

COE CST 3rd Annual Technical Meeting:

Task 294: Development of Minor Injury Severity Scale for Orbital Human Space Flight

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Overview

- Team Members
- Purpose of Task
- Research Methodology
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Team Members

- **PI: Richard Jennings, MD** (UTMB Aerospace Medicine)
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- **Co-I: Eric Kerstman, MD** (Wyle Integrated Science and Engineering)
- **Co-I: Jonathan Clark, MD** (Center for Space Medicine, Baylor College of Medicine)
- **Student/Resident: James Cushman, MD** (UTMB Aerospace Medicine)
- **Program Manager: Ken Davidian** (FAA)
- **Technical Monitor: Henry Lampazzi**



Purpose of Task

- FAA COE-CST Task 294
 - Minor injuries of small consequence on the ground may have a large operational impact if they were to occur in space.
 - A Minor Injury Severity Scale (MISS) for human space flight (HSF) was developed for identification of unacceptable injuries that could disrupt HSF operations.

Research Methodology

- Systematic literature review on existing injury scoring systems which were used to create the MISS
 - PubMed
 - MedLine
 - Google Scholar

Results

- Injury Severity Scoring is a process by which complex and variable patient data is reduced to a single number. This value is intended to accurately represent the patient's degree of critical illness. In truth, achieving this degree of accuracy is unrealistic and information is always lost in the process of such scoring. As a result, despite a myriad of scoring systems having been proposed, all such scores have both advantages and disadvantages.

Outcome = Anatomic Injury + Physiologic Injury + Patient Reserve

GLASGOW COMA SCORE

The Glasgow Coma Score (GCS) is scored between 3 and 15, 3 being the worst, and 15 the best. It is composed of three parameters : Best Eye Response, Best Verbal Response, Best Motor Response, as given below:

Best Eye Response (4)

1. No eye opening
2. Eye opening to pain
3. Eye opening to verbal command
4. Eyes open spontaneously

Best Motor Response (6)

1. No motor response
2. Extension to pain
3. Flexion to pain
4. Withdrawal from pain
5. Localizing pain
6. Obeys Commands

Best Verbal Response (5)

1. No verbal response
2. Incomprehensible sounds
3. Inappropriate words
4. Confused
5. Oriented

Note that the phrase 'GCS of 11' is essentially meaningless, and it is important to break the figure down into its components, such as E3 V3 M5 = GCS 11. A Coma Score of 13 or higher correlates with a mild brain injury, 9 to 12 is a moderate injury and 8 or less a severe brain injury.; Teasdale G., Jennett B., Lancet 1974; 81-83.

Results: Injury scales

ABBREVIATED INJURY SCALE

- The Abbreviated Injury Scale (AIS) is an anatomical scoring system first introduced in 1969. Since this time it has been revised and updated against survival so that it now provides a reasonably accurate ranking of the severity of injury. The latest incarnation of the AIS score is the 1998 revision.

Injury	AIS Score
1	Minor
2	Moderate
3	Serious
4	Severe
5	Critical
6	Unsurvivable

Copes WS, Sacco WJ, Champion HR, Bain LW, "Progress in Characterising Anatomic Injury", In Proceedings of the 33rd Annual Meeting of the Association for the Advancement of Automotive Medicine, Baltimore, MA, USA 205-218

Injury Scales

INJURY SEVERITY SCORE (ISS) & NEW INJURY SEVERITY SCORE (NISS)

The Injury Severity Score (ISS) is an anatomical scoring system that provides an overall score for patients with multiple injuries. Each injury is assigned an AIS and is allocated to one of six body regions (Head, Face, Chest, Abdomen, Extremities (including Pelvis), External). Only the highest AIS score in each body region is used. The 3 most severely injured body regions have their score squared and added together to produce the ISS score.

