

SAS Constipation 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	3	3	3	3

Comments and limitations:

1. General comments. This CLIFF focuses on constipation during the first 5 days after insertion into orbit which is, by definition, when “space adaptation” symptoms occur. Constipation is a very common, but somewhat vague, medical diagnosis as its symptoms are very individualized. Generally, it refers to a constellation of findings that may include infrequent, hard stools, incomplete evacuation, bloating, abdominal distention and discomfort. Since there is a wide variation in the frequency of stools between individuals, there is poor correlation between symptoms and the number of stools per week. During the acclimation period to microgravity, astronauts are prone to constipation because of fluid shifts causing increased urination and poor liquid intake from nausea, both of which lead to relative dehydration. In addition, hormonal changes and low gut motility in microgravity have been cited as possible mechanisms for constipation. From a practical standpoint, some astronauts may intentionally maintain a low residue diet and fluid restrict in an effort to avoid defecation during the early portion of the mission. This could be motivated by operational considerations where defecation might interfere with mission objectives, or it could be from a desire to minimize the use of onboard facilities. This was particularly true during short, busy shuttle flights or during EVA’s. It is likely that this condition is under-reported as constipation may be associated

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with little, if any, discomfort and may be even intentional, as discussed above. The best case is considered to be symptomatic complaints of constipation, requiring treatment with hydration and dietary changes while the worst case is symptomatic complaints of constipation that do not respond to initial treatment and require medication and/or dis-impaction.

2. Incidence. There is no terrestrial data that can inform the incidence of this condition. The composite incidence for this CLIFF is based on data from the previous IMM CLIFF that referenced the most up to date LSAH drop. There have been 151 reports of constipation from the Mercury program through the ISS Expedition 40. Since each astronaut who has gone into space encounters the SAS period during the first 5 days of the mission, the composite incidence is based on “person-missions” rather than “person-years”. Thus, the denominator is 807 person missions for this data set. There is also joint US-Russian data that describes constipation, but this was not included because of possible inconsistencies in reporting. It may be unclear whether constipation originated during the SAS period or after, and this is a possible limitation. In addition, some astronauts intentionally limit solid food intake to avoid the need to defecate which may skew the incidence. It is likely that episodes may not be reported, perhaps from lack of significant symptoms or by intent. This could lead to an underestimation of the true incidence. The best case/worst case probabilities, clinical phase durations, RTDC and Loss of crew life used data from the previous IMM CLIFF. Both RTDC and Loss of crew life probabilities were considered to be zero given the medical condition definition although an extensive literature search was not done. 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 defined as occurring during the initial 5 days of spaceflight. However, it may also be applicable during gravity well operations such as the transition from lunar or Martian surface activities to microgravity.

6. Limitations

- It is likely that episodes may not be reported, perhaps from lack of significant symptoms or by intent. This could lead to an underestimation of the true incidence.
- It may be unclear whether an episode of constipation originated during the SAS period or after, and this is a possible limitation in reporting.
- Some astronauts may intentionally limit solid food intake to avoid the need to defecate which may skew the incidence.
- The paucity of data available in the literature regarding the duration of Space Adaptation constipation resulted in re-using the durations from the IMM CLIFF.
- It is assumed that the Loss of crew life probability for all scenarios would be 0%. While this is likely a reasonable assumption, no literature searches were performed to substantiate this.

Reviewed by:

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