Acute Diverticulitis Cliff

Branch Baseline

A colonic diverticulum is a herniation of mucosa and sub mucosa, corresponding to a weak point where the vasa recti penetrate the tunica muscularis (West, 2008). Colonic diverticula are usually multiple and occur most often in the sigmoid colon. Acute diverticulitis occurs when a diverticulum becomes acutely inflamed. Persons with acute diverticulitis typically present with severe left iliac fossa pain associated with fever, malaise, and altered bowel habit with left iliac fossa tenderness, associated with general signs of infection, such as fever and tachycardia. (Humes, 2011)

Diverticular disease of the colon is among the most prevalent conditions in western society and is among the leading reasons for outpatient visits and causes of hospitalization. While previously considered to be a disease primarily affecting the elderly, there is increasing incidence among individuals younger than 40 years of age. The clinical spectrum of diverticular disease is variable, ranging from uncomplicated presentations, such as episodic pain or mild diverticulitis, to potentially life-threatening complicated disease such as abscess, perforation or hemorrhage. The cornerstone of management for uncomplicated diverticulitis is antibiotic therapy and bowel rest. Surgical management may be required for patients with recurrent diverticulitis or one of its complications including peridiverticular abscess, perforation, fistulizing disease, and strictures and/or obstruction. (Weizman, 2011)

The majority of individuals with diverticulosis are asymptomatic and about 20 percent have symptomatic diverticular disease. Acute diverticulitis is divided into uncomplicated and complicated diverticulitis. The Hinchey's classification is the most widely used in the literature for complicated diverticulitis. (Andersen, 2012)

In 1978, Hinchey et al. described a staging of acute complicated diverticulitis, which since then has been prevalent: Stage 1, Mesocolic / pericolic abscess. Stage 2, Pelvic abscess. Stage 3, Generalized peritonitis. Stage 4, Fecal peritonitis (Hinchey, 1978); cited in (Andersen, 2012)

Under ICD-10, diverticular disease is coded by anatomical site (small intestine, large intestine, both, or unspecified), although nearly all disease occurs in the large intestine, and by complication (perforation, abscess, or peritonitis). Under ICD-9, complications are not listed, but would presumably fall under diverticulitis, which is not a code under ICD-10.(Everhart, 2008)

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

Data Characteristics	
Fixed Rate:	0.00142

Incidence Comments

In 2004, diverticular disease was the fifth most common reason for ambulatory care visits, after GERD, constipation, abdominal wall hernia, and hemorrhoids. (Everhart, 2008)

Acute diverticulitis has not occurred in flight (Walton, 2010); thus our incidence is based on terrestrial data.

Recent incidence data is scarce. Differences in terminology and outcomes make difficult to compare studies (Salem, 2006). IMM reviewed United States incidences presented by Everhart, 0.00142 (Everhart, 2008), Etzioni, 0.000777 (Etzioni, 2009), and Ricciardi, 0.0076 (Ricciardi, 2009). Everhart data was selected based on providing the age range 45-64, close to the age of our astronaut population. It also provides rates for ambulatory care and hospitalization. Everhart estimated 3 years average, 2003-2005, from the National Ambulatory Medical Care Survey (NAMCS) and National Hospital Ambulatory Medical Care Survey (NHAMCS) and Healthcare Cost and Utilization Project Nationwide Inpatient Sample (HCUP NIS).

Ambulatory Care Visits, First-Listed Diagnosis, rate per 100,000, in 2004, By age 15-44, 222 (0.00222 per person-year), By age 45-64, 879 (0.00879 per person-year), By age 65+, 2,607 (0.02607 per person-year). Hospital discharges, first listed diagnosis, rate per 100,000, By age 15-44, 31 (0.00031 per person-year), **By age 45-64, 142 (0.00142 per person-year),** By age 65+, 477 (0.00477 per person-year) (Everhart, 2008). Confidence intervals are not published.

