Clinical Finding Form (CliFF)

Branch	Baseline

ICL97_Space Adaptation - Space Motion Sickness

Space Motion Sickness (SMS) is a phenomenon that is experienced by large proportion of spaceflight crew members, up to 60% (Davis et al., 1998; Ortega et al., 2019), that results in general malaise, nausea, gastrointestinal discomfort, and fatigue. There are several theories to explain its etiology including cephalad fluid shifts and neuroanatomical sensory conflicts (Russomano et al., 2019; Lackner et al., 2006). SMS is considered to be part of Space Adaptation Syndrome. This CLiFF condition only includes SMS which initiates from transitioning from gravity to microgravity. Entry Motion Sickness (EMS) or Earth-readaptation syndrome is a similar condition that results from transitioning from microgravity to gravity, and is handled in a different CLiFF.

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

This condition is tied explicitly to being in spaceflight, and consequently incidence from LSAH pulls and previous IMM efforts are rated most highly. Unfortunately, at the time of this CLiFF completion, a repeat LSAH gathering event was not possible and missions past 2017 are not represented. Of note, the authors of this CLiFF recommend that should a repeat LSAH pull become available, the incidence for this CLiFF condition be recalculated given the many limitations and assumptions needed to interpret the prior IMM incidence calculation. In the prior CLiFF effort, entitled “Space Motion Sickness (space adaptation)”, the authors did not use LSAH data from the Walton pull as they believed that this condition was significantly under-reported in the early missions. Instead, data gathered from the Ortega et al. (2008) for Barratt et al (2008) which stemmed from Reschke et al. (1993 and 1996). The crewmembers from Mercury and Gemini (a total of n=26) were subtracted as the other conditions in IMM did not account for these missions. The authors report: “the incidences per mission are: Apollo 11/33 = 0.33; Skylab 5/9 = 0.56; Apollo-Soyuz Test Project = 0; Space Shuttle, 1981-1986 57/85= 0 .67, 1988-1998, 252/315 = 0.80.” which led to “the cumulative incidence (# events / # crew) for the US space program, from 1962 to 1998 is (325/445) = 0.73.” When reviewing this data in the recent corresponding Barratt chapter (2019), the authors of this effort noted some inconsistencies. For example, Shuttle 81-86 is reported as 74 events/103 mission. Further, the Ortega et al. (2019) hypothesize in their chapter that events were less frequent in the early missions as crewmembers had less freedom of movement in their smaller cabin sizes, which is a protective factor against space motion sickness. The previous CliFF furthers adds data from the Saile pull (2017): “Added the incidence information from the real world system. Added 95 new medical events (18 ISS for a total of 18 and 77 STS to the existing 309 events for total of 386 STS events). Added 144 persons at risk to the 445 persons at risk for a new total of 589 persons at risk (Saile, 2017). Updated the Persons at Risk based on the revised real world system integrated incidence data. The integrated RWS persons at risk from 144 to 143 so the conditions integrated iMED value went from 589 to 588 (Saile L., 2017).” Incidence calculated for the prior CliFF was noted to be 419 events/588 persons at risk. Again, the authors of this effort do not have access to the raw LSAH data, but they are unable to reconcile why the number of events was not 420 (=325 + 95). After consultation with the biostatistician, the authors of this effort chose to not change the previous IMM incidence uncorrected as there was no way to determine which calculations were more right than others without the raw data. However, should future LSAH pulls occur, it is recommended that a new incidence be recalculated using updated data, including the early missions. Antonsen et al. (2017) was rated less highly than the data in the previous IMM CLiFF as the data compiled in these tables come directly from LSAH pulls as well and Table 1 could not be adequately reconciled with this specific condition’s definition. For example, ‘SMS’, ‘Vestibular’ and ‘Fluid Shift categories are all potentially related to this condition.” Table 1 was mislabeled as 'ISS through Exp 40' when it should read ' ISS expeditions 9 and 14 through 40'. Of note, there are 325 events (similar to what is reported in the previous IMM effort above) in Table 2. The authors of this CliFF wonder whether, the authors of the previous effort had mistakenly used this value rather than individually adding the incidences per mission as they report. There are several other individual studies detailing both the United States and Russian (or Soviet Union) experience with SMS (Davis et al., 1988; Heer et al., 2006, Oman et al., 1996, Gontcharov et al., 2005) however these studies were downrated secondary to limited years of inclusivity and often small sample sizes.

