

Clinical Finding Form (ClIFF)

Branch Baseline

ICL13_Bhp - Adjustment Disorder

Adjustment disorder occurs when there is a maladaptive response, either emotional or behavioral, to a recognized psychosocial stressor (O'Donnell et al., 2019). The reaction must ensue within three months of the reactionary event. The resulting response must be uncharacteristic or out of proportion to the severity of socially accepted reactions. The symptoms must not represent normal bereavement, nor can they be attributed to a different behavioral disorder (Zelviene et al., 2018). The DSM-5 changed the classification of this condition to a traumatic condition; however, the actual definition of adjustment disorder has not changed from the DSM-4 (Bachem et al., 2018). Adjustment disorder should resolve when the stressor is removed or a different level of adaptation is reached, which can include a transition to a different mental-health pathology. In previous IMM efforts, all behavioral pathologies were grouped into a single ClIFF entitled "Behavioral Emergency ClIFF." For this iteration, with the expertise from NASA's Behavioral Health and Performance (BHP) program, certain syndromes that were thought to be most relevant to spaceflight were identified for their own ClIFF conditions. Regrettably, previous LSAH pulls did not attempt to classify behavioral conditions. A repeat LSAH pull is not currently possible. Per the prior effort: "to date, no behavioral emergencies have occurred before, during or after any U.S. space flight." Unfortunately, it is unknown how this statement relates to the incidence of adjustment disorder, as this condition is often not characterized as an emergency. Related conditions covered in other ClIFFs include anxiety, depression, grief-reaction, psychosis secondary to depression and sleep disturbance.

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

Although there are numerous studies and reports detailing behavioral pathologies in spaceflight, there is a paucity of literature pertaining to this specific condition. In Boyd et al. (2007) a questionnaire was used to calculate a depression score among American astronauts and Russian cosmonauts aboard the International Space Station (ISS); adjustment disorder was not mentioned. Kanas et al., (2005) analyzed a questionnaire of America and Russian crewmembers and mission control personnel who were involved in international long-duration missions to the Mir space station and the International Space Station. The authors concluded that there were demonstrated changes in levels of mood and group climate over time but did not diagnose and psychiatric conditions. Kanas et al. (2008) analyzed the content of crewmembers' communications to elucidate psychological emotional status but made conclusions regarding generalizations and not specific psychiatric disorders.

ANALOG LITERATURE

In Palinkas et al. (2004), 220 men and 93 women who spent a full winter at either McMurdo or South Pole Antarctic stations were debriefed by three psychiatrists and one clinical psychologist between 1994 and 1997. All participants, who were either military or civilian personnel were required to undergo medical and psychological evaluations prior to deploying to Antarctica. All subjects remained in Antarctica for approximately 12 months. Evaluation of participants consisted of an interview with a U.S. Navy psychiatrist and clinical psychologist and completion of multiple standardized clinical assessments, including the Minnesota Multiphasic Personality Inventory (MMPI) (33), the 16-Personality Factor Test (16-PF) (34) and the Michigan Alcoholism Screening Test (MAST). Although this was a voluntary study and was likely limited secondary to participant hesitation for fear that future deployments might be affected, this was a highly screened population similar to what we might expect from spaceflight crews. This study presented prevalence data, but incidence data was able to be calculated given the data provided. Bohnker et al. (1992) conducted a descriptive study of 150 patients on an aircraft carrier over the course of 11 months (July 1990 – May 1991). The ships population was used as a representative control group. This was not a highly screened population as these were surface-line recruits. There were a total of 2827 people onboard the ship and a total of 21 diagnoses of "adjustment disorder." Campbell et al. (2021) performed a retrospective longitudinal study utilizing the military health system datasets for active United States Army individuals from 2005-2011. Although there were three study groups (Deployed, Combat-Exposed; Deployed, Not-Combat-Exposed; and Not Deployed), only deployed, Not-Combat-Exposed would be relevant to our target population. In this study, there were over 80752 subjects with 13,329 diagnoses of adjustment disorder over 130,353 person-years resulting in an incidence rate of 10.2/100 person-years (Std error:1.4). This study was downrated as the population involved was not highly screened. In Tansey et al. (1979) medical reports from 1963-1973 of 885 fleet ballistic missile submarine patrols were analyzed and compared to illness rates found in crewmembers on surface-level vessels. Within this timespan there was only one reported event of transient stress reaction out of a total of 7,650,000 man-days. This study is severely limited by lack of voluntary reporting and psychiatric definition changes.

TERRESTRIAL LITERATURE

Gradus et al., (2014) conducted a retrospective review of Danish-born citizens of Denmark who were diagnosed with stress and adjustment

disorders between January 1, 1995 and December 31, 2011. To calculate incidence data, Danish population demographics were used from medical and social longitudinal registers. An incidence rate for this population (n=66,823) was calculated to be 97 per 100,000 person-years.

