Keywords: Consciousness/Glasgow Coma Scale/Clinical assessment/Standardisation
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Forty years after its initial implementation, the Glasgow Coma Scale has been updated to address variations in technique that have developed over time

Forty years on: updating the Glasgow Coma Scale

In this article...

- Variations in the use of the Glasgow Coma Scale
- Review of the scale's composition and its application
- Structured approach to assessment

5 key points

1. The Glasgow Coma Scale is an integral part of assessing levels of consciousness
2. It uses a simple standardised approach
3. The scale has been revised to make sure it remains an accurate tool
4. The overall coma score should not be used to convey clinical findings
5. The scale can be used with children who are over 5 years old

Author Sir Graham Teasdale is emeritus professor of neurosurgery, Institute of Health and Wellbeing, University of Glasgow; Douglas Allan was senior lecturer, School of Health and Life Sciences, Glasgow Caledonian University; Paul Brennan, is clinical lecturer in neurosurgery, Department of Clinical Neurosciences, NHS Lothian, IGMM, University of Edinburgh; Evelyn McElhinney is lecturer, School of Health and Life Sciences, Glasgow Caledonian University; Laura Mackinnon is senior charge nurse, Department of Neurosurgery, Institute of Neurological Sciences, Southern General Hospital, Glasgow.

Abstract Teasdale G (2014) Forty years on: updating the Glasgow Coma Scale. *Nursing Times*; 110: 42, 12-16.
Since the Glasgow Coma Scale was developed 40 years ago it has been accepted throughout the world as a method for assessing impaired consciousness. This article addresses the variations in technique that have developed since the scale was published. The details of the composition of the scale and its application are reviewed, and a structured approach to assessment set out. These provide a basis for standardising practice and ensure the scale is useful, in a practical sense, in the future.

The Glasgow Coma Scale (GCS) was developed in 1974 to provide a practical method for the assessment of impaired consciousness (Teasdale and Jennett, 1974). Nursing, medical and other staff welcomed its straightforward approach and use of simple terms to record and communicate their findings; the scale became an integral part of the care of patients with acute brain injury from head trauma, intracranial haemorrhage and many other causes.

The GCS reflects the initial severity of brain dysfunction, while serial assessments demonstrate the evolution of the injury. Each is crucial for decision making. The GCS is also a guide to prognosis and an essential tool for research studies.

