Executive Summary

The objective of this IMM support request is to quantify medical risk for NESC. The runs will simulate various crew sizes using an ISS medical kit over a 9-month mission. The summary of the main simulation metrics are shown below. Summary statistics for QAMTL for medical conditions for each DRM are also provided in the document.

DRM 1: 9-month mission with 4 crew

- **TME**
  - **MedCap – 79.919**
  - **Fully Treated – 79.996**
  - **Fully Untreated – 74.388**
- **CHI**
  - **MedCap – 93.806%**
  - **Fully Treated – 94.049%**
  - **Fully Untreated – 53.945%**
- **Probability of EVAC**
  - **MedCap – 0.0443%**
  - **Fully Treated – 0.0324%**
  - **Fully Untreated – 0.485%**
- **Probability of LOCL**
  - **MedCap – 0.005%**
  - **Fully Treated – 0.005%**
  - **Fully Untreated – 0.02%**
  -

DRM 2: 9-month mission with 12 crew

- **TME**
  - **MedCap – 239.156**
  - **Fully Treated – 239.927**
  - **Fully Untreated – 223.018**
- **CHI**
  - **MedCap – 91.595%**
  - **Fully Treated – 94.042%**
  - **Fully Untreated – 53.919%**

- **Probability of EVAC**
  - **MedCap – 0.209%**
  - **Fully Treated – 0.092%**
  - **Fully Untreated – 0.864%**
- **Probability of LOCL**
  - **MedCap – 0.015%**
  - **Fully Treated – 0.015%**
  - **Fully Untreated – 0.057**

Background

The IMM is a stochastic model that uses Monte Carlo methodology to simulate medical outcomes during spaceflight missions. The IMM consists of a three-step process. First, mission and crew member characteristics are specified to define a particular mission profile, or design reference mission (DRM). Next, medical events and outcomes during the space flight mission are randomly generated based on pre-defined incidence values and probability distributions. Finally, total crew health and mission impact outcomes are summarized. For this report, the primary outcomes of interest are average number of total medical events (TME), crew health index (CHI), need for evacuation (EVAC) and loss of crew life (LOCL).

The IMM is most useful for comparing risks across multiple mission profiles based on probable events and resource availability. Biased results may be incurred due to limitations of the model, but the bias will be consistent across mission profiles within the same service request.

Methods

Crew and Mission Parameters

The DRMs were configured using the crew profile shown in Table 1 and Table 2. The outcomes of certain IMM medical conditions are influenced by pre-existing medical history including: coronary artery calcium score (CAC), dental crowns, contact lenses, and history of prior abdominal surgery. Pre-existing conditions, as defined here, are consistent with historical U.S. crew data.

Table 1: DRM 1 crew profile

	Sex	Crowns	EVA	CAC	Contacts	Prior Abdominal Surgery
Crew 1	Male	Yes	0	None	No	No
Crew 2	Male	No	0	Positive	No	No
Crew 3	Female	No	0	None	Yes	No
Crew 4	Female	No	0	None	No	Yes

Table 2: DRM 2 crew profile

	Sex	Crowns	EVA	CAC	Contacts	Prior Abdominal Surgery
Crew 1	Male	Yes	0	None	No	No
Crew 2	Male	No	0	Positive	No	No
Crew 3	Female	No	0	None	Yes	No
Crew 4	Female	No	0	None	No	Yes
Crew 5	Male	Yes	0	None	No	No
Crew 6	Male	No	0	Positive	No	No
Crew 7	Female	No	0	None	Yes	No
Crew 8	Female	No	0	None	No	Yes
Crew 9	Male	Yes	0	None	No	No
Crew 10	Male	No	0	Positive	No	No
Crew 11	Female	No	0	None	Yes	No
Crew 12	Female	No	0	None	No	Yes

Medical Conditions and Resources

The one hundred medical conditions currently included in the IMM are shown in Appendix B. However, to better approximate the mission simulation, the set of conditions was modified for this request as described in Appendix C. The incidence of IMM medical events occurring during

simulated missions are based on historical mission and cohort data contained within the Integrated Medical Evidence Database (iMED). For each condition the percentage of “best case” and “worst case” scenarios are specified, as well as a defined set of medical resources that are used to treat the condition. The iMED entry for each condition details the specific medical resources and quantity necessary for treatment in both the best and worst-case scenarios. Inflight medical treatment is assumed to follow a specified protocol [5] or clinical practice guidelines for each medical condition and is constrained by resource availability on the ISS.

