Angina/Myocardial Infarction Cliff

Branch Baseline

Typical or stable angina is recurrent, brief episodes of chest pain (up to 15 min) precipitated by exertion or by exertion and emotion and relieved by rest or nitroglycerin, and whose character and radiation were consistent with the diagnosis. In unstable angina, patients have increased risk for adverse cardiac events, such as myocardial infarction or death. New-onset exertional angina can occur at rest, is of increasing frequency or duration or is refractory to nitroglycerin. (Gandhi, 1995)

Acute coronary syndrome (ACS) refers to a spectrum of clinical presentations ranging from those for ST-segment elevation myocardial infarction (STEMI) to presentations found in non–ST segment elevation myocardial infarction (NSTEMI) or in unstable angina. In terms of pathology, ACS is almost always associated with rupture of an atherosclerotic plaque and partial or complete thrombosis of the infarct-related artery. In some instances, however, stable coronary artery disease (CAD) may result in ACS in the absence of plaque rupture and thrombosis, when physiologic stress (e.g. trauma, blood loss, anemia, infection, tachyarrhythmia) increases demands on the heart. (Ruff, 2011)

The diagnosis of acute myocardial infarction in the hospital setting requires a finding of the typical rise and fall of biochemical markers of myocardial necrosis in addition to at least 1 of the following: ischemic symptoms, development of pathologic Q waves, ischemic ST-segment changes on electrocardiogram (ECG) or in the setting of a coronary intervention. Acute coronary syndrome (ACS) is caused primarily by atherosclerosis. (Luepker, 2003)

ACS without elevation in demand requires a new impairment in supply, typically due to thrombosis and/or plaque hemorrhage. A syndrome consisting of chest pain, ischemic ST-segment and T-wave changes, elevated levels of biomarkers of myocyte injury, and transient left ventricular apical ballooning has been shown to occur in the absence of clinical CAD, after emotional or physical stress.

Incidence Data Included in the Model

The model imports the following incidence information from the IMM database: incidence data category, space adaption status, incidence data, 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. fixed data). Space adaptation identifies medical events that onset occurs in the first 5 days of flight and does not reoccur. Incidence values vary by data category and define the number of medical events per person-year or medical events per person-at-risk for each medical condition. Incidence values can be modified by crew characteristics such as gender. 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 crew member 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 IMM Technical Description Document.

Incidence	
Data Category:	Fixed
Space Adaptation:	No
Incidence Type:	Rate

Distribution Data	
Incidence:	Fixed
Occurrence:	Poisson

Female Data Characteristics	
Fixed Rate:	0.00047

Male Data Characteristics	
Fixed Rate:	0.00063

Incidence Comments

The term acute coronary syndrome (ACS) is increasingly used to describe patients who present with either acute myocardial infarction (AMI) or unstable angina (UA). We are maintaining the name Chest Pain/Angina for this CliFF medical condition based on current terminology in use by Space Medicine at NASA.

There have not been any events of chest pain reported in flight. (Walton, 2010). Symptoms of cardiac ischemia have nevertheless occurred during flight. An Apollo program crewmember experienced a brief run of bigeminy, concomitant with a feeling of extreme fatigue. The same crewmember experienced a myocardial infarction 2 years later from which he recovered (Marshburn, 2008).

Lacking in flight evidence, IMM is using terrestrial data for the model incidence.

Our model incidence was based in British population (Gandhi, 1995).

The overall crude annual incidence of typical angina was 0.83 (95% CI 0.66 – 1.0) per thousand patients aged 31-70 years per year. For the age 41-50 cohort, the annual incidence for male was 0.63 (95% CI 0.24 -1.02) and females 0.47 (95% CI 0.12-0 82). All per 1000 person years. Events/person year for male are 0.00063; (95% CI 0.00024- 0.00102); for female 0.00047;(95% CI 0.00012-0.00082).

Incidence of angina increased in both sexes with age, but at all ages it was higher in men.

