

Back sprain/strain CLIFF Peer Review

1. *Strength of evidence presented in CLIFF in modeling the characteristics and mission impact of this medical condition within the spaceflight environment?*

Score: 3

Grading Scale:

4 - *Confident*

3 - *Somewhat confident*

2 – *Neutral*

1 – *Somewhat unconfident*

0 – *Not confident*

2. How confident are you that these data accurately represent the spaceflight environment?	Tables 1, 2 Composite Incidence and Level of Confidence	Table 3, 4 BC/WC Loss of Crew and probability	Table 4 - Clinical Phase 1, 2 durations Table 5 – CP 2 Loss of Crew	Table 4 – RTDC % Table 6 – RTDC Loss of Crew	Table 4 – Loss of Crew Life % Table 7 – Loss of Crew Life, Loss of Crew	Table 8 – TI
Score	3	2	3	3	3	3

Comments and limitations:

1. **General comments.** Back injury usually involves a strain or sprain in the supporting muscles or ligaments of the vertebral spine, and often results in pain and task impairment. On earth lifting heavy objects against gravity is the most common mechanism of back injury while in microgravity it may occur during translation of a massive object or during exercise. A pre-existing history of a significant back injury increases the risk of occurrence on orbit. Of note, partial G, that would be encountered during surface lunar or Martian operations, would be expected to result in a higher incidence of back injury than is represented here since most of the data used is from flight in microgravity. Since back pain is a very common complaint, particularly during the SAS phase of flight as unloading of the spine occurs, it may be difficult for astronauts to distinguish between back strain and back discomfort due to microgravity during the early part of the mission. SAS-related back pain, however, is not included in this CLIFF as it is the subject of a separate medical condition, ICL 91. The best case is considered to be a Grade I (minor) or II (moderate) strain/sprain in which there is minimal or partial muscle or ligamentous tearing while the worst case is a Grade III (severe) strain/sprain in which there is full thickness muscle or ligamentous tearing, and/or instability.

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2. Incidence. The incidence distribution for this CLIFF is based on 61 documented U.S. in-flight “back injuries” that were reported in several annotated reviews of records from Mercury through ISS Expedition 40. Terrestrial and analog studies were not deemed to be useful because of differences in environment, in mechanism, and in demographics. The best case/worst case probabilities used data from a previous CLIFF that estimated 2-3% worst case probability and a terrestrial study that showed a 0% worst case probability. The clinical phase durations, RTDC and Loss of crew life probabilities are supported by terrestrial evidence, and I am in agreement with their calculation. Loss of crew life probabilities were considered to be zero given the medical condition definition. The probability density curve that was derived appears to be a reasonable representation of the data presented.

3. Clinical phase data. I am in agreement with the clinical phase 1 duration entered in this CLIFF. This data was compiled by a team of expert clinicians, and I was involved in the discussions leading to the calculation of the clinical phase duration. CP2 was supported by terrestrial evidence.

4. Task impairment. The analysis was performed and reviewed by a separate team of expert clinicians. I am aware of the methods that were used but did not directly participate in the discussions.

5. Dependence on mission phase or duration of mission. This medical condition is dependent on mission phase. EVA operations may have a higher incidence since they often involve the translation of massive objects, and astronauts may perform more twisting movements. In addition, the incidence may be higher during partial G surface operations.

6. Limitations

- Under-reporting for this condition could have occurred during past space missions due to subtle back pain that was not mentioned during debriefs. This may result in underestimation of the incidence.
- This medical condition is dependent on mission phase. EVA operations may have a higher incidence since they often involve the translation of massive objects, and astronauts may perform more twisting movements. In addition, the incidence may be higher in partial G surface operations.
- The incidence for this condition is based on spaceflight data regarding inflight “back injuries.” While the vast majority of these can be assumed to be sprains/strains, it is not explicitly specific to back sprain/strain injuries.
- There is a paucity of data to inform the best-case, worst-case probabilities for this condition. The values used in this CLIFF were based on a study in elite snowboarders (and the prior IMM CLIFF).
- The duration values are based primarily on studies regarding “acute low back pain” rather than specifically back sprain/strain.

Reviewed by:

David C. Hilmers