Model outcomes can be given for the all-treated (continuous resupply, e.g. ISS in low earth orbit), all-untreated (no Medkit) and baseline MedCap (one ISS Medkit without resupply). For exploration missions, the MedCap state should most closely resemble a real-world deep space mission where resupply is not possible but where utilization of partial and alternative treatment can occur as resources are depleted.

Main Outcomes

The IMM primary medical outcomes include the number of total medical events (TME), crew health index (CHI), probability of Evacuation (EVAC), probability of Loss of Crew Life (LOCL), and required resources.

CHI is a calculated percentage using the quality-adjusted mission time lost (QAMTL) due to in-flight medical events and resources available to treat those conditions [2].

CHI = (1- (QAMTL ÷ Mission Length)) x 100

For a given condition, QAMTL is determined by summing the product of functional impairment and duration for all three clinical phases of that condition: i) diagnosis and initial treatment, ii) ongoing treatment, and iii) end-state. CHI percent values range from 0-100, where zero represents complete crew impairment and one hundred represents a completely functional crew.

EVAC in the context of IMM means that medical evacuation from the ISS would be considered for definitive treatment of the afflicted crew member(s). EVAC is considered an end state result if any of the following criteria are met: 1) potential LOCL; 2) potential significant permanent impairment; or 3) potential intractable pain. When EVAC is calculated by the IMM, no consideration has been given to the availability of a return vehicle or the likelihood of a successful clinical outcome should a return vehicle be available.

LOCL in the context of IMM should be interpreted to mean that the clinical scenario resulted in death of the affected crew member(s). In version 4.1 of the IMM, the simulation usually assigns each crew

member only one end state of EVAC or LOCL. In rare instances a crewmember can get a condition that will go to EVAC or LOCL, and then develop another condition that will also go to EVAC or LOCL in the time between the onset of first condition and the EVAC or LOCL time. Both events are recorded as EVAC or LOCL outcomes. These assumptions should result in more accurate IMM forecasts for the occurrence of EVAC and LOCL as compared to the prior versions of the model. Catastrophic vehicle failures such as the Challenger and Columbia accidents, and MMOD (micrometeorite and orbital debris) are not considered as possible causes of EVAC and LOCL.

Required resources for treatment are tracked for each simulated mission trial. The number of each resource that is used to treat a given condition is decremented from available resources. If more of any particular resource is used than is available, then that resource is considered “depleted” in the MedCap (no resupply) scenario. The assumption in the MedCap scenario is that as the resources are utilized for the treatment of conditions during the simulation, the quantities of consumable decreases and cannot be replenished. Therefore, consumable resources may become depleted. Events that require a “depleted” resource is considered “partially treated” if only a portion of the required resources are available. If there are sufficient available alternate resources in the MedCap, the event is considered "fully treated." If none of the resources are available to treat the event, the event is considered "untreated." The initial quantities for medical resources are baselined to one fully stocked ISS medical kit (MedCap). Note that when an event is partially treated, its outcomes are based on a weighted average of the treated and untreated values. For example, if a condition has a 0% chance of going to EVAC in the best case treated scenario and a 0-100% chance of going to EVAC in the best-case untreated scenario, then under best case partial treatment, it is possible the condition will go to EVAC.

Modeling Approach

One hundred thousand (100,000) trials were run for each DRM where each trial can be considered an individual “mission”. This ensures that the distribution of outcomes meet convergence criteria. Convergence criteria are met when there is less than or equal to a 5% change in the average standard deviation of the CHI, EVAC, and LOCL primary model outcomes in the last 2 - 1,000 mission increments. This last step is performed manually by the modelers using the IMMV4ConvergenceReport.

IMM outcomes were determined for the DRMs using the new optimized MedCap scenario where all conditions are treated, partially treated or untreated based on the available resources of the optimized kit MedCap without resupply. CHI is calculated as a percentage, with 95% confidence intervals (CIs) for the associated distributions. EVAC and LOCL are probabilities, with 95% CI for EVAC and LOCL obtained using bootstrap resampling of the simulation output [3]. In this report, TME, CHI, EVAC and LOCL results are presented. Features, assumptions and limitations pertinent to this report are

described in a separate section below.