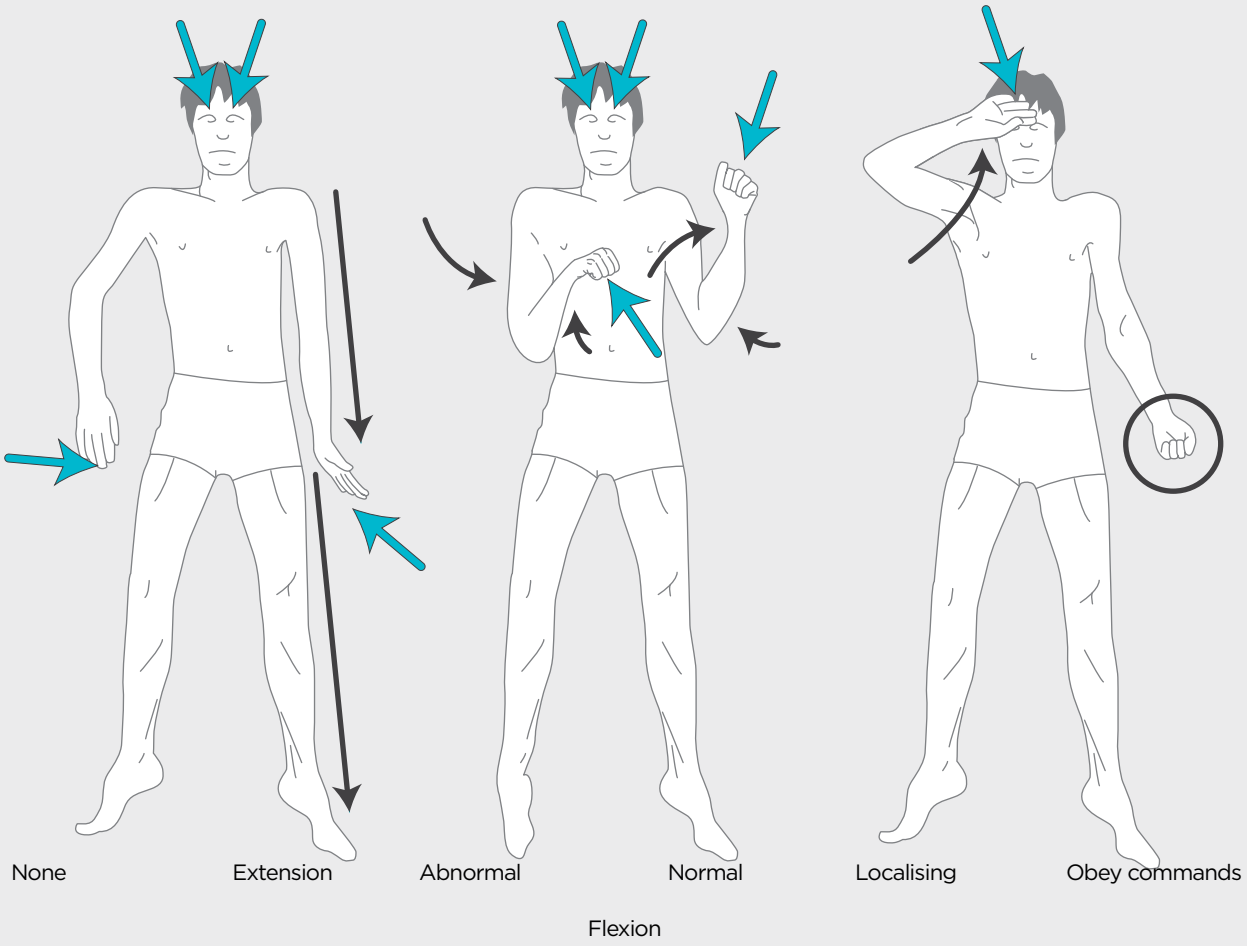
Four decades after its introduction, the GCS has gained worldwide acceptance (Teasdale et al, 2014). It is now employed in more than 80 countries, has been translated into more than 60 languages and there are more than 18,000 references to its use (Middleton, 2012).

Unfortunately, this widespread use has

TABLE 1. **GCS TERMS OF 1974 AND 2014**

Indicator of level of consciousness	Term used	
	1974	2014
Eye opening	Spontaneous	Spontaneous
	To speech	To sound
	To pain	To pressure
	None	None
Verbal response	Orientation	Orientated
	Confused conversation	Confused
	Inappropriate speech	Words
	Incomprehensible speech	Sounds
	None	None
Motor response	Obeying commands	Obey commands
	Localising	Localising
	Flexor	Normal flexion
		Abnormal flexion
	Extensor posturing	Extension
	None	None

FIG 1. **MOTOR RESPONSES IN GLASGOW COMA SCALE**



Source: adapted from Van Der Naalt, 2004 (modified with permission)

been accompanied by:

- Increasing variations in the way it is used; and
- Decreasing reliability of assessment and communication (McLernon, 2014; Reith et al, 2014; Middleton, 2012; Baker, 2008).

Standardised approach

To promote a more consistent use of the GCS, we have set out a standardised, structured approach to assessment.

This re-emphasises some of the original principles in the application of the scale (Teasdale, 1975) and draws on subsequent reviews and proposals for practice (McLernon, 2014; Middleton, 2012; Zuercher et al, 2009; Palmer and Knight, 2006; Fairley and Jake, 2005; Lacono and Lyons, 2005; Waterhouse, 2005; Edwards, 2001; Shah, 1999).

