli in visual field: L-Left, R-Right, U-Up, D-Down		L, R	L, R, U, D
Visual discrimination: Written instruction	No	No	Yes/No Cards Colour Cards

Technique / responses observed	WHIM	CRS-R	SMART
Location			L, R, U, D
Eye contact	Yes	No	Yes
Explores picture	Yes	No	No
Auditory responses			
No response (N), reflexive (R), withdrawal (W), localising (L)			
Response to loud sound and voice	L	N, R, L	N, R, W, L
Ignores distraction	Yes	No	No
Following verbal instruction	Yes	Yes 2 commands given	Yes 3–6 commands given
Presses single auditory feedback switch to instruction	No	No	Yes
Yes/no responses with single auditory feedback switch	No	No	Yes
Touch / point to object	Yes	Yes Object	In SMART treatment manual following assessment
Tactile responses			
No response (N), reflexive (R), withdrawal (W), localising (L)			
Response to light stimuli Face / upper limbs	No	No	Yes N, R, W, L
Tap on shoulder	No	No	Yes R, W, L
Differentiate two tactile stimuli	No	No	Yes
Olfactory responses			
No response (N), reflexive (R), withdrawal (W), localising (L)			
Response to olfactory stimuli	No	No	N, R, W, L
Differentiate two olfactory stimuli	No	No	Yes
Gustatory responses			
No response (N), reflexive (R), withdrawal (W), localising (L)			
Response to gustatory stimuli	R	No	N, R, W, L
Differentiate two gustatory stimuli	No	No	Yes

Technique / responses observed	WHIM	CRS-R	SMART
Functional communication			
Vocalisation/gesture spontaneous	No	Yes	Yes
Vocalisation/gesture to stimuli	Yes	Yes	Yes
Non meaningful words / facial expression, rambling speech	Yes	No	Yes
Purposeful facial expression / mouthing words/sounds/, whispers	Yes	Yes	Yes
Discriminates, but no 'yes/no' response ie gesture	Yes	Yes	Yes
Yes and no	Yes	Yes	Yes
Answers biographical question	No	No	Yes
Answers situational questions	Yes	Yes (visual and or auditory set) 2–6	In SMART treatment manual following assessment
Answers orientation question	Yes	No	No
Higher-level function	Words to express mood, time of day, orientation, recall of items, previous session, name staff member, left/right of self	Words to instruction Verbalisation, alphabet board, writing	Words to instruction Letter scanning Switch Verbalisation, alphabet board, writing
Motor			
No response, reflexive, withdrawal, localising	Yes	Yes	Yes
Discriminating	Yes Playing cards	Yes	Yes
Functional activity	Pen	Comb, pen or any choice	Comb, pen Treatment phase: any choice

Technique / responses observed	WHIM	CRS-R	SMART
Pointing – motor	Yes Coins	No	Treatment
Wakefulness/arousal			
Eye opening	Yes (>30 sec)	Yes	Yes
Length of time eyes open per session	Yes (< 30 sec; >30 sec)	No	Yes
Wakefulness per modality	No	No	Yes
Prompts required to remain awake	No	Yes	Yes

CRS-R = JFK Coma Recovery Scale – Revised; SMART = Sensory Modality Assessment and Rehabilitation Technique; WHIM = Wessex Head Injury Matrix

References

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