The IMM is baselined to ISS. To better approximate the medical risk for the NESC assessment, the set of conditions listed in Appendix C were removed or modified for this request. All condition incidences and outcomes are consistent with iMED lockdown 78

Features, Assumptions and Limitations of IMM Version 4.1 [3]

1. All non-space adaption (SA) and non-extravehicular activity (EVA) related conditions have a uniform likelihood of occurring throughout the mission duration. With the exception of VIIP, Space Adaptation Syndrome conditions occur in the first 5 days of the mission, with a peak occurrence at 48 hours.
2. Individuals cannot get the same condition for which they are currently being treated (i.e. during Clinical Phase (CP) I and II).
3. EVAC and LOCL are generated for each medical event, and then the timing of the EVAC or LOCL is generated according to a specified distribution.
4. Individuals are no longer at risk for further conditions once their status changes to either EVAC or LOCL. From the start time of the EVAC or LOCL, the functional impairment of the crew member is assumed to be 100%.
5. When the status of a crew member changes to EVAC, only one crew member is evacuated.
6. The IMM assumes that, per crew member, the first condition requiring a specific therapy utilizes all resources required for treating that condition before a second condition has access to those resources.
7. Most medical conditions, with exceptions including acute radiation syndrome (triggered by Solar Particle Events) and EVA-linked conditions (triggered by EVA events), occur independently of the occurrence of mission events and other medical conditions. Currently there is no correlation or association within or between crew members for most medical conditions.
8. The model assumes another crew member is available to act as caregiver but does not track the time impact of providing this care.
9. Medical procedures are accurately followed and successful; no mistakes occur in executing medical procedures.
10. Crew medical skill level and preflight/inflight training is not modeled.
11. All diagnoses are 100% accurate.
12. All pharmaceuticals maintain maximum efficacy.
13. All medical events receive the appropriate treatment.
14. All medical events respond to the treatment as expected terrestrially.
15. All medical equipment is 100% reliable.
16. For each of the medical conditions specified in iMED, all crew members with the same

characteristics (sex, presence of CAC, crowns, contacts, history of abdominal surgery) have the same likelihood distribution of experiencing the condition.

17. All crew members are assumed to have all intrinsic body parts intact (i.e. appendix, gall bladder, and uterus or prostate, etc.).
18. IMM assumes ISS power, potable water and oxygen resources are always available in unlimited supply.
19. No Russian medical capabilities aboard the ISS are available to US crew members in this model.
20. Medical capabilities do not include the use of personal crew carry-on items contained in the Individual Medical Accessories Kit, (IMAK).
21. If a crew member is undergoing treatment for concurrent medical conditions requiring the same consumable resource, the crew member will only utilize resources at the level required by the condition that requires the most resources.
22. If the primary resource required for treating a medical condition is unavailable, one or more alternative resources are considered, if appropriate. One example might be using acetaminophen in place of ibuprofen.
23. Total quantities of a consumable medical resource requiring a daily dose will be adjusted if a dosage schedule runs past the end of the mission.
24. If a solar particle event causes acute radiation sickness in one or more crew members, IMM assumes the condition begins identically in all affected crew members at the beginning of the solar particle event.
25. The IMM does not decrement non-consumable items and allows all non-consumable items to be used simultaneously by multiple astronauts (e.g. blood pressure cuff).

Results

The IMM MedCap results for TME, CHI, EVAC, and LOCL for the simulated DRMs are presented in the tables below. Table 3 shows the average number of total medical events (TME) during the mission across all DRMs. In longer duration DRMs, it is possible that the average TME will be larger for the fully treated timeline than the medical capabilities or fully untreated timeline. This is because as resources become depleted, there is a greater chance for certain events to end the simulation with EVAC or LOCL, thereby reducing the crew size, and resulting in less medical events occurring for the remainder of the simulation trial. Table 4 shows the average CHI across all the DRMs. Table *5* shows the average probability of EVAC and LOCL across all the DRMs. Table 6 and Table 7 show the summary stats for QAMTL per crew per trial.

Table 3: Average Number of Total Medical Events (TME) for the DRMs. As noted in the Results section, it is not uncommon for the Fully Treated timeline to have a higher average TME than the Fully Untreated timeline for longer duration missions. For longer duration missions, crewmembers have a higher probability of proceeding to EVAC and LOCL, which could lead to less crewmembers and therefore less medical events during a single trial. This results in lower average CHI and higher probability of EVAC and LOCL for the Fully Untreated Timeline.

