Assessing the Severity of Traumatic Brain Injury (TBI):
Glasgow Coma Scale (GCS), the FOUR Score, and the CBI-M Framework

How do neurologists, neurosurgeons, and other clinicians assess how severe a traumatic brain injury (TBI) is? There are currently three major approaches, the last of which has only been advanced recently (2025).

Glasgow Coma Scale (GCS)

- The GCS was first published in the mid-1970s through the research of several neurosurgeons (Bryan Jennett and Graham Teasdale) at the University of Glasgow (Scotland) Medical School.
- Based on motor responsiveness, verbal performance, and eye opening to appropriate stimuli, the Glascow Coma Scale was designed and should be used to assess the depth and duration coma and impaired consciousness. This scale helps to gauge the impact of a wide variety of conditions such as acute brain damage due to traumatic and/or vascular injuries or infections, metabolic disorders (e.g., hepatic or renal failure, hypoglycemia, diabetic ketosis), etc.
- Education is necessary to the proper application of this scale.

The components of the GCS involve

Eye Opening Response

- Spontaneous--open with blinking at baseline **4 points**
- To verbal stimuli, command, speech **3 points**
- To pain only (not applied to face) **2 points**
- No response **1 point**

Verbal Response

- Oriented **5 points**
- Confused conversation, but able to answer questions **4 points**
- Inappropriate words **3 points**
- Incomprehensible speech **2 points**
- No response **1 point**

Motor Response

- Obeys commands for movement 6 points
- Purposeful movement to painful stimulus 5 points
- Withdraws in response to pain 4 points
- Flexion in response to pain (decorticate posturing) 3 points
- Extension response in response to pain (decerebrate posturing) 2 points
- No response 1 point

Categorization:

Coma: No eye opening, no ability to follow commands, no word verbalizations (3-8)

Head Injury Classification:

Severe Head Injury--- GCS score of 8 or less
Moderate Head Injury----GCS score of 9 to 12
Mild Head Injury --- GCS score of 13 to 15
(Adapted from: Advanced Trauma Life Support: Course for Physicians, American College of Surgeons, 1993).

The Full Outline of UnResponsiveness (FOUR) Score

- "The Full Outline of UnResponsiveness (FOUR) Score is a 16-point clinical scale used to assess patients with severely impaired consciousness, providing a more detailed assessment of neurological function than the Glasgow Coma Scale. It evaluates four components—**Eye response, Motor response, Brainstem reflexes, and Respiration pattern**—each graded from 0 to 4 points, with a lower total score indicating a worse neurological condition. The FOUR score offers a comprehensive assessment, including information on brainstem reflexes and breathing patterns, making it useful for patients who are intubated or have specific neurological impairments. Conclusions: The FOUR score has been shown to be a useful outcome predictor in many patients with depressed level of consciousness. It displays good inter-rater reliability among physicians and nurses." (Google AI; emphasis added)

- Almojuela, Hasen, & Zeiler (2019) describe the FOUR as "a neurological assessment score. Its theoretical benefit over preexisting scores is its evaluation of brainstem reflexes and respiratory pattern which may allow better assessment of patients with severe neurologic impairment" (Abstract).

- The FOUR Score scale was originally developed in the early 20002 by Eelco F. Wijdicks and his colleagues in the Critical Care Neurology Division of the Mayo Clinic College of Medicine in Rochester, MN (Wijdicks et al., 2005).

- A comprehensive review of the literature by Schey et al. (2024) found that the FOUR score was equal to or superior to the GCS in the intensive care setting. "Both coma scales showed similar accuracy in predicting "unfavorable" functional outcome. The FOUR score appeared to be more responsive than the GCS in the ICU, as most patients with a GCS score of 3 obtained FOUR scores between 1 and 8 due to preserved brainstem function. The FOUR score may be superior to the GCS for predicting mortality in ICU settings."

The following page contains a comparison of the GCS and the FOUR score.

Glasgow Coma Scale

Eye Opening

4. spontaneous
3. to speech
2. to pain
1. none

Best Motor Response

6. obeying commands
5. localizing to pain
4. withdrawal from pain
3. abnormal flexion response to pain
2. extension response to pain
1. none

Verbal Response

5. oriented
4. confused
3. inappropriate words
2. incomprehensible speech
1. none

Full Outline of UnResponsiveness Scale (FOUR)

Eye Response

4. eyelids open or opened, tracking, and blinking to command
3. eyelids open but not tracking
2. eyelids closed, but open to loud voice
1. eyelids closed, but open to pain
0. eyelids remain closed with pain

Motor Response

4. thumbs up, fist, or peace sign
3. localization to pain
2. flexion response to pain
1. extension response to pain
0. no response to pain or generalized myoclonus status

Brainstem Reflexes

4. pupil & corneal reflexes present
3. one pupil wide & fixed
2. pupil or corneal reflexes absent
1. pupil & corneal reflexes absent
0. absent pupil, corneal, & cough reflex

Respiration

4. not intubated, regular breathing pattern
3. not intubated, Cheyne-Stokes breathing pattern
2. not intubated, irregular breathing
1. breathes above ventilator rate
0. breathes at ventilator rate or apnea

The CBI-M Framework (clinical, biomarker, imaging, modifier)

- In 2022, the National Academies of Science, Engineering, and Medicine (NASEM) proposed that a new and more comprehensive framework needed to be put in place to evaluate and classify TBI patients than currently provided by the GCS or FOUR score. The current classification of TBI as "mild, moderate, or severe" promotes bias that can limit care, says the report. For example, someone with a "mild" TBI might have persistent symptoms, yet their treatment is withdrawn too soon. Conversely, with the right supports, someone with a "severe" injury can have a more favorable outcome than generally expected.