OVERALL INCIDENCE SUMMARY

INCIDENCE

mean 0.03834 and SD 0.01113

INCIDENCE SUMMARY

Bayesian posterior distribution for the incidence rate given the analog data (12 events over 313 person-years is Gamma(shape=11.866, rate=309.6) with mean 0.03834 and SD 0.01113.

TABLE 1. INCIDENCE MODEL

Incidence Details
Incidence Type
General
Segment
All
Env. Exposure
NA
Sex
Any
Crowns
Any
Contacts
Any
Pregnancy
Any
Incidence Distribution
Occurrence Dist
Poisson
Incidence Dist.
Gamma
Mean
0.0383269
SD
0.0111263
Gamma
(Shape): 11.866
(Rate): 309.6

TABLE 2. INCIDENCE LEVEL OF CONFIDENCE (LOC)

Citation	Source	LOC Value
Bohnker et al., 1992	Analog	2
Campbell et al., 2021	Analog	2
Palinkas et al., 2004	Analog	3
Tansey et al., 1979	Analog	1
Gradus et al., 2014	Terrestrial	1

Incidence was calculated from analog studies as spaceflight studies did not characterize behavioral pathologies into specific psychiatric diagnoses and there were no available LSAH data.

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

There exists several preflight behavioral evaluations. A cognitive assessment measuring memory, attention reasoning and spatial processing is performed for every crewmember participating in missions greater than 30 days. A behavior observation of training is also required in two preflight training sessions to provide data about individual behavior and crew interactions. An assessment of crew flight readiness is done during the preflight psychiatric/psychologic status check which occurs at both L-240/180 and L-90/30 days.

BEST CASE SCENARIO DEFINITION

Adjustment reactions caused by stressful events that alleviate without any impact to the mission or personal life, and/or requires pharmacological therapy PRN, or behavioral health intervention and increasing behavioral health countermeasures.

WORSE CASE SCENARIO DEFINITION

Adjustment Disorders that cause significant distress or decline in areas including but not limited to work performance, sleep, or interpersonal dynamics, and require long-term pharmacologic therapy (minimum 6 months) and/or behavioral health intervention.

CONDITIONS INCLUDED, BUT NOT EXPLICITLY STATED (CNES)

BHP - Adjustment Reaction

BEST CASE/WORST CASE PROBABILITY COMMENTS

In O'Donnell et al. (2016), individuals between the ages of 16 to 70 years old with injury admissions to level 1 trauma centers in Australia between April 2004 to February 2006 were assessed at 3 and 12 months using the Clinician Administered PTSD Scale, the Mini-International Neuropsychiatric Interview 5.5, and the World Health Organization Quality of Life-BREF. A total of 782 participants completed assessments at both timepoints. Out of 156 participants that were diagnosed with adjustment disorder at three months, only 54 of these continued to have adjustment disorder at 12 months. Consequently, the worst-case scenario from this study was estimated to be 34.6% (54/156). Unfortunately, there was not a 6-month time-point consistent with this CLIFF definition and consequently this result may be an underestimation.

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

Citation	Source	LOC Value
O'Donnell et al., 2016	Terrestrial	2

Studies were limited given the change in definitions in Diagnostic and Statistical Manual of Mental Disorders (DSM) and lack of epidemiological research for the worse-case condition. The worst case probability is likely an underestimation given that there were no epidemiological studies that exactly fulfilled the worst-case definition.

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 0.03834 and SD 0.01113	65 - 65	100	0.7333	0	24	4380	0	0	0	0	0
Treated Worst Case (TWC)		35 - 35	100	0.7333	29.1257	4380	8760	0	0	7.1	0	0
Untreated Best Case (UTBC)	N/A	N/A	N/A	0.7333	0	24	4380	0	0	0	0	0
Untreated Worst Case (UTWC)	N/A	N/A	N/A	0.7333	29.1257	4380	8760	0	0	7.1	0	4

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

Diagnosing adjustment disorder is extremely difficult as there is no recognized gold standard DSM-5 diagnostic instrument (O'Donnell et al., 2019). Previously, adjustment disorder had a chronic specifier in the DSM-4, however this was removed from the DSM-5. Although this modifier no longer present, the best-case likely refers to what was previously termed acute adjustment disorder and the worst-case likely refers to what was previously termed chronic adjustment disorder (symptoms lasting longer than 6 months). According to the DSM-5, emotional or behavioral symptoms must occur after an identifiable stressor within 3 months and the condition must resolve or transition within 6 months of when the stressor is removed. Theoretically, adjustment disorder can last indefinitely if the stressor is still present, however most people experience an eventual adaption response to the stressor (O'Donnell et al., 2016). The RTDC surrogate for this condition was hospitalization.