Angina resolved spontaneously in 12 patients (11%), and with medical therapy in 21 (20%). About one third of patients (33%) reported continuing symptoms despite medication, and 4 (4%) were awaiting elective revascularization. Three patients who reported continuing chest discomfort were not receiving medical treatment.

Limitations of the study are that the study could underestimate the national rate; elective revascularization may have averted an adverse event; patients who report symptoms to a doctor tend to have prognostically more important disease; regional variation in the incidence may be different that in other areas of the country.

The incidence for our model is **men 0.00063, and women 0.00047.**

Information Regarding Prevention

Selection criteria

NASA Medical Standards for ISS Crewmembers list causes for rejection due to risk factors for heart disease include a history or evidence of hypertrophy, hypertension, pericarditis, myocarditis, endocarditis, congenital abnormalities, and a history of coronary artery disease, clinically significant cardiac dysrhythmias, or valvular disorders.

Other

Periodic and pre-flight testing includes cardiovascular risk marker lab testing, resting ECG, exercise stress testing, and a 24 hour Holter monitor. Astronauts have an ongoing cardiovascular conditioning program and pre-flight aerobic functional capacity testing.

Incidence Level of Evidence (LOE)

The IMM level of evidence appropriate assessment of the quality of the IMM input data. Since IMM incorporates input data from a wide variety of sources including astronaut population, terrestrial or analog populations, and external models, an innovative approach to assess the quality of input data was required. Information obtained from the astronaut population and/or space flight is the more relevant so it is assigned the highest level of evidence and less relevant data sources are assigned a lower level of evidence.

Citation	LOE Value	LOE Category
Gandhi, 1995	4	Incidence

Alternative Incidence Data

A study published in 2006 was a cross-sectional data review of primary care patients for angina morbidity between April 2001 and March 2002 in Scotland. The best fit for our population age range we used the incidence rates for males (30-54 years old) and females (30-54 years old).

Males were 79/135,843 person years or 0.00058 events per person year and females 46/131,928 person years or 0.00035 events per person year. These incident rates tend to support the rates used in our model. (Murphy, 2006)

The **Framingham Heart Study (**FHS), initiated in 1948, is a population-based, longitudinal investigation of physiological, environmental, and genetic factors influencing the development of CVD in men and women initially free of those conditions. Almost all of the study subjects were caucasian. The original cohort of 5,209 men and women, ages 28–62 at entry, was recruited in Framingham, MA, and was given an extensive baseline examination. Since 1948, they continue to participate every 2 years in a detailed medical history, physical examination, and laboratory tests. Enrollment of the original cohort's offspring and their spouses began in 1971; by 1975, 5,124 men, women, and children, ages 5–70 at entry, had been recruited. After receiving an extensive baseline examination, they continue to return to the study every 4 to 8 years for a detailed medical history, physical examination, and laboratory tests

The FHS diagnosis of angina pectoris (AP): Brief recurrent chest discomfort of up to 15 minutes duration, precipitated by exertion or emotion and relieved by rest or by nitroglycerine, was regarded as angina pectoris if two physicians interviewing the subject agreed that this condition was definitely present. This diagnosis was based on evaluation of a subjective manifestation; no abnormality in the ECG after exercise or at rest was required.

The FHS diagnosis of myocardial infarction (MI): Recent or acute MI was designated when there were serial changes in the ECGs indicating the evolution of an infarction, including S-T segment elevation in the ECG associated with later inversion of T waves and the loss of initial QRS potentials (i.e., development of "pathologic" Q waves of 0.04 second duration), followed by serial changes indicating reversion towards normal. An old or remote MI was considered to be present when the ECG showed a stable pattern including a pathologic Q wave of 0.04 second or loss of initial QRS potential (R wave) in those leads in which this would not be expected to occur. Also, an old MI was indicated when changes from a previous tracing showed development of loss of R-wave potential or appearance of pathologic Q waves not otherwise explained. More weight was given to this finding if a T-wave abnormality was also associated.