Composition of the GCS

The principle of assessing an individual's level of consciousness is about determining the degree of (increasing) stimulation that is required to elicit a response from them, based on three modes of behaviour: eye opening, verbal response and motor response. The findings in each response are described in clear terms, aimed at minimising ambiguity. However, the precise wording used in the GCS has varied over time; Table 1 outlines the terms used 40 years ago and those used today. This incorporates the expansion of the motor component of the assessment that was introduced soon after the GCS was originally described (Teasdale and Jennett, 1976).

Changes to the GCS

Eye opening: Spontaneous opening – that is, in the absence of stimulation – is the highest response that can be recorded on the scale but should not be equated to "alertness" or "awareness".

The next step in the scale is now termed opening eyes "to sound", and a response to a specific spoken command is not required. When a physical stimulus is needed, this is done through the application of graded pressure (see below).

Verbal response: An orientated verbal response requires the patient to provide a defined minimum in three fields of information:

- Person – their name;
- Place – their location, for example in hospital or other specific location; and
- Time – the month.

The person is confused if any one of the three items of information is not provided correctly, even if communication is through coherent phrases or sentences. If the patient's response lacks structured sentences or phrases, it is classified as "words"; this moves away from use of the term "inappropriate", which requires a potentially subjective interpretation. Likewise, an "incomprehensible speech" is now classified simply as "sounds".

Motor response: Five kinds of active motor response are now identified (Fig 1). Classifying a patient as "obeys commands" means establishing that they make a specific response to a request and not an automatic or reflex reaction.

The instruction is, therefore, complex and must specify movement in two parts, such as:

- Squeeze and release the examiner's fingers;

Catherine Hollick

» Raise and lower your arms; or
» Put out and put back your tongue.

The term "localising" implies a connection between the location of the sensory input and the specific movement made in response; the recommended standard is that a hand is brought above the clavicle towards a stimulus on the head or neck. Bringing a hand to the opposite side of the body is not sufficient.

Bending the elbow in a flexion motor response can be classed as either normal or abnormal (Fig 1). This differentiation was not in the GCS described in 1974 because studies of observer variability showed that the distinction was difficult for nurses and junior doctors, who are usually responsible for routine clinical monitoring (Teasdale et al, 1978).

However, although rarely a key factor in decision-making about individual patients, it became clear that the distinction does differentiate degrees of severity of brain damage and hence prognosis (Marmarou et al, 2007; Teasdale et al, 1979). This led to its incorporation in an extended scale that was used in research and progressively taken up in routine clinical care; it is now used by most nursing and medical disciplines (Reith et al, 2014).

Incorporating both normal and abnormal flexion into the motor component is now standard for clinical and research purposes. To help keep practice consistent, normal flexion should be selected unless it is clear that movement closely matches the features of an abnormal response (Table 2, Fig 1). Straightening the elbow constitutes an "extension" response.

Standard structured assessment

When the GCS was first introduced, the focus was on describing its components. In the accounts by Teasdale and Jennett (1974), and Teasdale (1975), little was said about the practical approach to assessing and assigning findings. Indeed, there was a wish to avoid appearing to try to impose a "straightjacket", in the expectation that experienced staff would use their skills to apply the scale in the way most suited to the clinical circumstances.

Reflecting this, the component steps in each response were set out in terms of "typical" features, to which observations were matched subjectively. This flexibility may have initially helped with acceptance, but did so at the cost of subjective interpretation and inconsistent use. To address this, the new recommendations set out a standard approach to examination, applying a structured set of defined criteria for allocating ratings.

There are four stages in assessment:
» Check;
» Observe;
» Stimulate; and
» Rate.

