# Clinical Finding Form (CliFF)

Branch: Baseline

## ICL44_Eva Related Paresthesia

Paresthesia occurs when sustained pressure has been applied over a nerve inhibiting or stimulating its function. Removing the pressure will typically result in gradual relief of the paresthesia, often described as a "pins and needles" feeling. Persistent paresthesia in the EVA setting is often a symptom of compressive neuropathy of peripheral nerves. The most frequently observed are of the digital, ulnar, median, supra-clavicular, and peroneal nerves. These usually resolve within 3 to 45 days (NASA, Paresthesias Secondary to Extravehicular Activity CLiFF, 2017). Numerous conditions can lead to paresthesia post-EVA, including pressure on neurovascular structures, hyperventilation, DCS, and electrolyte imbalances. (NASA, Paresthesias Secondary to Extravehicular Activity CLiFF, 2017) This CLiFF only considers paresthesia secondary to EVA suit pressure points.

### INCIDENCE DATA INCLUDED IN THE MODEL

The model imports the following incidence information from the MEDPRAT Evidence Library Database: incidence data category, space adaption status, EVA status, incidence data type, incidence and occurrence distribution data and incidence data characteristics. Data category defines the type of data available for incidence calculations (i.e. raw data vs. adjusted data). Space adaptation identifies medical events that where onset occurs in the first 5-7 days of flight and does not reoccur. EVA-related incidence values identify medical events that occur only during an EVA. Incidence values types vary by data category and define the number of medical events per person-year (rates) or medical events per person at-risk (proportion) for each medical condition. Incidence values can be modified by crew characteristics such as gender sex and certain crew medical history characteristics. Modifying characteristics are noted below and incidence values are listed individually for each characteristic. Distributions are assigned to medical events incidence values and occurrences in the model. For each crewmember in a given trial, the incidence and number of occurrences of each medical condition are randomly selected from these probability distributions. Detailed descriptions of the distributions are included in the MEDPRAT Technical Description Document.

### INCIDENCE DATA

#### SPACEFLIGHT LITERATURE

The former IMM CLiFF reports 53 paresthesia events related to EVA in 414 persons at risk. This includes data from both the 2010 and 2017 LSAH data pulls. Antonsen et al, 2017 corroborates the initial 26 cases from the 2010 LSAH data pull but does not include information from the 2017 LSAH data pull.

#### ANALOG LITERATURE

Published literature from EVA test-runs in the NBL is not specific to paresthesia. It focuses on "hot spots" caused by pressure injuries that result in contusions, abrasions, and pain other than paresthesia (Strauss, 2004). The incidence of these injuries is covered by a separate condition, "ICL46 EVA Suit Contact Injury."

#### TERRESTRIAL LITERATURE

It was assumed that terrestrial data would be inadequate for providing input that drives the incidence of this spaceflight specific condition. No terrestrial data searches were performed.

### OVERALL INCIDENCE SUMMARY

#### INCIDENCE

Mean: 0.1298
SD: 0.01657

#### INCIDENCE SUMMARY

The incidence for this condition was informed by the prior IMM CLiFF (53 events over 414 person-EVAs. IP: 0.128 (95%CI: 0.0974, 0.1641)) (NASA, Paresthesias Secondary to Extravehicular Activity CLiFF, 2017). The posterior distribution for the incidence proportion given the spaceflight data of 53 events over 414 person-EVAs under an uninformative prior is Beta(shape1=53.268, shape2=357.12) with mean 0.1298 and SD 0.01657.