TREATED BEST CASE (TBC) SCENARIO COMMENTS

By definition, adjustment disorder must occur within the first three months of a stressor, which is notably different from acute stress-reactions. However once adjustment disorder occurs, the authors of this CLIFF could not locate any data regarding the shortest possible duration of this disorder. In the most benign case, it was the gestalt of subject-matter-experts, that subjects would experience unproportionate reactions for at least 24 hours. The upper-bound on duration was taken from the previous DSM-4 criteria of being what was considered as acute adjustment disorder, less than six months (Carta et al., 2009). RTDC and LOCL are not expected in the best-case scenario.

TREATED WORST CASE SCENARIO (TWC) COMMENTS

The worst-case scenario pertains to a more devastating case of adjustment disorder and must be treated with at least six months of pharmacologic therapy, creating the lower bound of duration (4380 hours). Given the varying definitions of adjustment disorder between DSMs and subsequently research of corresponding era, an upper-bound was difficult to determine. Still, more recent studies using the DSM-5 criteria have utilized 12 months (8760 hours) as the longest time-points (O'Donnell et al., 2016; Rachyla et al., 2018). The authors of this CLIFF do recognize the theoretical possibility of adjustment disorder lasting to the end-of-mission if the stressor is not removed or the crewmember is not capable of adaptation; however, given the preflight screening, we believe that the probability of this is exceedingly low and that 12 months was a better estimate. Hospitalization for severe cases of adjustment disorder do occur. Albeit limited by changes in definitions in the DSM, a study of patients admitted through the psychiatric emergency demonstrated that 7.1% of adults were diagnosed with adjustment disorder (Greenberg et al., 1995). Another study found adjustment disorder to be the diagnosis of 7.8% inpatient psychiatric consults (Strain et al., 1998). Albeit these studies are only prevalence rates, they were used as an estimate of the upper-bound for RTDC given that the rate of hospitalization for adjustment disorder could not be found after a comprehensive literature search. The authors of this CLIFF also recognize that this may be an overestimation given the preflight screening that occurs in crewmembers. . LOCL is not expected for the treated case.

UNTREATED BEST CASE (UTBC) SCENARIO COMMENTS

There was a lack of systematic studies available to determine duration for the untreated best-case. The untreated best-case would be expected to last no less than the treated best case. RTDC and LOCL are not expected for the best-case scenario.

UNTREATED WORST CASE (UTWC) SCENARIO COMMENTS

There was a lack of systematic studies available to determine duration for the untreated worst-case as current convention is to pursue treatment. The untreated worst-case would be expected to last no less than the treated worst-case and accordingly the same range for duration and RTDC was used. Suicidality does occur in those diagnosed with adjustment disorder; without adequate treatment, LOCL is possible. In a population-based, case-control study in Denmark, adjustment disorder was diagnosed in 7.6% of suicide cases, approximately 12 times the rate of suicide as those without an adjustment disorder diagnosis (Gradus et al., 2010). In a retrospective review of patients given the diagnosis of adjustment disorder by the department of psychiatry at the University of Iowa Hospitals between 1971 through 1974, the risk of suicide was found to be 4%, mostly along with presence of alcohol abuse (Andreasen et al., 1982; Patra et al., 2013). However, in a highly screened spaceflight population, this value is expected to be less.

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

Citation	Source	LOC Value
Carta et al., 2009	Terrestrial	2
O'Donnell et al., 2016	Terrestrial	

Citation	Source	LOC Value
Rachyla et al., 2018	Terrestrial	

Duration was largely predetermined by the condition's DSM and scenario definitions. The upper-bound of the worst-case scenario duration was estimated to be the longest time-points in prospective, but low-powered studies.

TABLE 6. RTDC LEVEL OF CONFIDENCE (LOC)

Citation	Source	LOC Value
Greenberg et al., 1995	Terrestrial	1
Strain et al., 1998	Terrestrial	

There were no data available regarding the rate of hospitalization in adjustment disorder. RTDC was estimated from prevalence of institutional reviews of psychiatric hospitalizations.

TABLE 7. LOCL LEVEL OF CONFIDENCE (LOC)

Citation	Source	LOC Value
Gradus et al., 2010	Terrestrial	2
Andreasen et al., 1982	Terrestrial	
Patra et al., 2013	Terrestrial	

LOCL was estimated from single-institution, low-powered sample sizes.

CAPABILITY RESOURCE TABLE (CRT) OVERVIEW

Capabilities and Resourcing Scope

Overview

Worst Case Definition: Adjustment Disorders that cause significant distress or decline in areas including but not limited to work performance, sleep, or interpersonal dynamics, and require long-term pharmacologic therapy (minimum 6 months) and/or behavioral health intervention.