Check: A preliminary check is needed to identify factors that might interfere with assessment. Impediments may exist before the episode of acute intracranial damage as a consequence of existing treatment and impairments from injuries or deficits not relating to acute diffuse brain dysfunction. Impairments include:
» Pre-existing limitations such as language and cultural differences, intellectual neurological deficits, hearing loss or speech impediments;
» Effects of current treatments, such as physical interventions including intubation or tracheostomy, or pharmacological treatments including sedation; and
» Effects of other injuries or lesions including orbital/cranial fractures, dysphasia or hemiplegia and spinal cord damage.

Observe: Observation means the assessor must look for evidence of spontaneous behaviours in each of the three domains of the scale and then in response to stimulation.

Stimulate: Stimulation is applied with increasing intensity until a response is obtained, with an upper cut-off point for assigning lack of response. An auditory stimulus should be used first to assess the patient's responses to spoken or shouted requests. If this does not result in a response to a specific instruction, the next stimulus is physical.

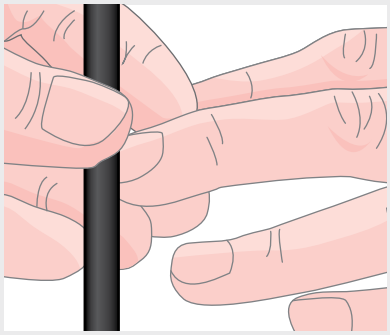
There are differing views about the appropriate method to use when applying physical stimulus (Waterhouse, 2009); the need for standardisation was highlighted by the recent finding that at least seven different techniques are currently in use (Reith et al, 2014).

The recommendations are pressure on the fingertip and on the trapezius muscle or supraorbital notch (Teasdale et al, 1975). These are often respectively termed "peripheral" and "central" but it should be noted that this refers to locations on the body, not the peripheral or central nervous systems.

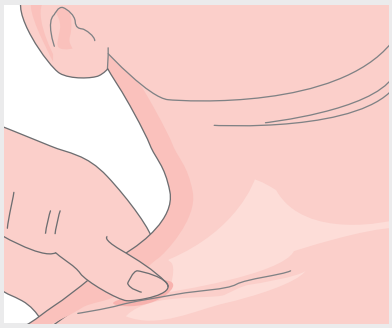
The appropriate sequence in practice is first a peripheral stimulus to assess eye opening, followed – if needed – by central

FIG 2. **WHERE TO APPLY PHYSICAL PRESSURE TO ELICIT RESPONSES**

(A) Fingertip pressure



(B) Trapezius pinch



(C) Supraorbital notch

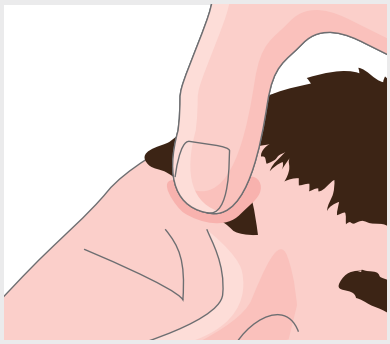


TABLE 2. **FEATURES OF DIFFERENT TYPES OF FLEXION MOTOR RESPONSE**

Abnormal Flexion	Normal Flexion
● Slow	● Rapid
● Stereotyped (the same response each time)	● Variable (or varying)
● Arm moves across chest	● Arm moves away from body
● Forearm rotates, thumb clenched	
● Leg extends	

"There should be compulsory dementia training for all"

Helen Goldsmith › p26

FIG 3. **CHART SUMMARISING STRUCTURED ASSESSMENT OF THE GCS**

GLASGOW COMA SCALE: DO IT THIS WAY

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Check
For factors Interfering with communication, ability to respond and other injuries

Observe
Eye opening, content of speech and movements of right and left sides

Stimulate
Sound: spoken or shouted request
Physical: pressure on fingertip, trapezius or supraorbital notch