#### TABLE 1. INCIDENCE MODEL

**Incidence Details**

Incidence Type
**EVA**

Segment
**EVA All**

Env. Exposure
**NA**

Sex
**Any**

Crowns
**Any**

Contacts
**Any**

Pregnancy
**Any**

**Incidence Distribution**

Occurrence Dist
**Binomial**

Incidence Dist.
**Beta**

Mean
**0.129799**

SD
**0.0165699**

Beta
**(Alpha): 53.268**
**(Beta): 357.12**

**TABLE 2. INCIDENCE LEVEL OF CONFIDENCE (LOC)**

| Citation | Source | LOC Value |
|---|---|---|
| NASA, Paresthesias Secondary to Extravehicular Activity CLiFF, 2017 | Spaceflight | 4 |
| Antonsen et al, 2017 | Spaceflight | 3 |
| Strauss, 2004 | Analog | 1 |

The 2017 IMM CLiFF reports 53 paresthesia events related to EVA in 414 persons at risk. This includes data from both the 2010 and 2017 LSAH data pulls. Antonsen et al, 2017 corroborates the initial 26 cases from the 2010 LSAH data pull but does not include information from the 2017 LSAH data pull. Strauss, 2004 is a prospective observational study of EVA related injuries during NBL training runs. It does not specify injuries due to paresthesia.

## CREWMEMBER SELECTION/PREVENTION

#### DISQUALIFYING CONDITIONS

Refer to Medical Evaluation Documents (MED) Volume A, Medical Standards for ISS Crewmembers, International Space Station Program, Rev 3.4 (2016).

#### PREFLIGHT PREVENTATIVE MEASURES

Prevention methods include optimizing suit fit, crew training including avoiding work outside of the normal work envelop, the application of suit padding and pressure absorbing dressings to known affected body areas. (Strauss, 2004)

#### BEST CASE SCENARIO DEFINITION

Mild paresthesias or local pain from a pressure or EVA suit pressure point, with tingling, numbness, and/or pain that resolves spontaneously.

#### WORSE CASE SCENARIO DEFINITION

Moderate to severe paresthesia and/or localized pain from a pressure or EVA suit pressure point that may require treatment with analgesics and/or steroids.

#### CONDITIONS INCLUDED, BUT NOT EXPLICITLY STATED (CNES)

None

## BEST CASE/WORST CASE PROBABILITY COMMENTS

Between 2002 and 2007 there were three documented cases of sensory compressive neuropathy (out of 114 reported paresthesias) during EMU NBL space suit training. Two of these involved the radial and median nerves respectfully and were both attributed to nerve compression due to poor glove fit. These resulted in the suspension of NBL training until the glove fit problems were corrected and there was full resolution of the neuropathies. One case involved the peroneal nerve at the dorsal foot and was attributed to a poor boot fit. The boot fit problem was corrected and there was full resolution of the neuropathy. In each case these took approximately 6 weeks to fully resolve. No recurrences were subsequently reported and each crew member went on to complete successful missions including multiple EVAs. These would be consistent with our definition of worst-case scenario. Therefore, the worst-case scenario probability was assigned 3/114 (2.6%) and the best-case scenario probability was assigned 97.4%.

#### TABLE 3.BEST/WORST CASE PROBABILITY LEVEL OF CONFIDENCE (LOC)

| Citation | Source | LOC Value |
|---|---|---|
| NASA, Paresthesias Secondary to Extravehicular Activity CLiFF, 2017 | Spaceflight | 3 |

The best and worst-case scenario probabilities are informed by the prior IMM CLiFF which stated that 3/114 reported paresthesia episodes from 2002-2007 in the NBL were consistent with a worst-case scenario paresthesia, taking 6 weeks to resolve.

**TABLE 4. CLIFF TREATMENT & OUTCOME TABLE BY CLINICAL PHASE**

| Case Scenario | Composite Incidence | Condition Probability % | CP1: Diagnosis | | CP2: Treatment | | | CP3: Condition End State | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | TI% | Duration | TI% | Duration | | TI% | RTDC | | LOCL | |
| | | | Preset | Preset | Preset | Min | Max | Preset | Min% | Max% | Min% | Max% |
| Treated Best Case (TBC) | Mean: 0.1298 SD: 0.01657 | 97 - 97 | 100 | 0.1 | 9.11507 | 0 | 24 | 0 | 0 | 0 | 0 | 0 |
| Treated Worst Case (TWC) | | 3 - 3 | 100 | 0.27 | 9.11507 | 24 | 168 | 0 | 0 | 0 | 0 | 0 |
| Untreated Best Case (UTBC) | N/A | N/A | N/A | 0.1 | 26.7606 | 0 | 24 | 9.11507 | 0 | 0 | 0 | 0 |
| Untreated Worst Case (UTWC) | N/A | N/A | N/A | 0.27 | 29.1257 | 24 | 1080 | 29.1257 | 0 | 0 | 0 | 0 |

