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## Injury Severity Score (ISS)

The Injury Severity Score (ISS) standardizes the severity of traumatic injury based on the 3 worst injuries from 6 body systems.

### Points & Pearls

- The Injury Severity Score (ISS) was initially derived in patients with blunt traumatic injury from motor vehicle accidents.
- The ISS is not intended to be used for bedside decision-making for a single patient in the emergency department setting, but rather as a tool to standardize the study of trauma patients.
- Due to the nature of the score, multiple combinations of Abbreviated Injury Scale (AIS) scores may result in the same ISS, each of which may indicate a different mortality rate. For example, an ISS of 17 can be calculated from patients with a combination of points based on the 3 most severe injuries, such as (4, 1, 0) or (3, 2, 2). The ISS assigns equal value to each body region.

### Instructions

First, the most severe injury from each of 6 body systems is assigned an AIS score on a scale of 0 (no injury) to 6 (unsurvivable injury). Next, those scores are used to determine the 3 most injured body systems. Finally, the ISS is calculated by squaring the AIS score for each of the 3 most injured body systems, then adding up the 3 squared numbers ( $A^2 + B^2 + C^2 = \text{ISS}$ , where A, B, and C are the AIS

### Why to Use

Due to the heterogeneous nature of trauma patients, standardizing the severity of traumatic injuries allows for comparison of much larger sample populations in trauma research studies.

### When to Use

The ISS attempts to standardize the severity of injuries sustained during trauma. This standardization allows for more accurate study and prediction of morbidity and mortality outcomes after traumatic injuries.

### Next Steps

As the ISS is intended primarily as a research tool, the score should not affect the initial management of a patient with traumatic injuries.

scores of the most severe injury in each of the 3 most severely injured body systems). Patients with an AIS of 6 in any body system are automatically assigned an ISS of 75, the maximum possible score.

The ISS is used primarily in research settings, so calculation of the score should not delay initial management of patients with traumatic injuries.

### Critical Actions

- In all trauma patients, the initial treatment strategy should focus on the primary and secondary survey, and assessing and stabilizing the patient.
- Although the ISS score is intended primarily for research purposes, it may have broader clinical use in the intensive care unit for prognostication following the initial stabilization of traumatic injuries.

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## Evidence Appraisal

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The ISS was derived by Baker et al (1974) by taking the previously used AIS (American Medical Association Committee on Medical Aspects of Automotive Safety 1971) and adding the squared value of each of the 3 most severely injured body systems, in an effort to add increasing importance to the most severe injuries. The top 3 most severe injuries were used to calculate the final score because it had been shown that injuries that would not necessarily be life-threatening in isolation could have a significant effect on mortality when they occurred in combination with other severe injuries. The derivation study included only injuries sustained from motor vehicle collisions, including the occupants of the vehicles and any pedestrians involved.

Further studies have validated the ISS to include other mechanisms of injury. A study by Beverland et al (1983) of 875 patients with gunshot wounds showed that an increasing ISS was associated with increasing mortality (chi-squared = 83.31,  $P < .001$ ). A study by Bull (1978) confirmed the correlation between increasing ISS and increasing mortality in road traffic accidents, and showed correlation between increasing ISS and increasing mean hospital length of stay.

In a study of 8852 trauma patients from the Illinois Trauma Program (including both vehicular and nonvehicular trauma), Semmlow et al (1976) had similar findings to Baker et al regarding the relationship between ISS and mortality. They also found that the ISS correlated with hospital length of stay.

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## Calculator Creator

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Susan P. Baker, MPH

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## References

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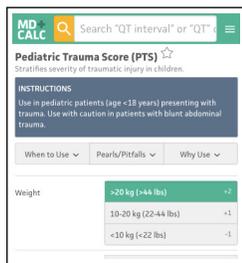
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# Pediatric Trauma Score (PTS)

The Pediatric Trauma Score (PTS) stratifies the severity of injury and mortality risk in pediatric trauma patients.

## Points & Pearls

- The Pediatric Trauma Score (PTS) is best used as a general predictor for stratifying traumatic injury severity.
- The PTS is poorly validated in blunt abdominal trauma and has not been shown to reliably predict isolated injuries to the liver or spleen (Saladino 1991).

## Advice

A low PTS correlates with high mortality risk, so a patient with a low score should be triaged for immediate medical attention at a pediatric trauma center (if nearby) or for stabilization at the nearest medical facility, at the discretion of the first responder.

Patients who have higher scores are less likely to have significant morbidity and mortality, but require reassessment as symptoms evolve. These patients should still be evaluated by a clinician, and a complete history and physical examination should be performed.

## Critical Actions

Reassessment is an essential component of patient care in all trauma cases. Patients who have a low initial PTS, which indicates high risk for morbidity and mortality, may have changes in their clinical status, so recalculation may be necessary. Patients who have a high PTS should not be advised against further medical attention, as evaluation by a clinician is still recommended.

## Evidence Appraisal

The PTS was first described by Tepas et al (1987) in a matched cohort study comparing 2 groups of 110 and 120 pediatric trauma patients, respectively. The study found a linear relationship between the PTS and the Injury Severity Score (ISS). The authors further validated their findings in a retrospective

## Why to Use

The PTS helps clinicians stratify injury severity and mortality risk in pediatric trauma patients. It can also be used to triage patients in a resource-limited environment, identifying the patients who are at high mortality risk versus patients who may not be as critically ill and will need fewer resources.

The PTS can be used for triage by first responders on the scene to help determine which patients require transfer to a pediatric trauma center.

## When to Use

- The PTS should be used for pediatric patients (aged < 18 years) who present with trauma.
- The score is poorly validated in patients with blunt abdominal trauma, so it should be used with caution in this population.
- The PTS should not be used to predict the presence of isolated injuries.

