Respiratory Infection

From HumanResearchWiki

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Introduction

Respiratory infections may involve different parts of the respiratory system, including the upper respiratory tract, the bronchi, or the lungs. Upper respiratory infections (URIs) are typically mild and self-limited. The most common ones are caused by viral infections, such as the common cold, and involve the mucosa of the nasal passages and pharynx. URIs are easily spread from one person to the next via airborne droplets.[1]

Bronchitis is an inflammation of the mucosa along the bronchi, and presents with cough and, occasionally, sputum production.[2] Pneumonia can be defined as inflammation of the lung parenchyma, caused most commonly by either bacteria or viruses. It may present with fever, cough, chest pain, and sputum production.[3] Respiratory infections have been reported in space flight in spite of efforts to mitigate this risk with a seven day pre-launch crew quarantine. The diagnosis during space flight can be challenging since similar symptoms have been attributed to a microgravity-associated cephalad fluid shift and the dry spacecraft cabin atmosphere. Establishing the diagnosis of pneumonia poses another unique challenge due to reliance on stethoscope auscultation, possibly by a non-physician Crew Medical Office (CMO), in a noisy cabin environment. Susceptibility to infection could possibly be increased due to an impaired immune response seen in astronauts during space missions.[4]

Clinical Priority and Clinical Priority Rationale by Design Reference Mission

One of the inherent properties of space flight is a limitation in available mass, power, and volume within the spacecraft. These limitations mandate prioritization of what medical equipment and consumables are manifested for the flight, and which medical conditions would be addressed. Therefore, clinical priorities have been assigned to describe which medical conditions will be allocated resources for diagnosis and treatment. “Shall” conditions are those for which diagnostic and treatment capability must be provided, due to a high likelihood of their occurrence and severe consequence if the condition were to occur and no treatment was available. “Should” conditions are those for which diagnostic and treatment capability should be provided if mass/power/volume limitations allow.
Conditions were designated as “Not Addressed” if no specific diagnostic and/or treatment capability are expected to be manifested, either due to a very low likelihood of occurrence or other limitations (for example, in medical training, hardware, or consumables) that would preclude treatment. Design Reference Missions (DRMs) are proposed future missions designated by a set of assumptions that encompass parameters such as destination, length of mission, number of crewmembers, number of Extravehicular Activities (EVAs), and anticipated level of care. The clinical priorities for all medical conditions on the Exploration Medical Condition List (EMCL) can be found here (https://humanresearchwiki.jsc.nasa.gov/index.php?title=Category:All_DRM). The EMCL document may be accessed here (https://humanresearchwiki.jsc.nasa.gov/images/6/62/EMCL_RevC_2013.pdf).

<table>
<thead>
<tr>
<th>Design Reference Mission</th>
<th>Clinical Priority</th>
<th>Clinical Priority Rationale</th>
</tr>
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<tbody>
<tr>
<td>Lunar sortie mission</td>
<td>Shall</td>
<td>While the signs and symptoms of a respiratory infection are usually an inconvenience more than a medical concern, the underlying cause of the symptoms may warrant treatment, especially if bacterial in origin. In addition, symptom alleviation may be important for optimal crew performance, and may be crucial for operations involving pressure changes, such as EVAs. Therefore, treatment shall be manifested.</td>
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<tr>
<td>Assumptions:</td>
<td></td>
<td></td>
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<tr>
<td>4 crewmembers (3 males, 1 female)</td>
<td></td>
<td></td>
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<tr>
<td>14 days total</td>
<td></td>
<td></td>
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<tr>
<td>4 EVAs/ crewmember</td>
<td></td>
<td></td>
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<tr>
<td>Level of Care 3</td>
<td></td>
<td></td>
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<tr>
<td>Lunar outpost mission</td>
<td>Shall</td>
<td>While the signs and symptoms of a respiratory infection are usually an inconvenience more than a medical concern, the underlying cause of the symptoms may warrant treatment, especially if bacterial in origin. In addition, symptom alleviation may be important for optimal crew performance, and may be crucial for operations involving pressure changes, such as EVAs. Therefore, treatment shall be manifested.</td>
</tr>
<tr>
<td>Assumptions:</td>
<td></td>
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<tr>
<td>4 crewmembers (3 males, 1 female)</td>
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<tr>
<td>180 days total</td>
<td></td>
<td></td>
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<tr>
<td>90 EVAs/ crewmember</td>
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<td></td>
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<tr>
<td>Level of Care 4</td>
<td></td>
<td></td>
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<tr>
<td>Near-Earth Asteroid (NEA) mission</td>
<td>Shall</td>
<td>While the signs and symptoms of a respiratory infection are usually an inconvenience more than a medical concern, the underlying cause of the symptoms may warrant treatment, especially if bacterial in origin. In addition, symptom alleviation may be important for optimal crew performance, and may be crucial for operations involving pressure changes, such as EVAs. Therefore, treatment shall be manifested.</td>
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<tr>
<td>Assumptions:</td>
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<tr>
<td>3 crewmembers (2 males, 1 female)</td>
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<tr>
<td>395 days total</td>
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<tr>
<td>30 EVAs/ crewmember</td>
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<tr>
<td>Level of Care 5</td>
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Initial Treatment Steps During Space Flight