**TABLE 4 KEY**

**Composite Incidence:** The same composite incidence will be used for both TBC and TWC. For EVA conditions: events per EVA (events/EVA). For space adaptation conditions: events per person (events/person). For non-spaceflight conditions: events per person year (events/py).

**Condition Probability:** The probability that CLiFF condition progresses to a worst case scenario. Best case scenario: 100%-Worst Case.

**Clinical Phase General Comments:**

- TI% = Task Impairment %. Task Impairment is the % of tasks that the crewmember is incapable of performing without impairment secondary to the medical condition.
- Durations are defined in hours.
- Removal to Definitive Care (RTDC): The probability the entire crew aborts the mission and returns to earth. This is considered as a condition end state result if any of the following criteria are met: 1) the potential for LOCL, 2) potential for significant permanent task impairment, or 3) potential for intractable pain.
- Loss of Crew Life (LOCL): The probability of death of affected crewmember due to medical condition.

**Clinical Phase 1: Initial Assessment and Diagnosis:**

- Covers only the initial assessment and diagnosis of the affected crewmember to define his or her medical condition. While the affected crewmember is being assessed, he or she is not able to perform any assigned tasks, thus Task Impairment (TI) during this phase is considered 100%. In the untreated case, there is no diagnosis performed, therefore Task Impairment and Duration will always be " not applicable."

**Clinical Phase 2: Stabilization, Treatment, and Convalescence:**

- The affected crewmember is receiving any appropriate initial or follow-on treatment for his or her medical condition to allow the crewmember to recover as much as he or she is able to recover in the spaceflight environment. Clinical phase 2 also encompasses relapses or recurrences of the same original medical condition in Clinical Phase 1. The duration of Clinical Phase 2 is expressed as minimum and maximum hours.

**Clinical Phase 3: Condition End State:**

- Reached once the affected crewmember has recovered from the medical condition as much as he or she is able to recover in the spaceflight environment amongst treated and untreated best and worst case scenarios. This may or may not be recovery from the given medical condition to the full extent possible. If this “recovered” state results in Removal to Definitive Care (RTDC) or Loss of Crew Life (LOCL) this will be noted in the condition end state results.

**SCENARIO OVERVIEW COMMENTS**

No RTDC surrogate was selected for this condition as no surrogate seemed appropriate. Typically, RTDC surrogates involve care that must be given after evacuation or return to a higher level of care. For paresthesia due to contact injuries, treatment would not differ terrestrially vs. in space. Physical therapy, nerve medications, etc. could all be given in spaceflight. An EMG for diagnostic purposes may be beneficial and that would require return to a higher level of care, but a) EMGs aren't useful until a minimum of 3 weeks after the injury (which exceeds the durations for all scenarios in this CLiFF) and b) it wouldn't be necessary during an exploration mission.

**TREATED BEST CASE (TBC) SCENARIO COMMENTS**

Duration of paresthesia varies widely in terrestrial and analog literature depending on the source. Spaceflight specific data is preferred to inform this duration. The prior IMM CLiFF provides durations based on spaceflight data (based on an in-flight "EVA Review Lockdown"). All durations in this CLiFF were taken from the IMM CLiFF given this data is specfic to spaceflight. The duration assigned for this scenario is 0-24 hours. (NASA, Paresthesias Secondary to Extravehicular Activity CLiFF, 2017) The best-case scenario definition for this condition "resolves spontaneously." Therefore, RTDC and LOCL probabilities were assigned 0%. No literature searches were performed.