Only 18% of coronary attacks are preceded by long standing angina pectoris (AP) (NHLBI computation of FHS follow-up since 1986). (National Institutes of Health National Heart, Lung, and Blood Institute(NHLBI), 2006)

Incidence of AP per 1000 person years by age, race, and sex (FHS 1980–2002/2003). AP uncomplicated based on physician interview of patient. Source: NHLBI. Table 2-1 (National Institutes of Health National Heart, Lung, and Blood Institute(NHLBI), 2006)

Cohort 45-54, Men 4.8; CI 95% (3.6-6.0); women 1.1, CI 95% 0.5-1.6

Cohort 55-64 , Men 8.9 CI 95% (7.2; 10.6), women 4.0 (CI 95% 2.9-5.1)

AP Incidence per person-year

Cohort 45-54 men 0.0048 CI 95% (0.00036- 0.0006); women 0.0011; CI 95% (0.0005- 0.0016)

Cohort 55-64 men 0.0089; CI 95% (0.00072- 0.0106); women 0.004 CI 95% (0.0029- 0.0051)

Incidence of MI per 1000 person years by age, race, and sex (FHS 1980–2002/2003). Source: NHLBI table 2-1 (National Institutes of Health National Heart, Lung, and Blood Institute(NHLBI), 2006)

Cohort 45-54 men 4.6; CI 95% (3.4; 5.8) women *0.8; CI 95% (0.3; 1.2)

Cohort 55-64 men 11.4; CI 95% (9.4; 13.3); women 3.2 ; CI 95% (2.2; 4.2)

* Rate is unreliable: Relative standard Error (RSE) is from 20 to 30 percent.

MI Incidence per person-year

Cohort 45-54 men 0.0046 CI 95% (0.00034- 0.00058); women 0.0008; CI 95% (0.0003- 0.0012)

Cohort 55-64 men 0.0114; CI 95% (0.00094- 0.0133); women 0.0032 CI 95% (0.0022- 0.0042).

Approximately 15% of the people who experience a heart attack (MI) will die of it (AHA computation). (Lloyd-Jones, 2010)

MI Incidence per person year minus 15% deaths as indicated above

Cohort 45-54 men 0.00391; CI 95% (0.000289 - 0.000493); women 0.00068; CI 95% (0.000255- 0.00102)

The total incidence for this analysis for the selected cohort 45-54 years old, was obtained adding AP incidence and MI incidence minus deaths, men 0.00871 and women 0.00043.

Analog populations

Data for analog populations are sparse and not complete.

2 events of chest pain have occurred on nuclear submariners (Britain). There were two EVACs due to cardiovascular conditions. We cannot determine if EVACs were linked to angina pectoris (Tansey, 1979).

A total of 1389 officers and 11,952 enlisted crew members served aboard 240 participating US submarines for 215,086 and 1,955,521 person-days at sea, respectively, during the study period, 1 January 1997 and 30 September 2000. The category of symptoms and ill defined conditions included 26 chest pain complaints among enlisted men and 0 among officers. The percentage rate is 0.22 (26/11952) and an extremely low incidence rate of 0.00000003 person-years. The study does not include information on evacuations or resolution of the events. Of note, officers are considered more similar to astronauts. (Thomas, 2003)

Another study including all US Navy surface ships, pacific fleet submarines and all ships of the military Sealift Command, documented the frequency and diagnosis factors for medical communications and evaluations. 8% of Medevacs were ill defined conditions primarily abdominal and chest pain (no rate available for each condition). One fatality was reported subsequent to a Medevac secondary to myocardial infarction. (Nice, 1987)

Among soldiers deployed to Iraq with non battle disease and injuries the percentage rate of cardiovascular disease, is 0.01 (14/1324). 35.7%

were Medevaced but description or cardiovascular events and reason for evacuation were not included. (Belmont, 2010).

Treatment and Outcomes

Based on the best evidence available best and worst case percentage ranges are assigned. The medical condition is divided into three clinical phases in all three clinical phases a functional impairment is assigned. The clinical phase I and II's functional impairments remain for the duration for that respective clinical phase. The function impairment in clinical phase III represents final impairment for this medical condition and remains for the rest of the mission. Other mission end states include evacuation and loss of crew life.

