

## Eye Retinal Injury 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<br>Composite Incidence and Level of Confidence | Table 3, 4<br>BC/WC<br>Loss of Crew and probability | Table 4 -<br>Clinical Phase 1, 2 durations<br><br>Table 5 – CP 2 Loss of Crew | Table 4 – RTDC %<br><br>Table 6 – RTDC Loss of Crew | Table 4 – Loss of Crew Life %<br><br>Table 7 – Loss of Crew Life, Loss of Crew | Table 8 – TI |
| Score                                                                                      | 2                                                          | 2                                                   | 3                                                                             | 3                                                   | 3                                                                              | 3            |

### Comments and limitations:

**1. General comments.** This CLIFF is concerned with retinal injury and includes retinal detachment, tears and burns. The most likely cause of retinal injury is retinal detachment (RD) wherein the neurosensory layer of the retina separates from the underlying pigmented layer. RD is classified as rhegmatogenous, traction, and exudative. The first type is often idiopathic and can occur if there is a small tear in the retina. This is the most likely type to occur in astronauts during spaceflight. Tractional RD often occurs in diabetics or in persons with retinal scarring. Since astronauts are screened for such pre-conditions, it is unlikely that this type of RD would occur. Exudative RD is caused by breaks in the blood vessels from trauma, macular degeneration or underlying eye disease. Again, pre-flight screening would eliminate underlying disease, and the forces needed to cause this type of RD are unlikely to be generated during spaceflight. RD can result in visual field defects, decreased visual acuity and permanent loss of vision when the detachment is extensive. There have been no reports of RD during spaceflight.

**2. Incidence.** Finding data that exactly matches the CLIFF definition (RD, tears and burns) is challenging, especially since there are no reports of RD during spaceflight. The decision was made to

## Eye Retinal Injury CLIFF Peer Review

use a study that looked at the incidence of RD in Olmstead County, Minnesota over 20 years. From this report, the incidence of idiopathic RD in patients without lens implants was used to represent the astronaut populations. Since retinal tears can lead to idiopathic RD, the incidence rate for idiopathic RD would also include some, but not all, retinal tears. There is little data available on the incidence of retinal burns, but it is postulated that the incidence would be extremely low in astronauts during flight given the protection afforded by the spacecraft design. Therefore, robust data describing the incidence of idiopathic RD was chosen to be representative of retinal injury during spaceflight. The best case/worst case probability is based on subject matter expert opinion using terrestrial data. The clinical phase durations, RTDC and Loss of crew life probabilities are supported by terrestrial evidence, and I am in agreement with their calculation. Of note, Loss of crew life associated with RD is considered to be zero while RTDC will always be necessary in cases requiring surgical intervention. 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 not dependent on mission phase as EVA operations are covered in a separate CLIFF. However, as the mission duration increases the incidence of RD may become more common as structural changes in the eye occur with long-term exposure to microgravity.

### 6. Limitations

- Finding data that exactly matched the CLIFF definition was challenging, especially since there are no reports of RD during spaceflight.
- Terrestrial idiopathic RD incidence data was used for the composite incidence for this CLIFF. This may be a slight underestimate since it does not specifically include other types of RD nor does it specifically include tears and burns.
- There is considerable uncertainty in the actual incidence rate during microgravity operations. Astronauts have intensive monitoring of their ocular health during and prior to flight, but the microgravity can cause structural changes in the eye that could lead to an increased incidence during long-duration spaceflight.

Reviewed by:

David C. Hilmers