**TREATED WORST CASE SCENARIO (TWC) COMMENTS**

Duration of paresthesia varies widely in terrestrial and analog literature depending on the source. Spaceflight specific data is preferred to inform this duration. The prior IMM CLiFF provides durations based on spaceflight data (based on an in-flight "EVA Review Lockdown"). All durations in this CLiFF were taken from the IMM CLiFF given this data is specfic to spaceflight. The duration assigned for this scenario is 24-168 hours. (NASA, Paresthesias Secondary to Extravehicular Activity CLiFF, 2017) No literature to indicate RTDC or mortality was identified through a NASA Technical Reports Server search. The RTDC and LOCL probabilities were therfore assigned 0%.

**UNTREATED BEST CASE (UTBC) SCENARIO COMMENTS**

Duration of paresthesia varies widely in terrestrial and analog literature depending on the source. Spaceflight specific data is preferred to inform this duration. The prior IMM CLiFF provides durations based on spaceflight data (based on an in-flight "EVA Review Lockdown"). All durations in this CLiFF were taken from the IMM CLiFF given this data is specfic to spaceflight. The duration assigned for this scenario is 0-24 hours. (NASA, Paresthesias Secondary to Extravehicular Activity CLiFF, 2017) The best-case scenario definition for this condition "resolves spontaneously." Therefore, RTDC and LOCL probabilities were assigned 0%. No literature searches were performed.

**UNTREATED WORST CASE (UTWC) SCENARIO COMMENTS**

Duration of paresthesia varies widely in terrestrial and analog literature depending on the source. Spaceflight specific data is preferred to inform this duration. The prior IMM CLiFF provides durations based on spaceflight data (based on an in-flight "EVA Review Lockdown"). All durations in this CLiFF were taken from the IMM CLiFF given this data is specfic to spaceflight. The duration assigned for this scenario is 24-1080 hours (1-45 days). Whereas the IMM CLiFF initially had 168 hours for the maximum duration of this scenario, it was changed to 1080 hours (45 days) based on information presented in the "Branch Baseline" of the IMM CLiFF stating that these typically resolve within 45 days. (NASA, Paresthesias Secondary to Extravehicular Activity CLiFF, 2017) No literature to indicate RTDC or mortality was identified through a NASA Technical Reports Server search. The RTDC and LOCL probabilities were therfore assigned 0%.

**TABLE 5. CLINICAL PHASE II DURATION LEVEL OF CONFIDENCE (LOC)**

| Citation | Source | LOC Value |
|---|---|---|
| NASA, Paresthesia Secondary to Extravehicular Activity CLiFF, 2017 | Spaceflight | 3 |

Duration of paresthesia varies widely in terrestrial and analog literature depending on the source. Spaceflight specific data is preferred to drive this duration. The IMM CLiFF provides durations based on spaceflight data (based on the "EVA Review Lockdown, 2011"). Note, the composer/editor of this CLiFF does not have access to this document, but since it is spaceflight specific was felt to be the best source for duration. All durations in this CLiFF were taken from the IMM CLiFF given this data is specific to spaceflight. The IMM CLiFF will be referenced as the source since the ExMC editor/composer of this CLiFF did not have access to the primary source.

**TABLE 6. RTDC LEVEL OF CONFIDENCE (LOC)**

| Citation | Source | LOC Value |
|---|---|---|
| N/A | N/A | 3 |

The best-case scenario definition for this condition "resolves spontaneously." Therefore, RTDC was assigned 0%. No literature searches were performed. No RTDC surrogate was selected for this condition as no surrogate seemed appropriate for worst-case scenarios. Typically, RTDC surrogates involve care that must be given after evacuation or return to a higher level of care. For paresthesia due to contact injuries, treatment would not differ terrestrially vs. in space. Physical therapy, nerve medications, etc. could all be given in spaceflight. An EMG for diagnostic purposes may be beneficial and that would require return to a higher level of care, but a) EMGs aren't useful until a minimum of 3 weeks after the injury (which exceeds the durations for all scenarios in this CLiFF) and b) it wouldn't be necessary during an exploration mission. No literature to indicate RTDC was identified through a NASA Technical Reports Server search. The worst-case RTDC probabilities were therefore assigned 0%.

