

Hearing Loss Noise Related 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	3	2	3	3	3

Comments and limitations:

1. **General comments.** Temporary and permanent hearing loss has been noted in up to one-third of astronauts on long-duration space missions although the etiology has been unclear. Hearing loss has been thought to be primarily noise-related as a result of the spacecraft environment. Studies have shown temporary and permanent differences in air and bone conduction from pre to post flight in the majority of astronauts. Since hearing loss has been studied extensively, only spaceflight data will be used for this CLIFF. This CLIFF covers noise-related deficits as does the IMM LD68 CLIFF while ICL65 covers sensorineural hearing loss..

2. **Incidence..** Spaceflight data was used exclusively to compute the composite incidence. There have been 4 cases of mission significant threshold shift (M-STs) hearing loss documented during the ISS and shuttle eras. This is likely to be an underestimation as testing has not been universally available and subtle differences in hearing might not be noted by the crew. The best case/worst case probabilities (65%/35%), clinical phase durations, RTDC and Loss of crew life probabilities are supported by terrestrial evidence, and I am in agreement with their calculation. The probability

Hearing Loss Noise Related CLIFF Peer Review

density curve that was derived appears to be a reasonable representation of the data presented and the associated standard deviation is appropriate for the level of uncertainty..

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 should not be dependent on mission phase.

6. Limitations

- Spaceflight data is limited primarily to ISS and STS vehicles. The ambient noise levels in Artemis vehicles may differ.
- There is considerable overlap with noise-related hearing loss that leads to sensorineural hearing loss (SNHL).
- Under-reporting for this condition could have been significant during past space missions due to lack of testing and subtle noise-related hearing loss that may not have been apparent to the crew. This may result in underestimation of the incidence.

Reviewed by:

David C. Hilmers