

Hearing Loss 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	2	3	3	3	3	3

Comments and limitations:

1. **General comments.** Sensorineural hearing loss (SNHL) is caused by pathology to the acoustic nerve or to the structures of the inner ear. It can result from autoimmune disease, aging, viruses or other infections, genetic disorders, trauma, aging, tumors, or may be noise-related. However, noise-related hearing loss is the subject of a separate CLIFF. This overlap causes difficulty in interpreting some studies as many papers do not differentiate between the various etiologies of SNHL. Most hearing loss reported in spaceflight has been noise-related, and there is no specific data available for SNHL.

2. **Incidence.** Since there is no spaceflight data for this condition, the most relevant study is Alexander, 2013 which reported the incidence of SNHL for both males and females ages 45-54 to be 30/100,000 = 0.003 events/person-year. This demographic fits well with the current average active astronaut age of 48 years. As this was a very large study, the standard deviation associated with the probability distribution is very small. This likely overestimates the confidence that we have in the composite incidence, particularly since it is difficult to tell how many of the reported cases are noise-related. The best case/worst case probabilities, clinical phase durations, RTDC and Loss of crew life

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probabilities are supported by terrestrial evidence, and I am in agreement with their calculation. 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 should not be dependent on mission phase.

6. Limitations

- No spaceflight data on SNHL is available that is not related to noise. There is no directly comparable IMM CLIFF for this condition. The IMM Hearing Loss CLIFF refers to noise-induced hearing loss in spaceflight and uses data from ISS and STS on-orbit hearing assessments.
- Because of the large sample size, the study used to compute the composite incidence most likely overestimates the confidence we have in the assigned value.
- In future versions, there should be consideration given to changing the best case definition to: "A reversible sensorineural hearing loss that resolves within 14 days and does not impair communication." Consideration could also be given to changing the worst case definition to "A sensorineural or non-reversible sensorineural hearing loss lasting greater than 14 days or that impairs communication." The change in definition to include 14 days as the duration is based on Mattox, 1997 in which 65% of idiopathic cases appeared to recover functional hearing levels regardless of treatment, most within 14 days.
- There is considerable overlap with noise-related hearing loss that leads to SNHL.
- Under-reporting for this condition could have been significant during past space missions due to subtle SNHL that may not have been apparent to the crew. This may result in underestimation of the incidence.

Reviewed by:

David C. Hilmers