**TABLE 7. LOCL LEVEL OF CONFIDENCE (LOC)**

| Citation | Source | LOC Value |
|---|---|---|
| N/A | N/A | 4 |

The best-case scenario definition for this condition "resolves spontaneously." Therefore, LOCL was assigned 0%. No literature searches were performed. No literature to indicate LOCL in worst-case scenarios was identified through a NASA Technical Reports Server search. The worst-case LOCL probabilities were therefore assigned 0%.

**CAPABILITY RESOURCE TABLE (CRT) OVERVIEW**

Capabilities and Resourcing Scope

Overview
This condition is reported by astronauts in space and likely results from localized disruptions in blood flow as an astronaut maneuvers within their space suit.

CNES: NONE

Diagnostic Scope and Resourcing
Diagnosis relies on history and physical exam

Clinical Phase 1 Duration and Rationale
This version of IMPACT presumes physician level knowledge, skill, and ability will be present on the mission. The CRT working group SME consensus duration is as follows:

CP1 BC (Treated or Untreated): 0.1 hours for history given the context of spaceflight and the self resolving nature

CP1 WC (Treated or Untreated): 0.27 hours including set up time, history, and physical exam including a focused neurological exam and careful attention to rule out mimic conditions like decompression sickness (DCS).

This condition requires a Scope of Practice 4 to rule out more dangerous conditions such as DCS

Treatment Scope and Resourcing
The best case requires no treatment. The worst case involves pain so topical and oral pain management is included with primacy given to NSAIDs.

Communications and Support Needs;

Communication needs are not expected to rise above the level of routine medical communications with the ground, given the non emergent nature of this condition

References
Barratt, Michael R., Ellen S. Baker, and Sam L. Pool. 2019. "Principles of clinical medicine for space flight." In. New York, NY: New York, NY : Springer.

**IMM CLIFF RECONCILATION COMMENTS**

This CLiFF is largely unchanged from the IMM CLiFF. The best and worst-case definitions in this CLiFF are unchanged from the IMM CLiFF. The incidence from the IMM CLiFF was used for this CLiFF, however, note there may be an overlap between this incidence and the incidence of a new condition (ICL46, EVA Related Suit Contact Injury). The incidence for EVA Related Suit Contact injury included only documented abrasions and contusions from Scheuring et al, 2009 that were related to the suit. It is unclear whether these “hot spot” injuries were also counted as paresthesia in the IMM CLiFF for paresthesia. The worst-case scenario probability of 2.6% in this CLiFF was also informed by the IMM CLiFF based on 3/114 cases of sensory compressive neuropathy from 2002-2007 in the NBL. The durations from the IMM CLiFF were used to inform this CLIFF. The RTDC and LOCL probabilities remain 0% in this CLiFF for all scenarios. Task impairment is unique in this CLiFF since it is calculated differently than Functional Impairment from IMM.

**LIMITATIONS SUMMARY**

• Some overlap between the incidence of ICL 44- EVA Related Paresthesia and ICL 46 EVA Related Suit Contact Injury may exist. The incidence for this CLiFF was taken directly from the IMM CLiFF and Antonsen et al, 2017 corroborates that the diagnosis of interest was reported as “paresthesia” for at least the first half of the events included. The incidence for ICL 46 EVA Related Suit Contact Injury was based only on documented abrasions and contusions caused by the suit (Scheuring et al, 2009). • The durations for this CLiFF were all taken from the prior IMM CLiFF which is based on an EVA Review Lockdown done in 2010. The ExMC composer/editor of this CLiFF does not have access to that primary source, but felt after looking through multiple other sources that these estimates for duration were the most reasonable given they are spaceflight specific. • The ExMC composer/editor of this CLiFF assumed that RTDC and LOCL for worst-case scenarios was 0%. A search through the NASA Technical Reports Server corroborated this assumption (i.e. no literature to support RTDC of LOCL from EVA related paresthesia was identified).