Rates for females are higher than for males, all are first listed diagnosis and rates per 100,000: 785 and 434, ambulatory care visits, and 108 and 99, hospital discharges respectively. Gender data is not stratified by age. (Everhart, 2008)

Based on Everhart data regarding hospital discharge, first listed diagnosis for age 45 to 64, the incidence rate is 0.00142 events per person-year. This incidence rate is chosen for the model because first listed diagnoses in hospital discharges is thought to be the most reliable data for new onset cases or acute exacerbations of diverticulitis. This age range of 45 to 64 captures the average age of the current active astronauts (age 47). However, since the current active astronaut population age range is 34 to 54, this estimated incidence of acute diverticulitis is probably slightly conservative.

Information Regarding Prevention

Selection criteria

Disqualifying conditions in the Abdomen and digestive system include: chronic diseases or disorders of the alimentary tract that interfere with performance of duties (e.g. Meckel's diverticulum). Diverticulitis or history of diverticulitis.

Diverticulosis requires Special Consideration by the MSMB. (International Space Station Program, 2011)

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
Everhart, 2008	4	Incidence

Alternative Incidence Data

Analog Populations

One case of diverticulitis, causing 4 sick days, has been reported among submariners. There were 4 transfers for gastrointestinal diseases, but information by condition is not provided (Tansey, 1979). IMM calculated incidence is 0.0000828 person-years (1/4,410,000 person days * 365). Nice reported 743 MEDEVAC events over a 9 month period. This figure extrapolates to 991 annual MEDEVACs. 17% of MEDEVACS were associated with digestive and dental conditions. One EVAC at sea was caused by diverticular disease, (Appendix G) (Nice, 1984)

Air Force: Query of Aeromedical Information Management Waiver Tracking System (AIMWTS) showed 52 cases of diverticulitis. Of the 52 cases, none were disqualified for diverticulitis. However, three were disqualified for unrelated medical conditions. There were no cases of symptomatic diverticulosis or any disqualifications related to symptoms after surgical treatment for diverticulitis (Aerospace Medical Association, 2010). Denominator is not available

Army: The Aeromedical Epidemiological Data Repository (AEDR) catalogs all Army flight physicals since 1960. There have been approximately 160,000 individual aircrew entered in this database. During this period of time, there were only eight aeromedical summaries submitted and all resulted in a granted waiver (Aerospace Medical Association, 2010).

Non Analog Populations

The patterns of practice and treatment of diverticulitis have evolved over time. Etzioni used the Nationwide Inpatient Sample (NIS) to determine patterns of practice in a nationally representative patient cohort from 1998 to 2005. For 2004-2005, United States age adjusted incidence rates for hospitalizations per 1000 population were overall 0.710, age cohorts 18-44 0.251, 45-64 0.777, 65-74 1.631, and 75+ 2.364. (Etzioni, 2009). IMM calculated rates per person overall 0.00071, and for the same age cohorts: 0.000251, 0.000777, and 0.001631, and 0.002364 respectively.

Mortality rates (in-hospital) for the period 2004-2005 were overall 1.0% and surgical 4.3%, average length of stay was 5.3 days. The overall rate at which patients underwent surgery was 14.4% and 2.5% had percutaneous drainage for the same time period (Etzioni, 2009).

Ricciardi conducted a retrospective analysis of patients with diverticular disease in the Nationwide Inpatient Sample, from 1991 through 2005. In 2005 the incidence rate for diverticulitis was 0.0076 (76 per 1,000). 1.5% had perforation and 9.6% had an abscess. Regarding surgical intervention colectomy occurred in 13.7% of uncomplicated cases and 55.5% of complicated diverticulitis. (Ricciardi, 2009)

A study to determine the trends of diverticular disease admissions between 1989/90 and 1999/2000 and mortality rates from 1979 to 1999 was conducted in England. Hospital Episode Statistics were obtained from the Department of Health and mortality data from the Office for National Statistics. Incidence rates were overall 0.00028. For age 45-54 0.00025 and 55-64 0.00052. In 1999/2000, 26.6% of men and 22.3% of women admitted for diverticular disease underwent an operation, and this percentage was higher in men than in women in each year of the study period. Mortality rates in 1999-2000 were 3.4%. Acute diverticulitis is the most common complication, presenting with abdominal pain, sometimes associated with perforation, intestinal obstruction, fistula and abscess formation. Lower gastrointestinal tract bleeding from diverticula is not associated with acute underlying inflammation, but rather with erosion of the sub mucosal blood vessels at the neck of a diverticulum. (Kang, 2003)

