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/secerted cytokine profiles.
LEUKOCYTE SUBSET DISTRIBUTION

- 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

CD25+
CD69+

CD25+
CD69+
CD8+ T cell – Intracellular IFNg

Secreted Cytokine Profiles (CD3/CD28 48hr)

INTRACELLULAR CD8+/IFNg+

CBA 3/28 48hr

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.

**Relative Quantification (Folds of Changes)**

- **TNF-α**
- **IL-1**
- **IL-6**

B.

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

Intervals of sample collection
Gene Expression of Markers of Innate (A) and Adaptive (B) Immune Responses (long-duration flights).
C. Virus specific T cell number, function, plasma stress hormone levels.
Plasma cortisol levels - ISS

Collection Time

Cortisol on ISS

ug/dL

 ug/dL
2 4 6 8 10 12 14 16 18 20
L-180 L-45 14d 2-4m 6m R+0 R+30

Collection Time
EBV T cell function - ISS

Collection Time

% CD8 T-cells

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.
Urine CMV Assessment

CMV copies/ml

L-180 L-10 R+0 R+14

sub 7
sub 15
sub 12
sub 9
sub 8
sub 14
sub H
Saliva VZV Assessment

VZV copies/ml

Pre flight  During flight  Post flight
-200  -180  -160  -10  0  10  16  24
0  200  400  600  800  1000  1200

Saliva VZV Assessment

SHUTTLE

VZV copies/ml

Pre flight  During flight  Post flight
-200  -180  -160  -10  0  10  16  4  14  24

Legend:
- Sub 7
- Sub 15
- Sub 12
- Sub 9
- Sub 8
- Sub 14
- Sub H