**TABLE 8. TASK IMPAIRMENT CALCULATION BASED ON AFFECTED HUMAN SYSTEMS TASK CATEGORIES (HSTC)**

| Clinical Phase 2: Treatment | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Affected HSTCs | | | | | | | | | | | |
| | Cognitive - Simple | Cognitive - Complex | Communications | Inter-personal Skills | Vision | Hearing | Cardio-pulmonary | Dentition | GI | GU | | |
| Treated Best Case (TBC) | | | | | | | | | | | | |
| Untreated Best Case (UTBC) | | 664 | | | | | | | | | | |
| Treated Worst Case (TWC) | | | | | | | | | | | | |
| Untreated Worst Case (UTWC) | | 664 | | 89 | | | | | | | | |
| | Affected HSTCs (Continued) | | | | | | | | TI Calculation | | | TI Score |
| | Hand (Dom) | Hand (Any) | Upper Extremity | Lower Extremity | Ambul & Standing (g) | Translation & Stabilization (microgravity) | Don/Doff Equipment | Pressure Ops | Total Tasks Impaired By Condition | Total Human System Category Tasks Full Mission | TI Decimal | TI % |
| Treated Best Case (TBC) | 132 | | | | | | | 211 | 343 | 3763 | 0.0911507 | 9.11507 |
| Untreated Best Case (UTBC) | 132 | | | | | | | 211 | 1007 | 3763 | 0.267606 | 26.7606 |
| Treated Worst Case (TWC) | 132 | | | | | | | 211 | 343 | 3763 | 0.0911507 | 9.11507 |
| Untreated Worst Case (UTWC) | 132 | | | | | | | 211 | 1096 | 3763 | 0.291257 | 29.1257 |

| Clinical Phase 3: Condition End State | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Affected HSTCs | | | | | | | | | | | |
| | Cognitive - Simple | Cognitive - Complex | Communications | Inter-personal Skills | Vision | Hearing | Cardio-pulmonary | Dentition | GI | GU | | |
| Treated Best Case (TBC) | | | | | | | | | | | | |
| Untreated Best Case (UTBC) | | | | | | | | | | | | |
| Treated Worst Case (TWC) | | | | | | | | | | | | |
| Untreated Worst Case (UTWC) | | 664 | | 89 | | | | | | | | |
| | Affected HSTCs (Continued) | | | | | | | | TI Calculation | | | TI Score |

| | Hand (Dom) | Hand (Any) | Upper Extremity | Lower Extremity | Ambul & Standing (g) | Translation & Stabilization (microgravity) | Don/Doff Equipment | Pressure Ops | Total Tasks Impaired By Condition | Total Human System Category Tasks Full Mission | TI Decimal | TI % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Treated Best Case (TBC)** | | | | | | | | | 0 | 3763 | 0 | 0 |
| **Untreated Best Case (UTBC)** | 132 | | | | | | | 211 | 343 | 3763 | 0.0911507 | 9.11507 |
| **Treated Worst Case (TWC)** | | | | | | | | | 0 | 3763 | 0 | 0 |
| **Untreated Worst Case (UTWC)** | 132 | | | | | | | 211 | 1096 | 3763 | 0.291257 | 29.1257 |

