A QUANTITATIVE RISK-BENEFIT ANALYSIS OF PROPHYLACTIC SURGERY PRIOR TO EXTENDED-DURATION SPACEFLIGHT

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INTRODUCTION: Among otherwise healthy astronauts undertaking deep space missions, the risks for acute appendicitis (AA) and cholecystitis (AC) are not zero. If these conditions were to occur during spaceflight they may require surgery for definitive care. The proposed study quantifies and compares the risks of developing de novo AA and AC in-flight to the surgical risks of prophylactic laparoscopic appendectomy (LA) and cholecystectomy (LC) using NASA's Integrated Medical Model (IMM).

METHODS: The IMM is a Monte Carlo simulation that forecasts medical events during spaceflight missions and estimates the impact of these medical events on crew health. In this study, four Design Reference Missions (DRMs) were created to assess the probability of an astronaut developing in-flight small-bowel obstruction (SBO) following prophylactic 1) LA, 2) LC, 3) LA and LC, or 4) neither surgery (SR# S-20160407-351). Model inputs were drawn from a large, population-based 2011 Swedish study that examined the incidence and risks of post-operative SBO over a 5-year follow-up period. The study group included 1,152 patients who underwent LA, and 16,371 who underwent LC.

RESULTS: Preliminary results indicate that prophylactic LA may yield higher mission risks than the control DRM. Complete analyses are pending and will be subsequently available.

DISCUSSION: The risk versus benefits of prophylactic surgery in astronauts to decrease the probability of acute surgical events during spaceflight has only been qualitatively examined in prior studies. Within the assumptions and limitations of the IMM, this work provides the first quantitative guidance that has previously been lacking to this important question for future deep space exploration missions.