		Average TME	95% CI	
DRM1-4 crew	MedCap	79.919	62	98
DRM2-12 crew	MedCap	239.156	208	271
DRM1-4 crew	Fully Treated	79.996	62	98
DRM2-12 crew	Fully Treated	239.927	209	271
DRM1-4 crew	Fully Untreated	74.388	50	96
DRM2-12 crew	Fully Untreated	223.018	182	261

Table 4: Average CHI for the DRMs

		Average CHI	95% CI	
DRM1-4 crew	MedCap	93.81	79.14	98.87
DRM2-12 crew	MedCap	91.6	83.67	96.16
DRM1-4 crew	Fully Treated	94.05	79.75	98.95
DRM2-12 crew	Fully Treated	94.04	86.62	97.79
DRM1-4 crew	Fully Untreated	53.94	38.21	66.61
DRM2-12 crew	Fully Untreated	53.92	45.14	61.67

Table 5: Probability EVAC and LOCL for the DRMs

		EVAC			LOCL		
		Probability	95% CI		Probability	95% CI	
DRM1-4 crew	MedCap	0.0443	0.0429	0.0456	0.0048	0.0044	0.0052
DRM2-12 crew	MedCap	0.209	0.207	0.211	0.0155	0.0148	0.0162
DRM1-4 crew	Fully Treated	0.0324	0.0313	0.0336	0.0047	0.0043	0.0052
DRM2-12 crew	Fully Treated	0.092	0.09	0.093	0.0147	0.0139	0.0154
DRM1-4 crew	Fully Untreated	0.4854	0.4825	0.4885	0.0196	0.0187	0.0204
DRM2-12 crew	Fully Untreated	0.864	0.862	0.866	0.0573	0.0559	0.0588

Table 6: Summary stats for Quality-Adjusted Mission Time Lost per crew per trial – 4-Crew DRM

Crew ID	Timeline	Mean QAMTL	Median QAMTL	Standard Deviation QAMTL	Min QAMTL	Max QAMTL	QAMTL 95% CI	
1	Med Cap	386.81	182.88	681.75	7.76	6470.49	382.58	391.03
2		387.51	183.38	685.39	5.48	6471.55	383.26	391.76
3		412.55	216.76	684.09	6.71	6449.98	408.31	416.79
4		418.47	215.55	701.84	6.31	6441.65	414.12	422.82
Overall		401.33	199.76	688.46	5.48	6471.55	399.20	403.47
1	Fully Treated	371.20	170.12	668.70	7.76	6471.37	367.05	375.34
2		371.86	170.65	671.90	5.48	6472.89	367.69	376.02
3		396.55	205.08	669.04	6.71	6449.98	392.40	400.69
4		402.88	204.42	689.55	6.31	6441.65	398.61	407.15
Overall		385.62	187.82	675.00	5.48	6472.89	383.53	387.71

Table 7: Summary stats for Quality-Adjusted Mission Time Lost per crew per trial – 12-Crew DRM

Crew ID	Timeline	Mean QAMTL	Median QAMTL	Standard Deviation QAMTL	Min QAMTL	Max QAMTL	QAMTL 95% CI	
1	Med Cap	523.24	332.04	688.28	5.60	6469.22	518.97	527.50
2		530.54	335.29	702.42	5.00	6464.36	526.18	534.89
3		559.91	365.20	702.47	8.75	6427.40	555.56	564.26
4		563.80	367.45	711.16	6.22	6454.63	559.39	568.20
5		527.62	334.57	697.05	6.97	6448.67	523.30	531.94
6		527.76	335.43	692.23	5.17	6448.62	523.47	532.05
7		564.13	366.71	709.77	7.76	6471.88	559.73	568.53
8		559.72	363.78	710.96	3.30	6464.57	555.32	564.13
9		530.23	334.37	703.45	5.38	6474.99	525.87	534.59
10		528.25	334.47	697.63	6.42	6459.42	523.93	532.58
11		558.13	366.76	701.13	9.72	6470.40	553.78	562.48

12		562.14	364.53	717.74	5.99	6458.85	557.69	566.59
Overall		544.62	349.88	703.10	3.30	6474.99	543.36	545.88
1	Fully Treated	369.33	171.43	660.77	5.60	6469.22	365.24	373.43
2		375.79	172.43	675.37	5.00	6464.36	371.61	379.98
3		395.97	204.53	668.50	8.75	6427.40	391.82	400.11
4		402.71	205.76	682.90	6.22	6454.63	398.48	406.94
5		372.09	171.70	666.07	6.35	6452.80	367.96	376.22
6		373.12	172.69	666.50	5.17	6448.62	368.98	377.25
7		399.39	204.33	671.99	7.76	6471.88	395.22	403.55
8		398.91	202.82	681.73	3.30	6464.57	394.68	403.13
9		376.04	171.94	676.39	5.38	6474.99	371.84	380.23
10		374.18	173.19	671.43	6.42	6459.42	370.02	378.35
11		393.60	202.23	665.14	9.72	6470.40	389.48	397.72
12		401.34	203.02	689.62	5.99	6458.85	397.07	405.62
Overall		386.04	188.42	673.20	3.30	6474.99	384.83	387.24

