International Space Station- Microbial observatory of pathogenic viruses, bacteria and fungi and the impact on astronaut health. C. Urbaniak[1] and K. Venkateswaran[2], [1]NASA Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, California. camilla.urbaniak@jpl.nasa.gov [2]NASA Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, California. kjvenkat@jpl.nasa.gov

Introduction: The International Space Station (ISS) is a unique built environment not found anywhere on Earth. While factors such as temperature, humidity, airflow, air source, occupant density, and surface materials have all been shown to influence the indoor microbiome on Earth [1,2], it is still not known about what factors affect the composition of the ISS microbiome. If certain conditions promote higher numbers of pathogens and their differential virulence characteristics, this will have a profound effect on astronaut health, as their risk of developing infections is already high due to immunosuppression caused by spaceflight. Pathogen transmission is not the only microbial influence on astronaut health. The trillions of microorganisms inhabiting our body (termed “human microbiome”) are important in maintaining health, and changes in composition and function have been implicated in numerous non-infectious diseases [3].

The dynamic interactions between astronaut and the ISS environment under microgravity will ultimately shape the composition of the human microbiome and if the host cannot adapt appropriately to this exposure, crew health will be at risk. On long term space missions, where access to medical care and facilities are limited, maintaining crew health is vital for the success of these missions.

Objectives: The objectives of this study will be to (i) provide a comprehensive catalogue of bacteria, viruses, and fungi that colonize the ISS; (ii) to correlate the presence of pathogens on the ISS with that of the crew, to determine how readily exchange of these microorganisms occur between crew/surfaces and other crew members and what factors may promote this transfer; (iii) to determine which pathogens persist across multiple ISS missions; (iv) to determine whether spaceflight changes the astronaut microbiome; and (v) to determine whether pathogen acquisition by the crew is influenced by the composition of one’s microbiota and whether a signature microbial profile exists that could minimize pathogen colonization of astronauts while in space.

Study design: Skin, oral and nasal swabs will be collected from 3 astronauts (flying on 3 separate missons) at 3 different time points; prior to flying to the ISS, while on the ISS (multiple times throughout their mission) and when they return to Earth (1 month and 3 months post flight). Surface and air samples will also be collected from 8 different locations across the ISS during each of the astronuats’ missions. Metagenome (functional characteristics), targeted microbiome (bacteria, fungi, virus), and resistome (antimicrobial resistance gene amplification) profiles will be carried out. Molecular analyses will also be complemented with culture analysis that enable to characterize microorganisms to elucidate changes incurred due to microgravity and other space conditions.

Significance: Data generated from this project will provide information of what is present on the ISS and how this is influenced by conditions such as microgravity, positive/negative pressure, airflow, air source, humidity, and air purification etc. This will give us an idea of what factors could lend itself to increased surface/crew transmission and whether the microorganisms colonizing the ISS could pose a health risk to the astronauts onboard. The data generated could be used by structural engineers to re-design equipment/surfaces on the ISS and future space vehicles that can help reduce pathogen-crew transmission and mitigate health risks. Understanding how the host microbiome (both pathogens and commensals) respond to spaceflight could allow for more informed health policies for astronauts, such as dose of antibiotics to give, develop countermeasures before space travel, and elimination of nutrients from diet to prevent the growth of certain organisms while in space.

References:: [1] Qian H. et al. (2010) *Build. Environ.* 45(3), 559–565. [2] Kim L. et al. (2014) *Appl. Environ. Microbiol.* 80(1), 177–83. [3] Shreiner A.B. et al. (2015) *Curr. Opin. Gastroenterol.* 31(1), 69–75.