Rate
Assign according to highest response observed

Eye opening			
Criterion	Observed	Rating	Score
Open before stimulus	✓	Spontaneous	4
After spoken or shouted request	✓	To sound	3
After fingertip stimulus	✓	To pressure	2
No opening at any time, no interfering factor	✓	None	1
Closed by local factor	✓	Not testable	NT

Verbal response			
Criterion	Observed	Rating	Score
Correctly gives name, place and date	✓	Orientated	5
Not orientated but communication coherent	✓	Confused	4
Intelligible single words	✓	Words	3
Only moans/groans	✓	Sounds	2
No audible response, no interfering factor	✓	None	1
Factor interfering with communication	✓	Not testable	NT

Best motor response			
Criterion	Observed	Rating	Score
Obey 2-part request	✓	Obeys commands	6
Brings hand above clavicle to stimulus on head neck	✓	Localising	5
Bends arm at elbow rapidly but features not predominantly abnormal	✓	Normal flexion	4
Bends arm at elbow, features clearly predominantly abnormal	✓	Abnormal flexion	3
Extends arm at elbow	✓	Extension	2
No movement in arms/legs, no interfering factor	✓	None	1
Paralysed or other limiting factor	✓	Not testable	NT

Sites for physical stimulation

Fingertip pressure | Trapezius pinch | Supraorbital notch

Features of flexion responses

Modified with permission from Van Der Naalt 2004 Ned Tijdschr Geneeskd

Abnormal flexion
Slow Sterotyped
Arm across chest
Forearm rotates
Thumb clenched
Leg extends

Normal flexion
Rapid
Variable
Arm away from body

For further information and video demonstration visit www.glasgowcomascale.org

stimulus for additional information about motor response.

The fingernail is the recommended site for peripheral stimulus. Pressure on the side of the finger has been proposed as an alternative to the nail bed because of concerns that undue force can result in damage (Waterhouse, 2009; Palmer and Knight, 2006). However, instances of damage to the nail are extremely rare and there is a lack of evidence that responses to the different sites are equivalent. Applying pressure to the distal part of the nail (Fig 2a) and varying the finger that is used should minimise the potential for harm.

Central stimulation is first applied by pinching the trapezius muscle in the neck to determine whether this leads to a localising movement (Fig 2b). If this does not happen, the next step is to apply pressure to the supraorbital notch (Fig 2c). This is located by feeling along the lower edge of the upper rim of the orbit until a groove is felt. This site should not be used if the patient has a fracture in this region.

Pressure behind the angle of the jaw (also referred to as retromandibular or styloid process pressure) is difficult to apply accurately and is, therefore, not recommended for routine use. Stimulation by rubbing the knuckles on the sternum is strongly discouraged; it can cause bruising and responses can be difficult to interpret (Shah, 1999).

Identification of the best motor response is done by comparing the movements of each arm. When the responses from the right and left sides differ, the better of the two is taken into account; the worse is an indication of the location of focal brain damage. Sometimes patients' responses change during an examination – usually increasing when compared with the initial performance (Edwards, 2001). When this is observed, it is the highest level of performance that is taken as the best motor response. The observer should satisfy him/herself that they have stimulated the highest level of responsiveness achievable for their patient. If there is a difference in the motor response to central or peripheral stimulus, the former takes priority. There is, in practice, a lack of information about the relative performance of different methods of stimulus and this would be a useful topic for research.

Rate: Rating is performed against defined criteria in a standard, structured sequence; firstly, whether the patient's findings meet the criterion for the top step for each mode of behaviour measured in the GCS is considered. If it is met, the appropriate rating is allocated; if not, subsequent steps are considered in a descending sequence until an absence of response is established. The criteria and ratings for each step of each mode of behaviour are set out in Fig 3.

If the initial check identifies that the response to a mode of behaviour cannot be validly assessed, the rating is classified as "not testable" and recorded as "NT".

A patient's ratings can be denoted by a corresponding numeral or score; although this allows for quick communication, it also carries the risk of introducing variability through errors in numbering and is not a substitute for reporting the patient's responses in full.