The IMM checks medical resource availability once the number of medical events and scenarios has been established. If there is not sufficient essential resources called out in the CliFF, then the medical condition will go down an untreated best or worst case scenario pathway.

The table below summarizes the treated and untreated best and worst case scenarios.

	Clinical Phase I Diagnosis & Initial Treatment[1]		**Clinical Phase II On-going Treatment / Convalescence[2]**		**Clinical Phase III Recovered / Mission End State[3]**		
	FI* (%)	**Duration (hrs)**	**FI* (%)**	**Duration (hrs) (Min - ML - Max)**	**FI* (%)**	**EVAC** (%)**	**LOCL** (%)**
ISS-based Treatment (best case scenario %: 70 - 100)	100	0.5	3 - 35	0.5 - 0.75 - 1	0	0 - 100	0
ISS-based Treatment (worst case scenario %: 0 - 30)	100	0.75 - 1	18 - 57	1 - 24.5 - 48	0 - 57	100	0
Untreated Best Case	0	0	18 - 57	0.5 - 0.75 - 1	0 - 35	100	0
Untreated Worst Case	0	0	36 - 86	1 - 24.5 - 48	36 - 86	100	0

[1]Clinical Phase I: Clinical phase I covers only the initial assessment of the affected crew member to define his or her medical condition, and completion of appropriate initial treatment to stabilize the crew member. While the affected crew member is being assessed, he or she is not able to perform any assigned tasks, thus Functional Impairment during this phase is considered 100%. In the untreated case, there is no diagnosis performed or treatment given, therefore Functional Impairment and Duration will always be "not applicable".

[2]Clinical Phase II: On-going Treatment and Convalescence- During clinical phase II, the affected crew member is receiving any appropriate follow-on treatment for his or her medical condition to allow the crew member to recover as much as he or she is able to recover in the ISS environment. Clinical phase II also encompasses relapses or reoccurrences of the same original medical condition in clinical phase I necessitating additional treatment or recovery time due to unsuccessful primary treatment response. The duration in Clinical Phase II is expressed in minimum, most likely (ML) and maximum hours. This was updated for future capabilities in IMM but is currently not being used by the model.

[3]Clinical Phase III: Recovered/Mission End State- Clinical phase III is reached once the affected crew member has recovered from the medical condition as much as he or she is able to recover in the ISS environment. This may or may not be recovery from the given medical condition to the full extent possible. If this "recovered" state results in an evacuation or loss of the crew member, this will be noted in the mission end state results.

*Functional Impairment (FI) is a measure of the affected crew member's health and performance ability.

**Two mission end state results are addressed in the CliFF: 1) Evacuation (EVAC) - crew and patient are evacuated from the spacecraft due to the medical condition, and 2) Loss of crew (LOCL) - death of affected crew member due to medical condition. EVAC is considered as 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. Probability distributions are assigned for each range of values within the Table of Treatments and Outcomes.

Refer to the Integrated Medical Model Technical Document for more information on how risk is reported by the IMM, Crew Health Index (CHI) and Quality Adjusted Mission Time calculations.

Definition and Probability of Best and Worst Case Scenario: (includes definitions of best and worst case scenarios and identifies the probability of those scenarios.)

Scenario Comments

Best case scenario definition: Cardiac chest pain that is brief, self-limited, is relieved spontaneously or with sublingual nitroglycerin and does not result in evidence of injury to the heart, e.g. Acute Myocardial Infarction (AMI).

Worst Case scenario definition: Cardiac chest pain associated with persistent chest pain at rest, with evidence of unstable angina (UA) and / or AMI such as dyspnea, cold clammy skin, and ST changes of at least 1 mm elevation or depression.

Percentages of how often best versus worst case scenarios occur

Based on our terrestrial incidence of acute coronary syndrome (National Institutes of Health National Heart, Lung, and Blood Institute (NHLBI), 2006); (Lloyd-Jones, 2010) 15% of women and 45% of men events will be worst case (MI). Based on the fact that terrestrial events include other comorbidities, while our astronaut population undergoes a strict selection criteria and maintains a high level of fitness, we averaged the 2 incidences of MI to obtain our worst case percentage upper bound, 30%. To allow for uncertainty the lower bound of the range was estimated at 0%.Thus our best case is 70-100%.

