Poster Title: Resistance of *Klebsiella* strains from the International Space Station to quaternary ammonium compound disinfectants

Authors/Institutions: Natasha S. Sushenko[1,2], Alireza Saidi-Mehrabad[2], Nitin K. Singh[3], Brian P. Hedlund[2,4], Kasthuri Venkateswaran[3], Duane P. Moser[2]

[1]School of Life Sciences, University of Nevada Las Vegas, Las Vegas, NV, USA
[2]Division of Hydrologic Sciences, Desert Research Institute, Las Vegas, NV, USA
[3]Biotechnology and Planetary Protection Group, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA
[4]Nevada Institute of Personalized Medicine, University of Nevada Las Vegas, Las Vegas, NV, USA

Abstract: The International Space Station (ISS) has been continuously inhabited for twenty years and harbors a diverse population of microorganisms, including Biosafety Level 2 opportunistic pathogens such as *Klebsiella pneumoniae,* under conditions of microgravity, elevated radiation, and isolation. Beyond these stressors of spaceflight, the impact of the quaternary ammonium compound (QAC) disinfectants employed for environmental hygiene on the ISS microbiome is poorly understood. Here, we examine the responses of three strains of *Klebsiella* (two ISS-origin and one Earth-origin strain) to different concentrations of QAC disinfectants used on the ISS with the aim of understanding the ISS strains' physical responses to this stressor and to determine the minimum inhibitory concentration (MIC) for future experiments. For these experiments, two different fluorescent viability dyes have been used in conjunction with varied techniques such as absorbance spectroscopy, flow cytometry, quantitative real-time PCR, and fluorescence microscopy. This work has shown that QACs are effective disinfectants for *Klebsiella,* with MIC values for each strain ranging from 0.175-0.1%. However, we observed drastically different phenotypic responses for all three strains after exposure to full-strength QAC disinfectant, which ranged from complete lysis of the bacterial culture to the formation of large clumps of cells in the culture. Based on viability assays, these clumps may serve a putative protective function to QAC exposure. This research aligns with several NASA priorities from the Space Biology area of interest, including *"Developing the scientific and technological foundations for a safe, productive human presence in space for extended periods"* and *"Effectively use microgravity and other characteristics of the space environment to enhance our understanding of fundamental biological processes."* By elucidating how opportunistic pathogens such as *Klebsiella* respond and adapt to spaceflight, these results will assist NASA in adapting their environmental hygiene strategies for future longer-term manned expeditions to protect the health of astronauts.

Support: This material is based upon work supported by the National Aeronautics and Space Administration under NASA EPSCoR Rapid Response Research Cooperative Agreement NNH18ZHA005C award number 80NSSC19M0169 to DPM. Additional support was provided through the Nevada Space Grant Consortium Graduate Research Opportunity Fellowship award number 13584 to NSS.