Seventy-seven patients with complicated diverticular disease were identified in Glasgow, UK, during one year 2003-2004. There were 53 females and 24 males, 68.8 and 31.2%, with a median age of 74 years (range 30-97 years). Complications included: acute diverticulitis 48% (37/77), fistula 15.6% (12/77), perforation 10.3% (8/77), bleeding 9.1 (7/77), abscess 9.1% (7/77) and stricture 7.8% (6/77). Only 8 had two or more previous documented episodes of diverticulitis. Twenty-five underwent surgery, 3 died (peritonitis 2, abscess1) and 5 had a complication (anastomotic dehiscence 1, adhesive obstruction 1, incisional hernia 2 and pneumonia 1). Three (5%) of 37 patients with acute diverticulitis had two or more admissions but none underwent surgery or developed further complications. CT was performed during acute admission in 14/37 patients with acute diverticulitis. The majority of patients with fistula (9/12), perforation (7/8), bleeding (6/7) and abscess (5/7) had no previous episode of diverticulitis while most patients with stricture (4/6) had previous documented episodes. (Salem, 2006)

During a 20 year period, 1986 to 2005, 977 patients were admitted to Oulu University Hospital in Finland. There were 695 admissions for uncomplicated (71%) and 282 for complicated diverticulitis (29%), of which there were 220 perforations, 44 strictures and 18 fistulae (23%, 4% and 2% respectively). Bleeding occurred on recurrence, none on the first episode of diverticulitis. Patients admitted for uncomplicated diverticulitis were younger than the others (mean 59, SD 13, age range 27-87, 281 male, 414 female. Overall hospital mortality was 2.3% (22/977), being 1% (7/695) among acute diverticulitis patients, and 5.5% (12/220) among patients admitted for diverticular perforation, 0% in fistula and 0% in stricture. (Makela, 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 %: 71 - 78)	100	1.5 - 2	2 - 24	168 - 204 - 240	0	0	0
ISS-based Treatment (worst case scenario %: 22 - 29)	100	2 - 3	17 - 50	0 - 12 - 24	0 - 50	0 - 100	0 - 3
Untreated Best Case	N/A	N/A	17 - 50	168 - 204 - 240	0 - 50	0 - 100	0
Untreated Worst Case	N/A	N/A	31 - 76	0 - 12 - 24	31 - 76	100	0 - 100

[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

Acute diverticulitis ranges in severity from uncomplicated phlegmonous diverticulitis to complicated diverticulitis with abscess or perforation. (Andersen, 2012)

The **best case scenario is defined** as an uncomplicated case of diverticulitis, that is self-limited or responds to available non-surgical treatment.

The **worst case scenario is defined** as a complicated case of diverticulitis, which may require surgical intervention.

Complicated acute diverticulitis may result in perforation and sepsis. Septic shock is addressed in the Sepsis Clinical Findings Form (CliFF). It may also result in bowel stricture leading to obstruction. Bowel obstruction is addressed in the Small Bowel Obstruction CliFF. Acute diverticulitis may cause bleeding and require emergency transfusion. Hypovolemia secondary to bleeding is addressed in the Hypovolemic Shock CliFF.

Lack of clarity in the definition of acute diverticulitis has led to difficulty in interpreting study results and comparing outcomes for complicated diverticular disease. Outcome is likely to be different for patients with uncomplicated diverticulitis compared to more selective studies which only includes patients with documented abscess formation, obstruction or inflammatory phlegmon. (Salem, 2006)

The American College of Gastroenterology recommends conservative management for small pericolic abscess, while fistulas and large abscesses require surgical intervention (Stollman, 1999).