## Next Steps

Patients should be monitored for any evolution of signs and symptoms, as conditions may change after the initial assessment and scoring with the PTS.

cohort study that included data for 615 children entered into the National Pediatric Trauma Registry between April and December 1985 (Tepas 1988). This study confirmed the correlation between increasing PTS and increasing ISS. Notably, the study authors did not correlate the findings with mechanism of injury. The study found that a PTS < 0 had a 100% mortality rate and a PTS > 8 was associated with no mortality; patients with a PTS of 0 to 8 had decreasing mortality rates as the PTS increased, showing an inverse linear correlation between increasing severity of injury and decreasing PTS.

Ramenofsky et al (1988) validated these findings in a cohort of 450 injured children who were evaluated by a paramedic in the field and a physi-

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cian in the emergency department. The study confirmed an inverse linear correlation of PTS with injury severity and found a 93.6% correlation between the 2 clinicians (correlation coefficient = 0.991). A later study (Saladino 1991) found the PTS to be a poor predictor of isolated blunt abdominal injuries (eg, liver and spleen).

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### Calculator Creator

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Joseph J. Tepas, III, MD

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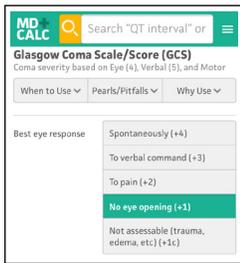
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- [Pediatric Trauma BIG Score](#)



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# Glasgow Coma Scale

The Glasgow Coma Scale (GCS) assesses impairment in a patient's level of consciousness using eye, verbal, and motor criteria.

## Points & Pearls

- The Glasgow Coma Scale (GCS) allows clinicians in multiple settings and with varying levels of training to communicate succinctly about a patient's mental status.
- The GCS has been shown to have statistical correlation with a broad array of adverse neurologic outcomes, including brain injury, need for neurosurgery, and mortality.
- The GCS score has been incorporated into numerous guidelines and assessment scores.
- The correlation of the GCS score with outcome and severity is most accurate when applied to an individual patient over time; the trend in the patient's GCS score is important.
- A GCS score of 8 should not be the only factor used to determine whether or not to intubate a patient, but it does suggest a level of obtundation that should be evaluated carefully.
- The reproducibility of GCS scores can be low; the GCS creators provide training and education to help improve scoring agreement between providers at [www.glasgowcomascale.org](http://www.glasgowcomascale.org).
- There are simpler scores that have been shown to perform as well as the GCS in the prehospital and emergency department setting (for initial evaluation); these are often contracted versions of the GCS itself. For example, the Simplified Motor Score uses only the motor portion of the GCS. These contracted scores are less well-studied than the GCS for trending over time and for outcomes such as long-term mortality.

## Critical Actions

Although it has been adopted widely and in a variety of settings, the GCS score is not intended for quantitative use. Clinical management decisions should not be based solely on the GCS score in the acute setting.

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## Why to Use

The GCS is an adopted standard for mental status assessment in the acutely ill trauma and nontrauma patient and assists with predictions of neurological outcomes (complications, impaired recovery) and mortality.

## When to Use

The GCS is designed for use in serial assessments of patients with decreased mental alertness from either medical or surgical causes and is widely applicable. It is commonly used in the prehospital and acute-care setting as well as over the course of a patient's hospitalization to evaluate for mental status in patients with either traumatic or nontraumatic presentations.

## Next Steps

- The GCS score can indicate the level of critical illness.
- Trauma patients presenting with a GCS score < 15 warrant close attention and reassessment.
- A declining GCS score is concerning in any setting, and should prompt airway assessment and possible intervention.
- A GCS score of 15 should not be taken as an indication that a patient is not critically ill.
- Decisions about management and treatment plans should be made based on clinical presentation and context, and should not be overridden by the GCS score.
- If a trauma patient has a GCS score < 8 and there is clinical concern that the patient is unable to protect the airway or there is an expected worsening clinical course based on examination or imaging findings, then intubation can be considered.
- In any patient, a rapidly declining or waxing and waning GCS score is concerning, and intubation should be considered.

## Advice

- For children who are preverbal or aged ≤ 2 years, use the [Pediatric Glasgow Coma Scale](#).

## Evidence Appraisal

The modified GCS (the 15-point scale that has been widely adopted, including by the original unit in Glasgow, as opposed to the 14-point **original** GCS) was developed to be used in a repeated manner in the inpatient setting to assess and communicate changes in mental status and to measure the duration of coma (Teasdale 1974).

In the acute care setting, the GCS has been shown to have highly variable reproducibility and inter-rater reliability (eg, 56% among neurosurgeons in one study, 38% among emergency department physicians in another study). In its most common usage, the 3 sections of the GCS are often combined to provide a summary of severity. The authors themselves have explicitly objected to the GCS being used in this way, and analysis has shown that patients with the same total score can have huge variations in outcomes, specifically mortality. A GCS score of 4 predicts a mortality rate of 48% if calculated 1E + 1V + 2M (for eye, verbal, and motor components, respectively), and a mortality rate of 27% if calculated 1E + 2V + 1M, but a mortality rate of only 19% if calculated 2E + 1V + 1M (Healey 2014).

In summary, the modified GCS provides an almost universally accepted method of assessing patients with acute brain damage. Summation of its components into a single overall score results in information loss and provides only a rough guide to severity. In some circumstances, such as early triage of severe injuries, assessment of only a contracted version of the GCS can perform as well as the GCS and is significantly less complicated. However, contracted scores may be less informative for patients with lesser injuries.

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## Calculator Creator

Sir Graham Teasdale, MBBS, FRCP

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