Best Case Comments

Chest Pain/Angina functional impairments (FI) calculation follows the IMM severe non-space adaptation template. Coronary artery disease ratings are based on Table 4-6, p.55 (American Medical Association, 2008). Complex Regional Pain Syndrome-Upper Extremity CRPS (UEI) is based on Table 15-26, p 454 (American Medical Association, 2008). The CRPS (UEI) ratings are then converted to percentage of Whole Person Impairment (WPI), which are based on Table 15-1, p 385 (American Medical Association, 2008). Combined FI ratings are calculated combining the mentioned tables using the Combined Values Chart as indicated in Appendix A, pp 604-606 (American Medical Association, 2008). For a detailed description of grading refer to the CliFF Appendix

Clinical Phase I: By definition FI is 100%; estimated duration of ISS procedures is 0.5 hour to take vital signs and ECG. During **Clinical Phase II**, FI is estimated at 3 to 35%; duration is estimated in 0.5 to 1 hour, for treatment with nitroglycerin and resolution of angina. During **Clinical Phase III,** by definition, AP will resolve and FI is estimated at 0%. EVAC is estimated in 0 to 100% for the best case scenario. Incidental finding of anomaly of the coronary artery is a Class IIx medical event, unlikely to occur in a microgravity environment or that would be detected in a pre-mission evaluation. Persistent chest pain or AMI is a class III significant medical event, requiring evacuation if occurring on orbit. (Johnston, 2008). By definition, LOCL is not expected.

Worst Case Comments

Chest Pain/Angina functional impairments (FI) calculation follows the IMM severe non-space adaptation template. Coronary artery disease ratings are based on Table 4-6, p.55 (American Medical Association, 2008). Complex Regional Pain Syndrome-Upper Extremity CRPS (UEI) is based on Table 15-26, p 454 (American Medical Association, 2008). The CRPS (UEI) ratings are then converted to percentage of Whole Person Impairment (WPI), which are based on Table 15-1, p 385 (American Medical Association, 2008). Combined FI ratings are calculated combining the mentioned tables using the Combined Values Chart as indicated in Appendix A, pp 604-606 (American Medical Association, 2008). For a detailed description of grading refer to the CliFF Appendix

Clinical Phase I: By definition FI is 100%; estimated duration to take vital signs, do ECG, provide IV fluids and monitor vital signs as indicated in the ISS procedures is 0.75 to 1 hour. During **Clinical Phase II**, FI is estimated at 18 to 57%; duration is estimated in 1 to 48 hours, based on time to determine if evacuation may be necessary. During **Clinical Phase III,** AP may or may not resolve with treatment; FI is estimated at 0 to 57%. EVAC is estimated at 100% for the worst case scenario. Incidental finding of anomaly of the coronary artery is a Class IIx medical event, unlikely to occur in a microgravity environment or that would be detected in a pre-mission evaluation. Persistent chest pain or AMI is a class III significant medical event, requiring evacuation if occurring on orbit. (Johnston, 2008). LOCL is not expected with timely evacuation to a health care facility.

Untreated Best Case Comments

Chest Pain/Angina functional impairments (FI) calculation follows the IMM severe non-space adaptation template. Coronary artery disease ratings are based on Table 4-6, p.55 (American Medical Association, 2008). Complex Regional Pain Syndrome-Upper Extremity CRPS (UEI) is based on Table 15-26, p 454 (American Medical Association, 2008). The CRPS (UEI) ratings are then converted to percentage of Whole Person Impairment (WPI), which are based on Table 15-1, p 385 (American Medical Association, 2008). Combined FI ratings are calculated combining the mentioned tables using the Combined Values Chart as indicated in Appendix A, pp 604-606 (American Medical Association, 2008). For a detailed description of grading refer to the CliFF Appendix

Clinical Phase II, FI is estimated at 18 to 57%; duration is estimated in 0.5 to 1 hour similar to the treated best case scenario; however there is no treatment available. During **Clinical Phase III,** AP may resolve or improve. FI is estimated at 0 to 35%. EVAC is estimated at 100% for the untreated best case scenario. Incidental finding of anomaly of the coronary artery is a Class IIx medical event, unlikely to occur in a microgravity environment or that would be detected in a pre-mission evaluation. (Johnston, 2008). EVAC is considered as an end state result with potential intractable pain. By definition, LOCL is not expected.

