Objectives

• Address significant lack of data regarding immune status *during* flight.

• Replace several recent immune studies with one comprehensive study that will include in-flight sampling.

• Determine the in-flight status of immunity, physiological stress, viral immunity/reactivation.

• Determine the clinical risk related to immune dysregulation for exploration class spaceflight.

• Determine the appropriate monitoring strategy for spaceflight-associated immune dysfunction, that could be used for the evaluation of countermeasures.
ASSAYS FOR INTEGRATED IMMUNE

**JSC Immunology Laboratory**
- Leukocyte subsets
- T cell function
- Intracellular/secreted cytokine profiles

**Mercer University**
- Plasma cytokine balance
- Leukocyte cytokine RNA

**Microgen Laboratories**
- Virus specific T cell number
- Virus specific T cell function
- Plasma stress hormones

**JSC Microbiology Laboratory**
- Latent herpesvirus reactivation (saliva/urine)
- Saliva/urine stress hormones
- Circadian rhythm analysis
SUBJECTS

Completed to date:

10 Short duration
5 Long duration

Total ‘n’:

17 Short duration
17 Long duration
A. Immunophenotype, T cell function, intracellular/secreted cytokine profiles.
• No in-flight changes in bulk leukocyte subsets
• Post-flight granulocytosis
• Late in-flight/postflight elevated B cells, reduced NK cells
• In-flight, post-flight trend towards elevated CD4:CD8 ratio, elevated memory T cell subsets
• Elevated effector memory, central memory in-flight
• No change in peripheral constitutively activated T cells
CD8+ T CELL FUNCTION: A+B 24 hours

ISS

SEA+SEB 24hr

- CD4/CD69
- CD8/CD69
- CD4/CD69/CD25
- CD8/CD69/CD25

CD8+ T CELL FUNCTION: A+B 24 hours
CD8+ T cell – Intracellular IFNg

Secreted Cytokine Profiles (CD3/CD28 48hr)
B. Leukocyte cytokine mRNA
Gene Expression of Markers of Innate (A) and Adaptive (B) Immune Responses (short-duration flights).

A.

B.
Gene Expression of Markers of Innate (A) and Adaptive (B) Immune Responses (long-duration flights).

**A.**
- **TNF-α**
- **IL-1**
- **IL-6**

**B.**
- **IFN-γ (Th1 clones)**
- **IL-4 (Th2 clones)**
- **IL-10 (Treg clones)**

Intervals of sample collection:
- L-180
- L-45
- early
- late
- R+0
- R+30

Relative Quantification (Folds of Changes)
C. Virus specific T cell number, function, plasma stress hormone levels.
Plasma cortisol levels - ISS

![Graph showing cortisol levels over time on the International Space Station (ISS). The x-axis represents collection time (L-180, L-45, 14d, 2-4m, 6m, R+0, R+30) and the y-axis represents cortisol levels in ug/dL. The graph indicates a decrease in cortisol levels from L-180 to 14d, followed by an increase to R+30.](image-url)
Collection Time

L-180 L-45 14d 2-4m 6m R+0 R+30

% CD8 T-cells

EBV T cell function - ISS

% CD8 T-cells

EBV T-cell function - ISS

Collection Time

L-180 L-45 14d 2-4m 6m R+0 R+30
D. Latent herpesvirus reactivation (saliva/urine), saliva/urine stress hormones, circadian rhythm analysis.
Saliva VZV Assessment

![Graph showing VZV copies/ml over time during pre-flight, during flight, and post-flight phases for various subjects marked Sub 7 to Sub H.](image-url)
Saliva VZV Assessment

ISS

VZV copies/ml

Pre flight

During flight

Post flight

-200 -180 -160 0 20 40 60 80 100 120 140 160 180

0 200 400 600 800 1000 1200
Questions?