A link is provided to a prior version of the International Space Station (ISS) Medical Checklist, which outlines the initial diagnostic and treatment steps recommended during space flight for various conditions which may be encountered onboard the ISS. Further diagnostic and treatment procedures beyond the initial steps outlined in the Medical Checklist are then recommended by the ground-based Flight Surgeon, depending on the clinical scenario. Please note that this version does not represent current diagnostic or treatment capabilities available on the ISS. While more recent versions of this document are not accessible to the general public, the provided version of the checklist can still provide a general sense of how medical conditions are handled in the space flight environment.

Medical Checklists will be developed for exploration missions at a later point in time.

Please note this file is over 20 megabytes (MB) in size, and may take a few minutes to fully download.

ISS Medical Checklist (http://www.nasa.gov/centers/johnson/pdf/163533main_ISS_Med_CL.pdf)

Capabilities Needed for Diagnosis

The following is a hypothetical list of capabilities that would be helpful in diagnosis. It does not necessarily represent the current capabilities available onboard current spacecraft or on the ISS, and may include capabilities that are not yet feasible in the space flight environment.

- Vital signs measurement capability (blood pressure, pulse, respiratory rate, temperature, pulse oximetry, as required per the patient's clinical state)
- Auscultation device (such as a stethoscope)
- Light source (such as a penlight)
- Tongue depressor
- Imaging (such as X-ray or ultrasound for chest and/or sinus imaging)

Capabilities Needed for Treatment

The following is a hypothetical list of capabilities that would be helpful in treatment. It does not necessarily represent the current capabilities available onboard current spacecraft or on the ISS, and may include capabilities that are not yet feasible in the space flight environment.

- Cough lozenges
- Cough suppressants
- Expectorants
- Decongestants
- Antibiotics
- Supplemental oxygen
Associated Gap Reports

2.01 - We do not know the quantified health and mission outcomes due to medical events during exploration missions.
2.02 - We do not know how the inclusion of a physician crew medical officer quantitatively impacts clinical outcomes during exploration missions.
3.01 - We do not know the optimal training methods for in-flight medical conditions identified on the Exploration Medical Condition List taking into account the crew medical officer’s clinical background. (Closed)
3.03 - We do not know which emerging technologies are suitable for in-flight screening, diagnosis, and treatment during exploration missions.
4.01 - We do not have the capability to provide a guided medical procedure system that integrates with the medical system during exploration missions.
4.02 - We do not have the capability to provide non-invasive medical imaging during exploration missions.
4.04 - We do not have the capability to deliver supplemental oxygen to crew members while minimizing local and cabin oxygen build-up during exploration missions.
4.05 - We do not have the capability to measure laboratory analytes in a minimally invasive manner during exploration missions.
4.14 - We do not have the capability to track medical inventory in a manner that integrates securely with the medical system during exploration missions.
4.15 - Lack of medication usage tracking system that includes automatic time stamping and crew identification
4.17 - We do not have the capability to package medications to preserve stability and shelf-life during exploration missions.
4.19 - We do not have the capability to monitor physiological parameters in a minimally invasive manner during exploration missions.
4.23 - We do not have the capability to auscultate, transmit, and record body sounds during exploration missions.
4.24 - Lack of knowledge regarding the treatment of conditions on the Space Medicine Exploration Medical Condition List in remote, resource poor environments (Closed)
5.01 - We do not have the capability to comprehensively manage medical data during exploration missions.

Other Pertinent Documents

List of Acronyms

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<tr>
<th>C</th>
<th>Crew Medical Officer</th>
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<tr>
<td>D</td>
<td>Design Reference Mission</td>
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<tr>
<td>E</td>
<td>Exploration Medical Condition List</td>
</tr>
<tr>
<td>I</td>
<td>Extravehicular Activity</td>
</tr>
<tr>
<td>I</td>
<td>International Space Station</td>
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<td>M</td>
<td>Megabyte</td>
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References


Last Update

This topic was last updated on 8/13/2014 (Version 2).


Category: Medical Conditions