**TABLE 8 KEY**
Human System Task Category (HSTC) Definitions: Cognitive-Simple: Tasks requiring simple cognitive involvement (low levels of attention, following simple checklists, and not requiring extensive decision making) in conjunction with inputs from other systems. Cognitive-Complex: Tasks requiring complex cognitive involvement (requiring constant attention, frequent interpretation of outside stimuli to inform real-time situations) in conjunction with inputs from other systems. Communication: Tasks requiring primarily communication, via hearing and speaking. Interpersonal Skills: Tasks requiring interpersonal, social interaction between crew including complex technical tasks that require extended crew interaction. Vision: Tasks in which visual information is required. Hearing: Tasks in which primarily auditory information is required, excluding communication, e.g. hearing alarms, medical auscultation, OOHAs. Cardiopulmonary: Tasks requiring greater-than-baseline cardiopulmonary effort, e.g. physically strenuous activities. Dentition: Tasks requiring use of teeth for mastication. GI (Gastrointestinal): Tasks requring use of the alimentary sytem, e.g. solids/liquids consumption and solids excretion. GU (Genitourinary): Tasks requiring use of the male/female genitourinary systems. Hand (Dominant): Tasks performed using primarily the hand, requiring use of the dominant hand (piloting, medical procedures, dental procedures). Hand (Any): Tasks performed using primarily the hand(s), with no preference for dominance, with equivalent bilateral effectiveness. Upper Extremity: Tasks requiring specific use of the upper extremities, excluding hands. Lower Extremity: Tasks requiring specific use of the lower extremities (excluding ambulation and standing in the presence of gravity), e.g. using exercise equipment. Ambulation and Standing (g): Tasks requiring use of both lower extremities to accomplish ambulation or standing in the presence of gravity. Translation and Stabilization (microgravity): Tasks requiring use of either the upper or lower extremities to accomplish translational movement and stabilization (securing oneself to remain stationary) in the setting of microgravity. Don/Doff Equipment: Tasks requiring the donning of personal equipment (including pressure suit, exercise harness, EVA equipment, etc). Pressure Ops: EVA/contingency tasks performed while pressurized in a suit.

**Criteria for Assignment of Conditions to HSTCs (any of the following):**
1) Is affected crew member physically incapable of performing the human system task category, without impairment, with the condition?
2) Would the treatment (e.g. medications) impair the crewmember's ability to perform the human system task category? (Does not apply to UTx)
3) Does the condition have a high likelihood of causing a significant aeromedical contraindication with an associated human system task category
4) Would performing tasks in an associated task category worsen the condition? (If so, it is affected).
5) Does pain associated with the condition impair any further human system categories?

## TASK IMPAIRMENT COMMENTS

CP2: No comment. CP3: No comment.

## EVIDENCE COLLECTION PROCESS

Mesh terms that most closely resembled the best-case and worst-case scenarios, and associated Conditions Included but Not Explicitly Stated (CNES), were utilized to build incidence, duration, RTDC, and LOCL searches by best- and worst-case.

**Incidence:**
Databases searched for spaceflight and analog incidence data included: PubMed, Google Scholar, NASA Technical Reports Server (NTRS) public search, Defense Technical Information Center (DTIC), and Barratt MR, Baker E, Pool SL. Principles of Clinical Medicine for Space Flight. New York, NY: Springer; 2019. 2nd Edition. Databases searched for terrestrial incidence included: DynaMed, PubMed, and Google Scholar.

**Duration, RTDC, LOCL:**
Databases searched for duration, RTDC, and LOCL included: Dynamed, Cochrane, PubMed, and Google Scholar. Note, that if duration, RTDC, or LOCL data was found in a DynaMed search, the other search engines were not included. Relevant articles were selected and reviewed. If applicable, the article was included in the CLiFF.

## LEVEL OF CONFIDENCE (LOC) SCORING

Articles obtained to update the evidence behind this CLiFF were scored by ExMC editors, based on their applicability to the Exploration Spaceflight environment using the following grading scale:

4 – Confident
3 – Somewhat confident
2 – Neutral
1 – Somewhat unconfident
0 – Not confident

The following considerations factor into the grading scale above:

• How closely does the paper describe the medical condition as defined by the IMPACT 1.0 Condiltion List (relevance)?
• How closely does the population included resemble the astronaut population?
• Quality of the paper (number of subjects, methods, etc.)
• How much does the editor trust the source of the evidence?
• How closely does the editor think that the data represents the exploration spaceflight environment?
• Other considerations, at the discretion of the editor, supported in the comments for LOE scoring.