There are divergent opinions about bleeding. For The American College of Gastroenterology diverticular bleeding is self limited in the majority of patients (Stollman, 1999). The World Gastroenterology Organization (WGO) estimates that 15% of patients with diverticulosis will bleed at some point. Severe blood loss is noted in 3 to 5%. Lewis reported that hemorrhage in diverticular disease occurs more frequently in the elderly, and with comorbidities such as diabetes, hypertension, anticoagulation, and heart disease (Lewis, 2008)

Terrestrially, overall mortality rates range from 0.000004 to 1% (Everhart, 2008), (Makela, 2010), (Etzioni, 2009)). Peritonitis and perforation are uncommon (Weizman, 2011). Subsequent mortality is secondary to sepsis and it is not included in this CliFF.

Percentages of how often best versus worst case scenarios occur were obtained from terrestrial data, There is no consensus in the rates of complication, hospitalization or surgery. In the United States 14% of diverticulitis required hospitalization (Everhart, 2008), 16.9% required surgical intervention (14.4% surgery and 2.5% percutaneous drainage) (Etzioni, 2009). In the United Kingdom surgery occurred in 22.3 to 26.6% (Kang, 2003). In Finland 29% of acute diverticulitis presented with complications (Makela, 2010). Considering the worst case scenario as cases presenting with complications or requiring surgery, the estimate for worst case percentage is **22%to 29%**. Thus the best case scenario is estimated as 71% to 78%.

Best Case Comments

Acute Diverticulitis is not included in the AMA Guides to the Evaluation of Permanent Impairment. We derived the Functional Impairment (FI) by using the IMM severe non-space adaptation condition template, except in the untreated best case scenario, where a higher class and grading was assigned to include untreated severe abdominal pain. Colonic and Rectal disorders ratings are based on Table 6-5, p.114 (American Medical Association, 2008). Complex Regional Pain (LEI) is based on Table 16-15, p.541. The CRPS (LEI) ratings are then converted to percentage of Whole Person Impairment (WPI), which are based on Table 16-1, p 495 and Table 16-10 pp.530-531 (American Medical Association, 2008). Combined FI ratings are calculated combining the Colonic and Rectal FI and CRPS Whole Body Impairment using the Combined Values Chart as indicated in Appendix A, pp 604-606 (American Medical Association, 2008). For further details refer to the CliFF Appendix.

By definition, in Clinical Phase I, FI is 100%. Duration to follow procedures specified in ISS checklist for abdominal pain, i.e. physical exam, vital signs, and abdominal ultrasound for the best case scenario, is estimated in 90 minutes to 2 hours. During Clinical Phase II, FI is estimated in 2 to 24%. Clinical practice guidelines recommend antibiotics treatment for 7 to 10 days, 168 to 240 hours (Stollman, 1999), which is the estimated duration. By definition, In Clinical Phase III, full recovery is expected and FI is 0%. By definition, EVAC and LOCL are not be expected for the best case scenario, hence both are estimated as 0%

Worst Case Comments

Acute Diverticulitis is not included in the AMA Guides to the Evaluation of Permanent Impairment. We derived the Functional Impairment (FI) by using the IMM severe non-space adaptation condition template, except in the untreated best case scenario, where a higher class and grading was assigned to include untreated severe abdominal pain. Colonic and Rectal disorders ratings are based on Table 6-5, p.114 (American Medical Association, 2008). Complex Regional Pain (LEI) is based on Table 16-15, p.541. The CRPS (LEI) ratings are then converted to percentage of Whole Person Impairment (WPI), which are based on Table 16-1, p 495 and Table 16-10 pp.530-531 (American Medical Association, 2008). Combined FI ratings are calculated combining the Colonic and Rectal FI and CRPS Whole Body Impairment using the Combined Values Chart as indicated in Appendix A, pp 604-606 (American Medical Association, 2008). For further details refer to the CliFF Appendix.

By definition, in Clinical Phase I, FI is 100%. Duration to follow procedures specified in ISS checklist, i.e. physical exam, vital signs, intravenous fluids, antibiotics, and abdominal ultrasound for the worst case scenario, is estimated in 2 to 3 hours.