ANALOG LITERATURE

SMS has been attempted to be replicated by the similar conditions that evokes space adaptation-headache (ICL 94) with a head-down tilt bed rest (Prakash et al., 2015). However, unlike in space adaptation-headache, this is not a clinically relevant method for inducing SMS.

TERRESTRIAL LITERATURE

This is a space-related condition and there are no applicable terrestrial studies.

OVERALL INCIDENCE SUMMARY

INCIDENCE

mean 0.7121 person-missions and SD 0.01875

INCIDENCE SUMMARY

The Bayesian posterior distribution for the incidence proportion given the spaceflight data (419 events over 588 person-missions) under an uninformative prior is Beta(shape1=414.55, shape2=167.6) with mean 0.7121 person-missions and SD 0.01875. Spaceflight evidence – 419 events over 588 person-missions. IP: 0.7126 (95%CI: 0.6742, 0.7489) This translates to a Beta (shape1=414.55, shape2=167.6) distribution.

TABLE 1. INCIDENCE MODEL

Incidence Details

Incidence Type
SAS

Segment
Space Adaptation

Env. Exposure
NA

Sex
Any

Crowns
Any

Contacts
Any

Pregnancy
Any

Incidence Distribution

Occurrence Dist
Binomial

Incidence Dist.
Beta

Mean
0.712102

SD
0.01875

Beta
(Alpha): 414.55
(Beta): 167.6

Onset Timing (Hours)
(Min): 1
(Max): 120
(Most Likely): 6

TABLE 2. INCIDENCE LEVEL OF CONFIDENCE (LOC)

Citation	Source	LOC Value
Ortega et al., 2008	Spaceflight	3
Reshcke et al., 1993	Spaceflight	1
Reshcke et al., 1993	Spaceflight	1
Ortega et al., 2019	Spaceflight	3
Saile et al., 2017	Spaceflight	3
Antonsen et al., 2017	Spaceflight	2

Citation	Source	LOC Value
Davis et al., 1988	Spaceflight	1
Heer et al., 2006	Spaceflight	1
Oman et al., 1996	Spaceflight	1
Gontcharov et al., 2005	Spaceflight	1
Prakash et al., 2015	Analog	0

Spaceflight incidence data was rated the highest as this is a condition, by definition, that can only occur in space. Analog and terrestrial studies would not accurately represent incidence for this condition.

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

This CLiFF condition is event-based and consequently there are no known preventative measures. However, to help exclude other causes of neurological pathologies, at L-21/18 months, if greater than 2 years since ISS section, crewmembers undergo MRI/MRA neuroimaging, a full annual medical exam L-6/9 months and brief medical exams at L-7/10 and L-1/2 days by the Flight Surgeon.

BEST CASE SCENARIO DEFINITION

Space motion sickness including mild to moderate symptoms (e.g. loss of appetite, malaise, stomach awareness, 2 or fewer episodes of emesis, resolves within 72 hours, causes no or minimal performance decrement).

WORSE CASE SCENARIO DEFINITION

SMS with severe and persistent symptoms (e.g. need to keep head from moving, greater than 2 episodes of emesis, significant performance decrement, persists for greater than 72 hours).