Discussion

The model outcomes were as expected based on the mission durations and crew size. The number of total medical events increased as mission duration and crew size increased. CHI decreased slightly when crew size was increased from 4 to 12. This can be explained by resource depletion due to increased demand which will lead to more conditions being partially treated or untreated. QAMTL per crew member increased as crew size increased from 4 to 12. This can also be explained by resource depletion. There is a slightly increased QAMTL for female crew members vs male. This can be explained by there being more female only medical conditions as well as a higher incidence rate of UTI among female crew members.

References

1. Integrated Medical Model Project. Integrated Medical Model Operations Plan. JSC-66114. 2011. Houston, TX, NASA, Johnson Space Center. *Ref Type: Report*

2. Integrated Medical Model Project. Integrated Medical Model Software Requirements Specification. IMM-SFTWR-008. 2017. Houston, Texas, KBRwyle Integrated Science, Technology and Engineering. *Ref Type: Report*

3. Integrated Medical Model Project. Integrated Medical Model version 4 Assumptions and Limitations. IMM-GEN-300. 2017. Houston, Texas, KBRwyle Integrated Science and Engineering Space Medicine Information Technology. *Ref Type: Report*

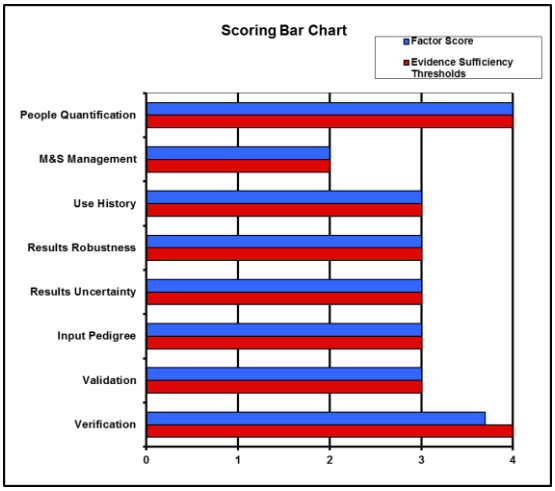
4. NASA-STD-7009: Standard for Models and Simulations (2008). NASA: Washington, DC.

5. ISS Medical Checklist (Med CL), 04 June 2014, NASA Johnson Space Center, Medical Operations Group
6. ISS PRA Model v.3.2.0. ISS PRA Fire and Ammonia Model Contributions to the Integrated Medical Model. 2015. Houston, Texas, NASA Johnson Space Center. *Ref Type: Report*

Appendix A: IMM Status at Time of Service Request Report

Validation status for IMM

IMM V&V Matrix: The following bar chart shows the IMM v4.1 MATLAB status of IMM validation for each IMM element listed.



Compliance with NASA-Standard-7009 requirements

IMM Compliance Matrix: The IMM has no waivers to any of the requirements in the NASA-Standard-7009 for Models and Simulations (6); however there are certain requirements that are not applicable to the IMM and other requirements where IMM compliance has not yet been fully attained.

Compliant	Compliance Incomplete	Not applicable
36	5	5

Current NASAStandard-7009 credibility assessment score

IMM Credibility Matrix: The following table shows the overall IMM v4.1 MATLAB credibility assessment score (CAS), individual factor CAS, customer-specified sufficiency thresholds, and weighted scores. Legend depicts CAS score designated range and color assignments from NASA-Standard-7009.

Factor	Sufficiency Thresholds	Factor Score	Weighted Scores	Overall Score
Verification	**4**	**3.7**	0.28	
Validation	**3**	**3**	0.45	
Input Pedigree	**3**	**3**	0.53	
Results Uncertainty	**3**	**3**	0.60	**3.06**
Results Robustness	**3**	**3**	0.45	
Use History	**3**	**3**	0.45	
M&S Management	**2**	**2**	0.10	
People Qualification	**4**	**4**	0.20	

Legend from NASA-STD-7009	
	CAS Score > Threshold ***Exceeds credibility requirements***
	Threshold ≥ CAS Score ≥ (Threshold-0.5) ***Ready for use***
	Threshold-0.5 > CAS Score ≥ Threshold-1.0 ***Use with caution***
	CAS Score < Threshold - 1.0 ***Use not recommended or to be used with EXTREME CAUTION by subject matter experts only***

Additional verification and validation information applicable to this analysis

None

Integrated Medical Evidence Database (iMED) code version and date accessed

iMED Lockdown IDs: (78), created on (6/24/2022)

IMM version and code version

Data analysis for this report was generated using IMM v4.1 with release 2016a of MATLAB software. MATLAB and all other MathWorks product or service names are registered trademarks or trademarks of MathWorks, Natick, MA, USA.