Untreated Worst Case Comments

Chest Pain/Angina functional impairments (FI) calculation follows the IMM severe non-space adaptation template. Coronary artery disease ratings are based on Table 4-6, p.55 (American Medical Association, 2008). Complex Regional Pain Syndrome-Upper Extremity CRPS (UEI) is based on Table 15-26, p 454 (American Medical Association, 2008). The CRPS (UEI) ratings are then converted to percentage of Whole Person Impairment (WPI), which are based on Table 15-1, p 385 (American Medical Association, 2008). Combined FI ratings are calculated combining the mentioned tables using the Combined Values Chart as indicated in Appendix A, pp 604-606 (American Medical Association, 2008). For a detailed description of grading refer to the CliFF Appendix.

During **Clinical Phase II**, FI is estimated at 36 to 86%; duration is estimated in 1 to 48 hours, similar to the treated worst case. During **Clinical Phase III,** AP will not resolve without treatment; FI is estimated at 36 to 86%; EVAC is estimated at 100% for the worst case scenario. Incidental finding of anomaly of the coronary artery is a Class IIx medical event, unlikely to occur in a microgravity environment or that would be detected in a pre-mission evaluation. Persistent chest pain or AMI is a class III significant medical event, requiring evacuation if occurring on orbit (Johnston, 2008). By IMM assumptions, potential intractable pain will cause EVAC.

Treatment and Options Level of Evidence (LOE)

The IMM level of evidence appropriate assessment of the quality of the IMM input data. Since IMM incorporates input data from a wide variety of sources including astronaut population, terrestrial or analog populations, and external models, an innovative approach to assess the quality of input data was required. Information obtained from the astronaut population and/or space flight is the more relevant so it is assigned the highest level of evidence and less relevant data sources are assigned a lower level of evidence.

Citation	LOE Value	LOE Category
National Institutes of Health National Heart, 2006	4	BCWC
Lloyd-Jones, 2010	4	BCWC
American Medical Association, 2008	3	FI
American Medical Association, 2008	3	FI
American Medical Association, 2008	3	FI
Johnston, 2008	2	EVAC

Additional Comments

Cardiovascular disease is one among three broad categories for deaths among NASA astronauts. Reynolds study results suggest that the risk of death from all three of these causes has been declining since the 1990s. Previous work on astronaut mortality demonstrated that the risk of death from all causes was elevated in comparison to both the general population and the LSAH controls.

The reduction in death from circulatory disease among the astronauts is most likely explained by two highly interrelated factors: high levels of physical fitness maintained by astronauts and the intensive screening for circulatory disease they receive both upon entry into the astronaut corps and periodically throughout their careers. In 1991 NASA revised this battery of medical screening procedures to make it more rigorous. The resultant screening regimen may help explain the particularly dramatic difference in circulatory disease mortality seen in the 2000s. {Reynolds, 2010 3332 /id

The Resource Table (RT)

