

## Coma Recovery Scale – Revised (CRS-R) Frequently Asked Questions

1. What is the CRS-R and how does it differ from routine bedside examination?

The CRS-R (Giacino, 2004) is a *standardized* neurobehavioral assessment measure designed for use in patients with disorders of consciousness (DoC). It consists of six subscales comprised of hierarchically-arranged items reflecting brainstem, subcortical and cortically-mediated behaviors (LaPorta 2013; Gerrard 2014). The lowest item on each subscale represents reflexive activity while the highest item represents cognitively-mediated behavior. The scale is intended to be used to establish diagnosis (Giacino 2004; Schnakers 2006; Vanhaudenhuyse 2008a, Vanhaudenhuyse 2008b; Schnakers 2009), monitor behavioral recovery (Wannez 2018; Giacino 2019; Martens 2019), predict outcome (Giacino 1997; Hamilton 2018; Portaccio 2018a; Portaccio 2018b, Lucca 2019; Giacino, 2019), and assess treatment effectiveness (Schiff, 2007; Schnakers 2008; Giacino, 2012). The CRS-R has high sensitivity for detection of signs of consciousness (Seel 2010), as it includes the criteria defined in 2002 for minimally conscious state (MCS) and emergence from MCS (eMCS, Giacino 2002).

2. What is the item composition of the CRS-R?

The CRS-R consists of 6 subscales designed to assess auditory function, receptive and expressive language, visuoperception, communication ability, motor functions, and arousal level, and yields a total score ranging from 0-23.

3. What is the target population for CRS-R assessment?

The CRS-R is intended for use in patients with traumatic and non-traumatic DOC who are not communicating reliably and are functioning between Ranchos Los Amigos Levels of Cognitive Function I-IV. The scale was normed on subjects between the ages of 17 to 79. The pediatric version of the CRS-R, the Coma Recovery Scale for Pediatrics (CRS-P) should be used when assessing children between the ages of one and five who have not yet completed language and motor development (Slomine 2019).

4. Is the CRS-R valid and reliable?

The CRS-R is well-represented in the scientific literature and its psychometric properties have been extensively studied. There is strong evidence supporting internal construct validity, inter-rater and test-retest reliability (Seel 2010). The CRS-R satisfies all the criteria required for interval measurement (ie, unidimensionality, local independence, item invariance, absence of differential item function across diagnostic groups) [La Porta 2013; Gerrard 2014]). Prior investigations have shown that the hierarchical structure of the six subscales remains stable across different settings and raters with variable levels of experience. In addition, scores remain invariant regardless of length of time post-injury, setting, age, or sex of the patients. Taken together, these findings indicate that the CRS-R is appropriate for use at the level of the individual patient.

The diagnostic utility of the CRS-R is also supported by functional and structural neuroimaging and electrophysiological studies (Coleman, 2007; Newcomb, 2010; Rosanova 2012, Casali 2013; Stender 2014; Casarotto 2016; Di Perri 2016; Comolatti 2019; Tan 2019).

In view of its psychometric properties, the American Congress of Rehabilitation Medicine ranked the CRS-R as the top-rated neurobehavioral rating scale for clinical assessment of patients with DoC (Seel 2010). The National Institute for Neurological Disorders and Stroke selected the CRS-R as a “common data element” (CDE) for TBI research involving patients with DoC (Wilde 2010). The scale has also been adopted by the Department of Defense and the U.S. Department of Veterans Affairs for use in TBI research.

5. Are there contraindications for use of the CRS-R?

The examiner should communicate with medical or nursing staff to identify any contraindications or precautionary measures that should be taken before initiating CRS-R assessment. Central complications (e.g., elevated ICP), peripheral injuries (e.g., fractures, decubiti) and implanted lines and devices may necessitate modification or discontinuation of specific items or deferring the entire examination. When one or more items cannot be administered, the corresponding subscale and total scores cannot be obtained. These items should be left blank (not scored “0”) and a Test Completion Code entered indicating the reason for the missing score (see also #14 below).

6. Is special training required to be certified to administer the CRS-R?

There is no required training or certification; however, it is essential that examiners adhere to the administration and scoring guidelines described in the CRS-R Guidelines for Administration and Scoring. Preliminary evidence suggests that raters’ level of experience with the use of CRS-R influences both inter-rater and test-retest reliability. (Lovstad 2010). A recommended training program is available at the [Rehabilitation Measure Database: https://www.sralab.org/rehabilitation-measures/coma-recovery-scale-revised](https://www.sralab.org/rehabilitation-measures/coma-recovery-scale-revised) and the [Spaulding Neurorehabilitation Lab Website: https://srhneurorehabilitationlab.org/resources/](https://srhneurorehabilitationlab.org/resources/).

7. How often should the CRS-R be administered? How much time should elapse between each administration?

- a. There are no specific guidelines governing the frequency of CRS-R administration. Best practice suggests that up to five assessments may be required to capture the optimal level of function (Cortese 2015; Wannez 2017).
- b. The frequency of assessment is also dependent upon the rate of change in performance on the CRS-R, which is usually associated with the length of time post-injury. Rate of change tends to be more rapid during the acute stage of recovery (i.e., first 28 days post-injury), suggesting the need for more frequent assessment (e.g., daily) than during the post-acute period (e.g., 1-2 times a week). The interval between assessments will depend on the clinical needs of the patient (e.g. if the patient has

fluctuating arousal, administration should be more frequent to observe these fluctuations in the CRS-R total score, but, if a patient fatigues easily, more time between administrations may be necessary).