Best Case Definition: Adjustment reactions caused by stressful events that alleviate without any impact to the mission or personal life, and/or requires pharmacological therapy PRN, or behavioral health intervention and increasing behavioral health countermeasures.

Diagnostic Scope and Resourcing

In the best-case scenario, diagnosis is based on a focused psychiatric history, psychiatric review of systems, mental status exam and assessment and plan. Additionally, vital signs and a cardiopulmonary exam should be conducted
For behavioral health conditions ground communication and further higher-level psychiatric consultation should occur for diagnostic clarification.

In the worst-case scenario, diagnosis is based on a focused psychiatric history, psychiatric review of systems, mental status exam and assessment and plan. Additionally, vital signs and a cardiopulmonary exam should be conducted
For behavioral health conditions ground communication and further higher-level psychiatric consultation should occur for diagnostic clarification.

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): 0.7333 (44 min).

1. Obtain Vital Signs
2. Take a proper history of the patient and psychiatric ROS
3. Perform a cardiopulmonary exam
4. Perform a mental status exam
5. Interpret the history and MSE
6. Obtain a psychiatry consult
7. Establish ground communication

CP1 WC (Treated or Untreated): 0.7333 (44 min)

1. Obtain Vital Signs
2. Take a proper history of the patient and psychiatric ROS
3. Perform a cardiopulmonary exam
4. Perform a mental status exam
5. Interpret the history and MSE
6. Obtain a psychiatry consult
7. Establish ground communication

The highest scope of practice code used in this CRT which includes interpretation of diagnosis, performing diagnostic tests and performing treatment would be a four, or an intern level.

Treatment Scope and Resourcing

Most best-case terrestrial populations resolve with ongoing brief psychotherapeutic interventions and do not require ongoing medication management. Cognitive behavioral therapy is an effective psychotherapeutic treatment modality for anxiety and in the BC should be provided on a weekly basis for one month and be continued bi-weekly thereafter for the duration of the mission. Furthermore, considering the austere environment and communication barriers that exist on long duration missions it is recommended that there be on board private psychological conferences for the direct administration of psychotherapeutic treatment.

The CES devices can be helpful for symptom reduction, are safe, require a minimal footprint and can be self-administered. However, justification as a primary treatment modality over psychotherapy remains controversial. However, they should be considered as an adjunct treatment modality along with therapy.

Terrestrially, worst case conditions generally do not require medications to treat sub-syndromal depression or anxiety and symptom distress is ameliorated by brief psychotherapy. Cognitive behavioral therapy is an effective psychotherapeutic treatment modality for anxiety and in the WC should be provided on a weekly basis for three months and be continued bi-weekly thereafter for the duration of the mission. Furthermore, considering the austere environment and communication barriers that exist on long duration missions it is recommended that there be on board private psychological conferences for the direct administration of psychotherapeutic treatment.

As above the CES devices can be helpful for symptom reduction, are safe, require a minimal footprint and can be self-administered. However, justification as a primary treatment modality over psychotherapy remains controversial. However, they should be considered as an adjunct treatment modality along with therapy.

Communications and Support Needs

Adjustment disorders generally are self-limited conditions which often resolve when the stressor is removed. In the BC it is recommended that ground communication and a psychiatric consult be established for diagnostic clarification and psychotherapeutic treatment guidance. Further support would include ongoing onboard private psychological conferences to provide direct psychotherapeutic care for the duration of the mission. Following suit, for WC, ground communication and a psychiatric consult should be established for diagnosis and psychotherapeutic treatment guidance. Further support would include ongoing onboard private psychological conferences to provide direct psychotherapeutic care for the duration of the mission.

REFERENCES

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CES Devices:

1. Alpha Stim: www.alphastim.com
2. FisherWallace Device: www.fisherwallace.com

IMM CLIFF RECONCILIATION COMMENTS

This condition has no previous predecessor as all psychiatric pathologies were encompassed in the previous CLiFF entitled "Behavioral Emergency." Given the breadth of conditions this former CLiFF did not adequately represent adjustment disorder.

LIMITATIONS SUMMARY

• The authors of this CLiFF did not have access to the original LSAH data and thus there was an implied dependence on already published sources which did not adequately apply to this condition • There is some overlap between this condition and other BHP CLiFF conditions. • Several assumptions needed to be made regarding the untreated cases, RTDC and LOCL given lack of available studies. • Terrestrial sources likely overestimate the incidence, RTDC and LOCL values given the extensive preflight screening that occurs in long-duration spaceflight crewmembers.

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)												
Treated Worst Case (TWC)		664		89								
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)									0	3763	0	0
Treated Worst Case (TWC)	132							211	1096	3763	0.291257	29.1257
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)												
	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	T1 Decimal	T1 %
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 requiring use of the alimentary system, 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 Condition 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

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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