Modifications made to the code for analysis

None

Appendix B: Medical Conditions in iMED by Category (iMED_20170221)

ENVIRONMENTAL
Acute Radiation Syndrome
Altitude Sickness
Barotrauma (ear/sinus block)
Burns secondary to Fire
Decompression Sickness Secondary to EVA
Eye Chemical Burn
Headache (CO_2 induced)
Smoke Inhalation
Toxic Exposure: Ammonia

INJURY/TRAUMA
Abdominal Injury
Acute Compartment Syndrome
Ankle Sprain/Strain
Back Sprain/Strain
Chest Injury
Dental: Avulsion (tooth loss)
Elbow Dislocation
Elbow Sprain/Strain
Eye Irritation/Abrasion
Eye Penetration (foreign body)
Finger Dislocation
Fingernail Delamination Secondary to EVA
Head Injury
Hip Sprain/Strain
Hip/Proximal Femur Fracture
Knee Sprain/Strain
Lower Extremity Stress Fracture
Lumbar Spine Fracture
Neck Sprain/Strain
Neurogenic Shock
Paresthesias Secondary to EVA
Shoulder Dislocation
Shoulder Sprain/Strain
Skin Abrasion
Skin Laceration
Traumatic Hypovolemic Shock
Wrist Fracture
Wrist Sprain/Strain

MEDICAL ILLNESS
Abdominal Wall Hernia
Abnormal Uterine Bleeding
Acute Angle-Closure Glaucoma
Acute Arthritis
Acute Cholecystitis/Biliary Colic
Acute Diverticulitis
Acute Pancreatitis
Acute Prostatitis
Acute Sinusitis
Allergic Reaction (mild to moderate)
Anaphylaxis
Angina/Myocardial Infarction

MEDICAL ILLNESS (continued)
Anxiety
Appendicitis
Atrial Fibrillation/Atrial Flutter
Back Pain (space adaptation)
Behavioral Emergency
Cardiogenic Shock Secondary to Myocardial infarction
Choking/Obstructed Airway
Constipation (space adaptation)
Dental: Exposed Pulp
Dental Caries
Dental: Abscess
Dental: Crown Loss
Dental: Filling Loss
Depression
Diarrhea
Eye Corneal Ulcer
Eye Infection
Gastroenteritis
Headache (Late)
Headache (space adaptation)
Hearing Loss
Hemorrhoids
Herpes Zoster Reactivation (shingles)
Hypertension
Indigestion
Influenza
Insomnia (space adaptation)
Medication Overdose/Adverse Reaction
Mouth Ulcer
Nasal Congestion (space adaptation)
Nephrolithiasis
Nose bleed (space adaptation)
Otitis Externa
Otitis Media
Pharyngitis
Respiratory Infection
Retinal Detachment
Seizures
Sepsis
Skin Infection
Skin Rash
Sleep Disorder
Small Bowel Obstruction
Space Motion Sickness (space adaptation)
Stroke (Cerebrovascular Accident)
Sudden Cardiac Arrest
Urinary Incontinence (space adaption)
Urinary Retention (space adaptation)
Urinary Tract Infection
Vaginal Yeast Infection
Visual Impairment and Increased Intracranial Pressure (VIIP) (space adaptation)

Appendix C: Medical Conditions Excluded or Modified for DRM1 and DRM2

Space adaptation conditions were removed with the exception of VIIP. The DRM for this request is simulating Mars transit. It is assumed that the transit will occur outside the normal window in which space adaptation conditions typically occur. The following conditions were removed:

- Back Pain (Space Adaptation)
- Constipation (Space Adaptation)
- Headache (Space Adaptation)
- Insomnia (Space Adaptation)
- Nasal Congestion (Space Adaptation)
- Nose Bleed (Space Adaptation)
- Space Motion Sickness (Space Adaptation)
- Urinary Incontinence (Space Adaptation)
- Urinary Retention (Space Adaptation)