Resource	Units Required Best Case	Units Required Worst Case	Units Available At Start Of Mission	Consumable	Essential	Rationale
Aspirin 325mg tab.	1	3	60	Yes	Yes	Anti-coagulation, to avoid thrombi formation, and pain relief
Blood Oximeter	1	1	1	No	Yes	Monitors the oxygen saturation of a patient's blood
Blood Pressure Cuff (regular, large)	1	1	2	No	Yes	Measure blood pressure
Blood Pressure Monitor	1	1	1	No	Yes	Measure blood pressure
BZK wipes	0	8	60	Yes	No	Cleanse skin.
CMRS	0	1	1	No	No	Restrain crew member to ensure safety
Dilaudid (Hydromorphone) 2mg/mL, 1mL syringe	0	2	18	Yes	Yes	Pain managment.
ECG Monitor (Device, USB Charge Cable, Lead Set Cable, Cue Card)	1	1	1	No	Yes	Measure and monitor ECG
Gauze pads (4x4)	0	2	50	Yes	No	To absorb blood or fluids from skin
IV administration set	0	1	3	Yes	Yes	IV fluid administration
IV Cap	0	1	5	Yes	No	Cap off the IV access.
IV Catheter (18G, 20G, or 22G)	0	1	14	Yes	Yes	IV fluid administration
IV Fluid 1L (1000mL)	0	2	5	Yes	Yes	IV hydration and medication administration.
IV Fluid Air Filter	0	1	3	Yes	No	To filter air from IV set
IV pressure infuser	0	1	1	No	No	IV fluid administration in decreased gravity
Medical tape	0	1	5	Yes	No	Single-coated pressure adhesive tape
Nitrile gloves (large, medium, and small) (pair)	0	1	30	Yes	No	Personal Protective equipment for CMO
Nitroglycerin tablet 0.4mg	1	3	25	Yes	Yes	Chest pain relief
Pack of 12 ECG electrodes	1	1	5	Yes	Yes	Measure and monitor ECG
Sharps container	0	1	40	No	No	To dispose of medical waste such as used medical needles, scalpels, IV catheters, razors, vials
Stethoscope	1	1	2	No	Yes	To listen to lung,heart, and bowel sounds, to blood flow in arteries and veins
Syringe (3cc)	0	3	20	Yes	Yes	To flush IV catheter
Tourniquet	0	1	1	No	No	To stop blood flow and engorge vein, this facilitates IV insertion

Resource	Units Required Best Case	Units Required Worst Case	Units Available At Start Of Mission	Consumable	Essential	Rationale
Variable Oxygen System	0	1	1	No	Yes	Contains ancilliary supplies for oxygen administration.

Resource Comments

Atrial fibrillation, cardiogenic shock, and sudden cardiac arrest resources are addressed in separate CliFFs.

All resources included and procedures are in the ISS Medical Checklist (Mission Operations Directorate (MOD), 2011) and CHeCS (ISS Medical Operations, 2009)

The AHA recommendations for treatment of angina terrestrially (O'Connor, 2010)differ slightly from ISS procedures for chest pain in nitroglycerin and aspirin administration.

AHA found insufficient evidence to support or refute the routine administration of nitroglycerin in the ED or pre-hospital setting in patients with a suspected ACS. There may be some benefit if nitroglycerin administration results in pain relief. AHA recommends that morphine be administered intravenously and titrated to pain relief in patients with STEMI. Morphine may be considered for pain relief in subjects with suspected NSTEMI. Some form of analgesia should be considered for patients with active chest discomfort. Despite limited direct evidence to support or refute the practice, AHA considers that it may be reasonable to consider aspirin administration, provided an adequate history can be obtained to exclude a true allergy or a bleeding disorder.

Required Resources Level of Evidence (LOE)

The IMM level of evidence appropriate assessment of the quality of the IMM input data. Since IMM incorporates input data from a wide variety of sources including astronaut population, terrestrial or analog populations, and external models, an innovative approach to assess the quality of input data was required. Information obtained from the astronaut population and/or space flight is the more relevant so it is assigned the highest level of evidence and less relevant data sources are assigned a lower level of evidence.

Citation	LOE Value	LOE Category
NASA Mission Operations Directorate (MOD), 2011	2	Resources
NASA ISS Medical Operations, 2011	2	Resources

Level Of Evidence

Input Data	LOE Average
Incidence	4
Functional Impairment	3
Best Case / Worst Case	4
EVAC / LOCL	2
Resources	2
QUALITY OF EVIDENCE	**3**

Description	Range
Excellent	1-2
Good	2.1-3
Fair	3.1-4
Poor	4.1-5

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