An example of the ISS calculation is shown below:

Region	Injury Description	AIS	Square Top Three
Head & Neck	Cerebral Contusion	3	9
Face	No Injury	0	
Chest	Flail Chest	4	16
Abdomen	Minor Contusion of Liver Complex Rupture Spleen	2 5	25
Extremity	Fractured femur	3	
External	No Injury	0	
Injury Severity Score:			50

The ISS score takes values from 0 to 75. If an injury is assigned an AIS of 6 (unsurvivable injury), the ISS score is automatically assigned to 75. The ISS score is virtually the only anatomical scoring system in use and correlates linearly with mortality, morbidity, hospital stay and other measures of severity. Its weaknesses are that any error in AIS scoring increases the ISS error. Many different injury patterns can yield the same ISS score and injuries to different body regions are not weighted. Also, as a full description of patient injuries is not known prior to full investigation & operation, the ISS (along with other anatomical scoring systems) is not useful as a triage tool.

Baker SP et al, "The Injury Severity Score: a method for describing patients with multiple injuries and evaluating emergency care", J Trauma 14:187-196;1974

Results: MISS

Anatomic (A)

Site	Score
Brain (CNS)	3
Spinal Cord (CNS)	3
Sensory (Eyes/Ears)	2
Spine	2
Chest/Pulmonary	2
Abdomen/Pelvis	2
Cardiovascular	2
Extremity	1
Nerve (PNS)	1
Skin	1
Psych	1

Functional Impairment (FI)

System	Score
Musculoskeletal	0/1/2/3
Neurologic	0/1/2/3
Pain	0/1/2/3

0= none, 1= mild, 2= moderate, 3= severe

Diagnosis/Treatment (Dx/Tx)

Diagnosis/Treatment	Score
Diagnostic testing required	0/1/2/3
Treatment required	0/1/2/3

0= none, 1= minimal, 2= moderate, 3=extensive

Total MISS Score= Adding Anatomic + Functional Impairment + Dx/Tx Range = 1-18 per injury

MISS Examples

Corneal abrasion (mild)

- resolving, no residual pain, vision normal
- no further dx/tx

$A = 2$ (eye) + $FI = 0$ + $Dx/Tx = 0$, thus $MISS = 2$

Corneal abraions (moderate)

- moderate residual pain, eye irritation
- further corneal evaluation recommended

$A = 2$ + $FI = 1$ (pain) + $Dx/Tx = 1$, thus $MISS = 4$

MISS Examples

Concussion (MTBI, mild)

- no residual symptoms (headache, dizziness, e.g.)
- no focal neurologic deficits
- no further dx/tx

$A=3 + 0 + 0$, thus $MISS = 3$

Concussion (moderate)

- residual intermittent post-concussive symptoms
- no focal neurologic deficits
- neurology f/u evaluation
- no further tx anticipated

$A=3 + 1(\text{pain}) + 1(\text{neuro f/u})$, thus $MISS = 5$

Proposed Limits for Total MISS

Pre-Flight: 1 = Go
 2 = Go/No Go
 ≥ = No Go

In-Flight: 1-2 = Go
 3 = Go/No Go
 ≥4 = No Go

Anatomic	Skin/Extremity	Large or Sensory Organ	CNS Insult
Functional Impairment	Mild	Moderate	Severe
Diagnosis/Treatment	None/Mild	Moderate	Extensive
	↓	↓	↓
	GO	Expert Consultation	NO-GO

Conclusion

- While there is no substitute for clinical judgment by the aerospace medicine physician, the MISS could serve as a general guideline and rationale for Go/No-Go decision-making for HSF. This system may serve as a way to classify injuries in both crew and space flight participants such that appropriate response decisions can be made before and during flight.

Next Steps

- Manuscript editing
- Publish results

Contact Information

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Task 294: Development of Minor Injury Severity Scale for Orbital Human Space Flight

Project At-A-Glance

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 - Co-I: Eric Kerstman, MD, MPH
 - Co-I: Jonathan Clark, MD, MPH
- Student Researchers: James Cushman, MD, MPH

Relevance to Commercial Spaceflight Industry

Minor injuries of small consequence on the ground may have a large operational impact if they were to occur in space.

A Minor Injury Severity Scale (MISS) for human space flight **Status**

(HSF) was developed for identification of unacceptable injuries that could disrupt HSF operations. Completed literature review and MISS development

Future Work

- Manuscript editing
- Publish results

Statement of Work

- Investigate and develop a Minor Injury Severity Scale (MISS) for Orbital Human Space Flight (HSF).