## REFERENCES


| Reference |
| --- |
| 1. Antonsen E, Bayuse T, Blue R, Daniels V, Hailey M, Hussey S, et al. Evidence Report: Risk of Adverse Health Outcomes and Decrements in Performance due to In-Flight Medical Conditions. Johnson Space Center: NASA; 2017. No: TR20170004604. |
| 2. Scheuring RA, Mathers CH, Jones JA, Wear ML. Musculoskeletal injuries and minor trauma in space: incidence and injury mechanisms in U.S. astronauts. Aviat Space Environ Med. 2009; 80(2):117–24 |
| 3. Strauss S. Extravehicular Mobility Unit Training Suit Symptom Study Report. Johnson Space Center: NASA; 2004. No: TP–2004–212075. |
| 4. NASA. Paresthesias Secondary to Extravehicular Activity Clinical Information Findings Form. Integrated Medical Database of the Human Health and Performance Contract Integrated Medical Model Project. 2017;v6.5. |


## ACRONYMS

| ACRONYM | PHRASE |
| --- | --- |
| **AAOMS** | American Association of Oral and Maxillofacial Surgeons |
| **AMA** | American Medical Association |
| **ARCL** | All Remaining Conditions List |
| **ARS** | Acute Radiation Sickness |
| **BHP** | Behavioral Health and Performance |
| **CAC** | Coronary Artery Calcium |
| **CHS** | Crew Health and Safety |
| **CL** | Condition List |
| **CliFF** | Clinical Finding Form |
| **CMO** | Crew Medical Officer |
| **COMFORT** | Clinical Outcome Metrics for Optimization of Robust Training |
| **CP1** | Clinical Phase 1 |
| **CP2** | Clinical Phase 2 |
| **CP3** | Clinical Phase 3 |
| **CRL** | Clinical Resource Level |
| **CRT** | Capability Resource Table |
| **CST** | Clinical Science Team |
| **DCS** | Decompression Syndrome |
| **DRM** | Design Reference Mission |
| **ED** | Emergency Medicine Doctor |
| **EL** | Evidence Library |
| **EMCL** | Exploration Medical Condition List |
| **EMT** | Emergency Medical Technician |
| **EVA** | Extravehicular Activity |
| **EXMC** | Exploration Medical Capability |
| **HRP** | Human Research Program |
| **ICD** | International Classification of Disease |

| | |
|---|---|
| **ICL 1.0** | IMPACT 1.0 Medical Conditions List |
| **ICU** | Intensive Care Unit |
| **IMCL** | iMED Condition List |
| **iMED** | Integrated Medical Evidence Database |
| **IMM** | Integrated Medical Model |
| **IMPACT-MD** | Impact Medical Database |
| **IP** | Incidence Proportion |
| **IR** | Incidence Rate |
| **ISS** | International Space Station |
| **IV** | Intravenous |
| **JSC** | Johnson Space Center |
| **LEO** | Low-Earth orbit |
| **LEVA** | Lunar Extravehicular Activity |
| **LOCL** | Loss of Crew Life |
| **LOM** | Loss of Mission |
| **LSAH** | Lifetime Surveillance of Astronaut Health |
| **LSO** | Lunar Surface Operations |
| **MCL** | Master Condition List |
| **MEVA** | Medical Extravehicular Activity |
| **NASA** | National Aeronautics and Space Administration |
| **N/A** | Not Applicable |
| **NP** | Nurse Practitioner |
| **OBGYN** | Obstetrics and Gynecology |
| **OR** | Occurrence Rate |
| **PA** | Physician Assistant |
| **PDQ** | Pain Disability Questionnaire |
| **PFCL** | Proposed Future Conditions List |
| **PPE** | Personal Protective Equipment |
| **PTRS** | Project Technical Requirements Specification |
| **PRL** | Pharmaceutical Resource Level |
| **QTL** | Quality Time Lost |
| **RCL** | Removed Conditions List |
| **REP** | Rochester Epidemiology Study |
| **RTDC** | Removal to Definitive Care |
| **SANS** | Spaceflight-Associated Neuro-ocular Syndrome |
| **SAS** | Space Adaptation Syndrome |
| **SEVA** | Spaceflight Extravehicular Activity |
| **SME** | Subject Matter Expert |
| **SoP** | Standard Operating Procedure |
| **SPE** | Solar Particle Event |
| **TBD** | To Be Determined |
| **TI** | Task Impairment |