CONDITIONS INCLUDED, BUT NOT EXPLICITLY STATED (CNES)

None

BEST CASE/WORST CASE PROBABILITY COMMENTS

Per the prior IMM iteration: “The BC/WC percentages were updated based on the empirical data from the Real World System data set. We are estimating our worst-case scenario at 3.19% (3/94), thus our best case is 96.81% 91/94 (Saile L., 2017).” However, in Davis et al. (1988) and replicated in Barratt et al. (2019), severe cases were defined almost exactly to the worst-case definition (“…more than two episodes of vomiting...”) and accounted for 15% of all SMS cases., whereas mild cases were 49% and moderate cases were 36%. The reason for the discrepancy between these two sources is currently unclear, but the authors of this CliFF chose to use the more recent reported LSAH calculations given that it is inclusive of the later missions. However, should a LSAH pull occur in the next effort, the authors recommend repeating this calculation and justifying the discrepancy.

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

Citation	Source	LOC Value
Saile et al., 2017	Spaceflight	3
Davis et al., 1988	Spaceflight	2

Only spaceflight data was utilized given the condition’s definition. Worst-case probability estimates from the previous IMM CLiFF effort were used as there had been no further studies published in the interim.

TABLE 4. CLIFF TREATMENT & OUTCOME TABLE BY CLINICAL PHASE

			CP1: Diagnosis		CP2: Treatment			CP3: Condition End State				
			TI%	Duration	TI%	Duration		TI%	RTDC		LOCL	
Case Scenario	Composite Incidence	Condition Probability %	Preset	Preset	Preset	Min	Max	Preset	Min%	Max%	Min%	Max%
Treated Best Case (TBC)	mean: 0.7121 person-missions SD: 0.01875	97 - 97	100	0.53	13.3138	0	72	0	0	0	0	0
Treated Worst Case (TWC)		3 - 3	100	0.53	30.9593	72	336	0	0	0	0	0
Untreated Best Case (UTBC)	N/A	N/A	N/A	0.53	33.3245	0	72	0	0	0	0	0
Untreated Worst Case (UTWC)	N/A	N/A	N/A	0.53	66.7287	72	336	0	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

Space motion sickness is part of space adaptation syndrome and is thought as a response of the neuro-vestibular system adapting to microgravity (Ortega et al., 2019). Symptoms of this condition have included nausea, pallor, cold sweating, increased salivation, drowsiness, pain, and central nervous system defects (Graybiel et al., 1968). Most symptoms develop within the first hours of microgravity but have begun to resolve or have dissipated completely by 72-96 hours (Lackner et al., 2006). The best-case adheres to this typical pattern and the worst-case refers to a particularly symptomatic case that continues persist past the fourth day. Given that this condition only exists in microgravity, there is no acceptable RTDC terrestrial-surrogate for this condition.

TREATED BEST CASE (TBC) SCENARIO COMMENTS

Symptoms of SMS can occur within minutes of being in microgravity (Ortega et al., 2019); hence the lower bound for duration was set at zero hours. The treated worst-case is defined as having both severe and persistent symptoms, greater than 72 hours. Consequently, the upper bound of duration was set at 72 hours.

TREATED WORST CASE SCENARIO (TWC) COMMENTS

By definition, the lower bound for the worst-case is set at 72 hours. In Matsnev et al. (1983) there was a case of SMS that continued over 14 days inflight, creating the upper bound. In the Russian long-duration mission experience, some astronauts intermittently experienced symptoms throughout their entire stay during microgravity (Ortega et al.2019; Kornilova et al., 1996). Still, these occurrences were described as relatively benign and did not affect mission tasks. To date, there have been no instances of RTDC or LOCL secondary to this condition in spaceflight.

UNTREATED BEST CASE (UTBC) SCENARIO COMMENTS

There exists little accessible data regarding duration for the untreated best case. Subject matter expert consensus was that it would be no less than the treated best-case-scenario. Again, RTDC and LOCL are not expected for this condition.