During Clinical Phase II, FI is estimated in 17 to 50%. Surgery or percutaneous drainage, recommended for complicated diverticulitis, are not available on board (Makela, 2010), (Kang, 2003), (Etzioni, 2009). Duration is estimated at 0 to 24 hours to prepare for EVAC.

In Clinical Phase III, full recovery may or may not occur and FI is 0-50%. EVAC has occurred at least once in the Navy (Nice, 1984) and hospitalization has occurred among the astronaut corps in the ground (Johnston, 2008). Acute diverticulitis is a Class IIc medical event, manageable with the HMS but may necessitate emergent evacuation if condition does not improve or worsen (Johnston, 2008). Hence, EVAC is estimated as 0 to 100% to capture uncertainty in clinical course and response to treatment. LOCL estimate for diverticulitis is 0 to 3% based the Makela and Elliott studies. [Overall hospital mortality was 2.3% (22/977), being 1% (7/695) among acute diverticulitis patients, and 5.5% (12/220) among patients admitted for diverticular perforation, 0% in fistula and 0% in stricture]. As per the Elliott study (Elliott, 1997), 5.7% of patients admitted with acute diverticulitis died (23/403) and 57% of deaths were due to causes other than sepsis (13/23). Since LOCL from Sepsis is captured in the Sepsis CliFF, the estimated LOCL probability for treated worst case acute diverticulitis is estimated as **0-3%** (57% of 5.7% = 3.2%).

Untreated Best Case Comments

Acute Diverticulitis is not included in the AMA Guides to the Evaluation of Permanent Impairment. We derived the Functional Impairment (FI) by using the IMM severe non-space adaptation condition template, except in the untreated best case scenario, where a higher class and grading was assigned to include untreated severe abdominal pain. Colonic and Rectal disorders ratings are based on Table 6-5, p.114 (American Medical Association, 2008). Complex Regional Pain (LEI) is based on Table 16-15, p.541. The CRPS (LEI) ratings are then converted to percentage of Whole Person Impairment (WPI), which are based on Table 16-1, p 495 and Table 16-10 pp.530-531 (American Medical Association, 2008). Combined FI ratings are calculated combining the Colonic and Rectal FI and CRPS Whole Body Impairment using the Combined Values Chart as indicated in Appendix A, pp 604-606 (American Medical Association, 2008). For further details refer to the CliFF Appendix.

During Clinical Phase II, FI is estimated in 17 to 50%. Duration is estimated at 48 to 72 hours to prepare for EVAC, similar to the treated worst case scenario.

In Clinical Phase III, recovery may or may not occur and FI is 0-50%. Based on the inability to treat pain and to capture uncertainty in the clinical course, EVAC is estimated as 0 to 100% for the untreated best case. By definition LOCL is not expected for this scenario.

Untreated Worst Case Comments

Acute Diverticulitis is not included in the AMA Guides to the Evaluation of Permanent Impairment. We derived the Functional Impairment (FI) by using the IMM severe non-space adaptation condition template, except in the untreated best case scenario, where a higher class and grading was assigned to include untreated severe abdominal pain. Colonic and Rectal disorders ratings are based on Table 6-5, p.114 (American Medical Association, 2008). Complex Regional Pain (LEI) is based on Table 16-15, p.541. The CRPS (LEI) ratings are then converted to percentage of Whole Person Impairment (WPI), which are based on Table 16-1, p 495 and Table 16-10 pp.530-531 (American Medical Association, 2008). Combined FI ratings are calculated combining the Colonic and Rectal FI and CRPS Whole Body Impairment using the Combined Values Chart as indicated in Appendix A, pp 604-606 (American Medical Association, 2008). For further details refer to the CliFF Appendix.

During Clinical Phase II, FI is estimated at 31 to 76%. Duration is estimated at 0 to 24, to prepare for emergent EVAC.

In Clinical Phase III, without available treatment, FI remains 31 to 76%. Without treatment, EVAC is expected and is therefore specified as 100% LOCL is estimated at 0 to 100% to account for the large uncertainty in mortality of an untreated worst case scenario.