8. When should the CRS-R be discontinued?

We recommend discontinuing use of the CRS-R when all three of the following behaviors have been elicited, concurrently, on three consecutive examinations conducted over two weeks:

- Consistent movement to command (Auditory Subscale = 4)
- Reliable yes-no responses (Communication Subscale = 2)
- Focused attention (Arousal Subscale = 3)

9. How long does it take to administer the CRS-R?

The CRS-R typically takes 15 to 30 minutes to administer, depending on the patient's level of consciousness and factors that may complicate administration of examination procedures (e.g., severe contractures, immobilization devices).

10. How is the CRS-R scored?

Scoring is standardized based on the presence or absence of operationally-defined behavioral criteria. Most items must be administered to obtain a score, although some behaviors (e.g., speech) can be scored when they occur spontaneously.

11. Should CRS-R items be scored when there is uncertainty as to whether the observed behavior meets the required response criteria?

Behavioral responses must be clearly-discernible before they are scored present. That is, all elements of the response criteria must be clearly observed. If there is doubt as to whether the behavior meets the required criteria, the item should not be scored as being present and the next item down should be administered. A rule-of-thumb for determining level of certainty is whether the examiner believes that at least nine out of ten observers would agree the response criteria were met.

12. Can the CRS-R be used to establish a diagnosis?

Yes. The clinical diagnosis of VS, MCS and eMCS can be derived directly from the CRS-R subscale scores (Giacino 2004). The CRS-R profile can also be used to differentiate patients into "MCS plus" and "MCS minus" subgroups, based on the presence or absence of receptive or expressive language function (Bruno, 2012; Thibaut, 2020).

13. What is the purpose of the CRS-R total score?

The primary purpose of the CRS-R total score is to monitor course of recovery. While the CRS-R total score should not be relied upon to establish a diagnosis, a total score of 10 or greater indicates a diagnosis of MCS or eMCS (Bodien 2016).

14. Can the CRS-R be used to establish a prognosis?

The rate of change in the CRS-R total score and CRS-R diagnosis may assist with prediction of subsequent functional outcome (Faugeras 2018; Giacino 1991; Giacino 1997; Giacino 2004; Portaccio 2018a; Portaccio 2018b; Lucca 2019; Giacino 2019).

15. Is it permissible to deviate from the standard protocol for administration and scoring?

- a. The CRS-R should be administered and scored as described in the manual. However, certain items or subscales may have to be omitted due to patient-specific factors (e.g., premorbid blindness, quadriplegia, eyes swollen shut). If one or more subscales are omitted, the total score cannot be obtained.
- b. When CRS-R items cannot be administered or scored in a valid manner, a Test Completion Code should be used to indicate that the examination is confounded.
- c. Some combinations of subscale scores are clinically improbable or occur with extremely low frequency. Such combinations may indicate an error in administration and scoring or signal the presence of an underlying impairment that should be investigated further (Chatelle 2016).

16. In which languages is the CRS-R available?

The CRS-R has been translated and re-validated in Spanish (Tamashiro 2014), Italian (Sacco 2011, Estraneo 2015), French (Schnakers 2008b), Portuguese (Simoes 2011), Norwegian (Lovstad et al., 2010), Russian (Iazeva 2018), German (Maurer-Karattup 2010), Polish (Binder 2018), Korean (Han 2018), and Chinese (Zhang 2019). The CRS-R is also available in Dutch, Swedish, Danish, and Greek, but has not been re-validated in these languages.

17. What are the limitations of the CRS-R and how can they be reconciled?

Because the CRS-R is a standardized measure, it may not be able to address questions that require a “personalized” approach to assessment. For example, it may be unclear why a patient who has reproducible command-following (i.e., Auditory 3) fails to respond to any visual stimuli (i.e., Visual 0). Under these circumstances, “Individualized Quantitative Behavioral Assessment (IQBA)” (Whyte 1999) should be considered. IQBA relies on single-subject quantitative experimental design procedures to address case-specific questions (e.g., Is there evidence of command-following or visual function?). IQBA findings can be used to further inform findings from the CRS-R.

The clinical utility of the CRS-R diminishes when patients emerge from MCS. At this stage of recovery, CRS-R performance tends to be near or at ceiling and measures designed for patients at a higher level of function should be employed. The Confusion Assessment Protocol (CAP) (Sherer 2005; Bodien 2020) is a combination of objective measures of cognition, orientation, and clinical symptoms designed for patients who can respond to commands and answer questions but cannot yet tolerate formal neuropsychological assessment. The CAP provides clinicians and researchers with a systematic method of monitoring recovery from the confusional state.

Under conditions of ongoing diagnostic uncertainty, neuroimaging and neurophysiological approaches may be used to complement neurobehavioral assessment procedures (Rodriguez-Moreno 2010; Edlow 2017; Giacino 2018)

18. Where can I find more information on the CRS-R?

a. [Rehabilitation Measure Database:](#)

<https://www.sralab.org/rehabilitation-measures/coma-recovery-scale-revised>

b. [Traumatic Brain Injury Common Data Elements](#)

<https://www.commondataelements.ninds.nih.gov/Traumatic%20Brain%20Injury>

c. [The Center for Outcome Measurement in brain Injury \(COMBI\)](#)

<https://www.tbims.org/combi/crs/>

d. [Spaulding Neurorehabilitation Lab Website](#)

<https://srhneurorehabilitationlab.org/resources/>

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