Fig 3 summarises the sequence in the assessment and the allocation of ratings in a chart that can be displayed as a poster, pocket flashcard or other aid to practice.

Factors affecting assessment

When the initial check identifies a factor that interferes with assessment, it may be possible to compensate by modifying the approach. If there is a barrier to communication, the method of interaction can be varied, for example by choice of language, examination by a culturally acceptable person or through written communication.

When it comes to problems resulting from treatment, the most common is endotracheal intubation. If the patient obeys commands, it may be possible to obtain information about orientation and quality of language via a written response. If the patient has been sedated and paralysed, treatment can be reversed

temporarily (a "wake-up test") when it is necessary to assess the patient's progress.

If other injuries interfere with the standard technique, another approach may be possible – for example, assessing whether a patient obeys commands through eye or tongue movements in a patient with a high cervical spinal cord lesion. If it proves impossible to test a component – as, for example, when swelling due to injury prevents eye opening – this should be documented in the patient's clinical record.

Even if one component of the GCS cannot be examined, it is important to understand that the findings in the remaining components can still yield information that can inform clinical decisions.

Assessment of children

These recommendations on how to use the GCS need not be modified for children who are aged over 5 years. In younger children and infants, however, an assessment of a verbal response as "orientated" and motor response as "obeys commands" is usually not possible.

Several modified paediatric coma scales have been described (Kirkham et al, 2008); the Adelaide Coma Scale (Simpson and Reilly, 1982) has remained popular but none have gained universal acceptance.

Relating coma scale to coma score

The coma score developed from the GCS. Numbers were attached to the results of the responses as a way of facilitating entry of clinical findings into a databank for research purposes.

Each step in the eye, verbal and motor sub-scales was assigned a number – the worse the response, the lower the number – and recorded separately as, for example, as E=1 V=1 M=1.

Although these numbers strictly represent ranking in a system of ordering rather than absolute values, aggregating the separate scores into a single total score was soon taken up as a way to summarise a patient's responsiveness and to present findings in groups of patients (Teasdale et al, 1979).

The use of a total score to describe an individual patient provides a quick overall index of severity of dysfunction.

The disadvantage is that it conveys less information than the description of the three responses separately and is liable to be invalid if one component of the scale is not testable.

The core concept of the scale is that the patient is described in simple, objective terms to convey a clear, unambiguous picture of their responsiveness.

This remains the proper approach in the care of an individual patient (Teasdale and Murray, 2000) and, as such, we do not advocate the use of score alone to convey clinical findings.

Online education and support

Experience and education significantly enhance the reliability of assessment of the patient using the GCS (McLernon, 2014; Martin, 1999; Fielding and Rowley, 1990). The approach to assessment described here is demonstrated in a video package, which is available free of charge online, along with background information and a self-assessment tool (www.glasgowcomascale.org).

This website also provides a downloadable summary of the recommendation.

These materials are copyright-free for use in clinical care, education and academic work. They support the education, training and assurance in competency in the use of the GCS that are prerequisites for all staff members responsible for assessing patients who may have an acute intracranial disorder.

Conclusion

Forty years after it was introduced, a wide-ranging review of the GCS pointed to the need to set out recommendations for its practical use to sustain and enhance its unique position in clinical care and research (Teasdale et al, 2014). A standard, good-practice, structured examination sequence is set out to counteract variations in technique. The assignment of ratings on the basis of a subjective comparison with "typical" responses has been replaced by explicit decisions based on the presence or absence of clearly stated criteria for each step.

For the foreseeable future, the GCS is likely to remain a fundamental part of the clinical care of a patient at risk of acute brain damage and further refinements and local variations can be expected. Their merits should be demonstrated by a formal, objective study before the standard assessment approach is modified, so that variation in technique is not increased and the relationships between findings in different places and over different times are properly understood. **NT**

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