UNTREATED WORST CASE (UTWC) SCENARIO COMMENTS

Duration is expected to be no less than the treated worst-case-scenario. To date, there have been no instances of RTDC or LOCL secondary to this condition in spaceflight

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

Citation	Source	LOC Value
Ortega et al., 2019	Spaceflight	4
Matsnev et al., 1983	Spaceflight	
Kornilova et al., 1996	Spaceflight	

The duration of SMS has been well characterized in several reviews, cross-sectional surveys and case reports.

TABLE 6. RTDC LEVEL OF CONFIDENCE (LOC)

Citation	Source	LOC Value
Walton, 2010	Spaceflight	4
Saile et al., 2017	Spaceflight	

Only spaceflight data was utilized given the condition’s definition.

TABLE 7. LOCL LEVEL OF CONFIDENCE (LOC)

Citation	Source	LOC Value
Walton, 2010	Spaceflight	4
Saile et al., 2017	Spaceflight	

Only spaceflight data was utilized given the condition’s definition.

CAPABILITY RESOURCE TABLE (CRT) OVERVIEW

Capabilities and Resourcing Scope

Overview
Space adaptation motion sickness is a common condition experienced by most astronauts. It can often be exacerbated by frequent rapid head movements soon after entering microgravity, and mitigated by limiting such movements until the brain has had time to adapt to the new surroundings.

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): 0.53 hours for set up, history, and physical exam.

CP1 WC (Treated or Untreated): 0.53 for a set up, history, and a more thorough exam including neurological, fundoscopic, and vision testing to rule out other, more dangerous causes of headaches.

This condition requires a Scope of Practice 4 to manage and rule out other similar presenting conditions, assess treatment response, and assess fitness for duty. However, most of the treatment will not rise above level 1 and the more common best case requires only SoP 1.

Treatment Scope and Resourcing
The best case is mild and treatment includes oral antiemetics. The worst case has the same treatment but lasts longer and will require additional doses of antiemetics. Ondansetron is given a primacy of 1. Anti-vertigo medications are also included for the worst case. and a reassessment of the patient.

Communications and Support Needs;

Communications are not expected to be necessary beyond the routine medical ground communications given the context and frequency of this condition. However, it is expected that routine ground communication will be present and available to assist with treatment.

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

The predecessor to this CLiFF was entitled “Space Motion Sickness (space adaptation).” Given lack of access to the original LSAH pulls and this being a condition that only occurs in microgravity, many of the resources between this CLiFF and the prior iteration remain the same. For this effort, with the help of a biostatistician, incidence data was updated to reflect person-missions rather than person-years as this condition can only be expected to occur at the initiation of spaceflight. The authors of this CLiFF did not agree with the duration values in the prior effort, and these were updated to better reflect the best- and worst-case definitions with a broader literature search.

LIMITATIONS SUMMARY

• The incidence should be considered a floor as some crewmembers may have minimized or denied their symptoms over fear of not being considered for future crew assignment. This was probably more of an issue during the Shuttle era when spaceflight lasted 2 weeks or less than it is during long-duration flights. • The authors did not have access to the original LSAH data and thus there was an implied dependence on already published sources. In the prior IMM CLiFF, the Walton LSAH pull was not used, and the authors of this CLiFF were unable to reconcile their calculations. • There may be some overlap between this condition and other CLiFF conditions, such as space adaptation headache. • Several assumptions needed to be made regarding duration and the untreated cases given lack of available studies.

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)							145		13			
Untreated Best Case (UTBC)		664		89			145		13			
Treated Worst Case (TWC)		664					145		13			
Untreated Worst Case (UTWC)	223	664		89			145		13			
	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	501	3763	0.133138	13.3138
Untreated Best Case (UTBC)	132							211	1254	3763	0.333245	33.3245
Treated Worst Case (TWC)	132							211	1165	3763	0.309593	30.9593
Untreated Worst Case (UTWC)	132	564	414	22		34		211	2511	3763	0.667287	66.7287

	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)												
	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)									0	3763	0	0
Treated Worst Case (TWC)									0	3763	0	0
Untreated Worst Case (UTWC)									0	3763	0	0

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.

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Reference
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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