- Their proposal led to the recent initial release of the CBI-M Framework as reported in Manley et al. (2025). Note that Manley was one of 94 medical researchers/clinicians from 14 countries who participated in arriving at this framework.

- As summarized by the Brain Injury Association of America (2025), the four pillars of this framework involve

  "**Clinical**: The clinical pillar retains the GCS score – which evaluates a person's level of consciousness along with pupil reactivity – as a central element of the assessment. The framework recommends including the scale's responses to eye, verbal, and motor commands or stimuli, presence of amnesia and symptoms like headache, dizziness, and noise sensitivity.

  Biomarker: The biomarker pillar uses biomarkers identified in blood tests to provide objective indicators of tissue damage. Low levels of these biomarkers determine which patients don't require CT scans, which helps reduce unnecessary radiation exposure and health care costs. Biomarkers can also identify patients to enroll in clinical trials to develop new medications for TBI. [Note: These markers include (a) Glial fibrillary acidic protein (GFAP), (b) Ubiquitin C-terminal hydrolase L1 (UCH-L1), and (c) S100 calcium-binding protein B (S100B)]

  Imaging: CT and MRI imaging are important in identifying blood clots, bleeding, and lesions, particularly in patients with more severe injuries, that can point to present and future symptoms.

  Modifiers: The modifiers pillar assess how an injury occurred – for example, if a patient was injured in a fall or sustained a blow to the head. This pillar also includes existing conditions, medications, health care access, prior TBI, substance abuse, and living circumstances."

- It is probable that this version of the CBI-M Framework will be elaborated in the future. Even as it is first presented, Feng et al. (2025) point to some weaknesses. ""The biomarker pillar has several limitations. In particular, **the detection of biomarkers requires time, and their specificity for the diagnosis of TBI is not high**. In these patients, clinically significant changes occur more often in the chronic phase of TBI, and are restricted by detection equipment settings… **Intracranial pressure, the most crucial physiological index in moderate-to-severe TBI, is unfortunately not considered in the CBI-M framework**" (p. 475; emphasis added).

References

Almojuela, A., Hasen, M., & Zeiler, F. A. (2019) The Full Outline of UnResponsiveness (FOUR) Score and its use in outcome prediction: A scoping systematic review of the adult literature. *Neurocritical Care, 31*, 162-175. https://dx.doi.org/10.1007/s12028-018-0630-9

Brain Injury Association of America (BIAA). (2025, May 20). New TBI classification system aims to improve diagnoses and treatment. https://biausa.org/public-affairs/public-awareness/news/new-tbi-classification-system-announced

Feng, J., He, Z., & Jiang, J. (2025). Integrating the characterisation of traumatic brain injury. The Lancet Neurology, 24(6), 475-476. https://dx.doi.org/10.1016/S1474-4422(25)00155-3

Institute of Neurological Sciences NHS Greater Glasgow and Clyde (2015). Glasgow Coma Scale: Do it this way. https://glasgowcomascale.org/downloads/GCS-Assessment-Aid-English.pdf

Manley, G. T., Dams-O'Connor, K., Alosco, M. L., … McCrea, M. A. (2025). A new characterisation of acute traumatic brain injury: the NIH-NINDS TBI Classification and Nomenclature Initiative. *The Lancet Neurology, 24*(6), 512-523. https://dx.doi.org/10.1016/S1474-4422(25)00154-1

National Academies of Sciences, Engineering, and Medicine (NASEM). (2022). *Traumatic brain injury: A roadmap for accelerating progress*. Washington, DC: The National Academies Press. https://doi.org/10.17226/25394.

Schey, J. E., Schoch, M., & Kerr, D. (2024). The predictive validity of the Full Outline of UnResponsiveness Score compared to the Glasgow Coma Scale in the intensive care unit: A systematic review. *Neurocrit Care*. https://doi.org/10.1007/s12028-024-02150-8

Teasdale, G. & Jennett, B. (1974). Assessment of coma and impaired consciousness. A practical scale. *The Lancet, 304*(7872), 81–84. https://dx.doi.org/10.1016/s0140-6736(74)91639-0

Teasdale, G. & Jennett, B. (1976). Assessment and prognosis of coma after head injury. *Acta Neurochirurgica, 34*, 45–55. https://dx.doi.org/10.1007/BF01405862

The Glasgow structured approach to assessment of the Glasgow Coma Scale [Internet]. Royal College of Physicians and Surgeons of Glasgow. https://www.glasgowcomascale.org

Wijdicks, E. F., Bamlet, W. R., Maramattom, B. V., Manno, E. M., & McClelland, R. L. (2005). Validation of a new coma scale: The FOUR score. *Annals of Neurology, 58*(4), 585-593. https://dx.doi.org/10.1002/ana.20611