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
American Medical Association, 2008	3	FI
American Medical Association, 2008	3	FI
American Medical Association, 2008	3	FI
Kang, 2003	4	BCWC
Makela, 2010	4	BCWC
Nice, 1984	2	EVAC
Johnston, 2008	2	EVAC
Elliott, 1997	4	EVAC

The Resource Table (RT)

Resource	Units Required Best Case	Units Required Worst Case	Units Available At Start Of Mission	Consumable	Essential	Rationale
Bactrim DS (Sulfamethoxazole/Trimethoprim) 800 mg/160 mg tablet	14	0	40	Yes	Yes	Antibiotic
Biohazard Trash Bag	0	1	15	Yes	No	To dispose of biohazard trash safely
Blood Oximeter	1	1	1	No	Yes	For VS measurement
Blood Pressure Cuff (regular, large)	0	1	2	No	Yes	Measure blood pressure
Blood Pressure Monitor	0	1	1	No	Yes	Measure blood pressure
CMRS	0	1	1	No	No	Restrain crew member to ensure safety
Ertapenem 1gm	0	3	6	Yes	Yes	Antibiotic
Flagyl (Metronidazole) 500mg	30	0	100	Yes	Yes	Anti infective
Gauze pads (4x4)	2	2	50	Yes	No	to absorb blood or fluids from skin
IV administration set	0	1	3	Yes	Yes	To infuse medications
IV Cap	0	1	5	Yes	No	IV administration
IV Catheter (18G, 20G, or 22G)	0	1	14	Yes	Yes	IV fluid administration
IV Fluid 1L (1000mL)	0	2	5	Yes	Yes	To replenish fluids
IV Fluid Air Filter	0	1	3	Yes	No	To filter air from IV set
IV pressure infuser	0	1	1	No	No	To infuse IV fluids
Lidocaine (Xylocaine) plain 1%, 10mL multi dose vial	0	3	3	Yes	Yes	Anesthetic for ertapenem injection
Medical tape	0	1	5	Yes	No	single-coated adhesive tape
Needle (23G)	0	3	20	Yes	Yes	For medication administration
Nitrile gloves (large, medium, and small) (pair)	0	1	30	Yes	No	Personal Protective equipment for CMO
Sharps container	0	1	40	No	No	To dispose of medical waste such as used medical needles, scalpels, IV catheters, razors.
Stethoscope	1	1	2	No	Yes	to listen to lung, heart, and bowel sounds, to blood flow in arteries and veins
Syringe (3cc)	0	5	20	Yes	Yes	For medication administration and to flush IVF line
Thermometer	1	1	1	No	No	To measure temperature
Tourniquet	0	1	1	No	No	Restrict blood flow while starting IV
Tylenol (Acetaminophen) 325 mg	84	0	150	Yes	Yes	Pain relief (mild)

Resource	Units Required Best Case	Units Required Worst Case	Units Available At Start Of Mission	Consumable	Essential	Rationale
Vicodin HP (Hydrocodone/ Acetaminophen HP) 10 mg/660 mg	0	24	30	Yes	Yes	Pain relief (severe)

Resource Comments

In-flight Treatment(s): Antibiotics are available for treatment of acute intra-abdominal infections and analgesics are available for abdominal pain (Mission Operations Directorate (MOD), 2011). Diverticulitis is not included in the ISS medical checklist. All resources in this table are available on board (Mission Operations Directorate (MOD), 2011).

Surgical capabilities are currently limited in flight. Percutaneous drainage and laparoscopic surgery might be available as future capabilities and would require vehicle capabilities, resources, and crew medical officer training (Campbell, 2008)..

Terrestrial Guidelines recommend antibiotic treatment for 7 to 10 days and pain management. Bowel rest and intravenous medications are recommended for severe cases. (Stollman, 1999), (Murphy, 2007).

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
Stollman, 1999	3	Resources
Murphy, 2007	3	Resources

Level Of Evidence

Input Data	LOE Average
Incidence	4
Functional Impairment	3
Best Case / Worst Case	4
EVAC / LOCL	2.66666666666667
Resources	2.66666666666667
QUALITY OF EVIDENCE	**3.26666666666667**

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

Reference List

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