



## Spaceflight Standard Measures

SK3/SR Zwart, Ph.D.

May 24, 2018

# Spaceflight Standard Measures

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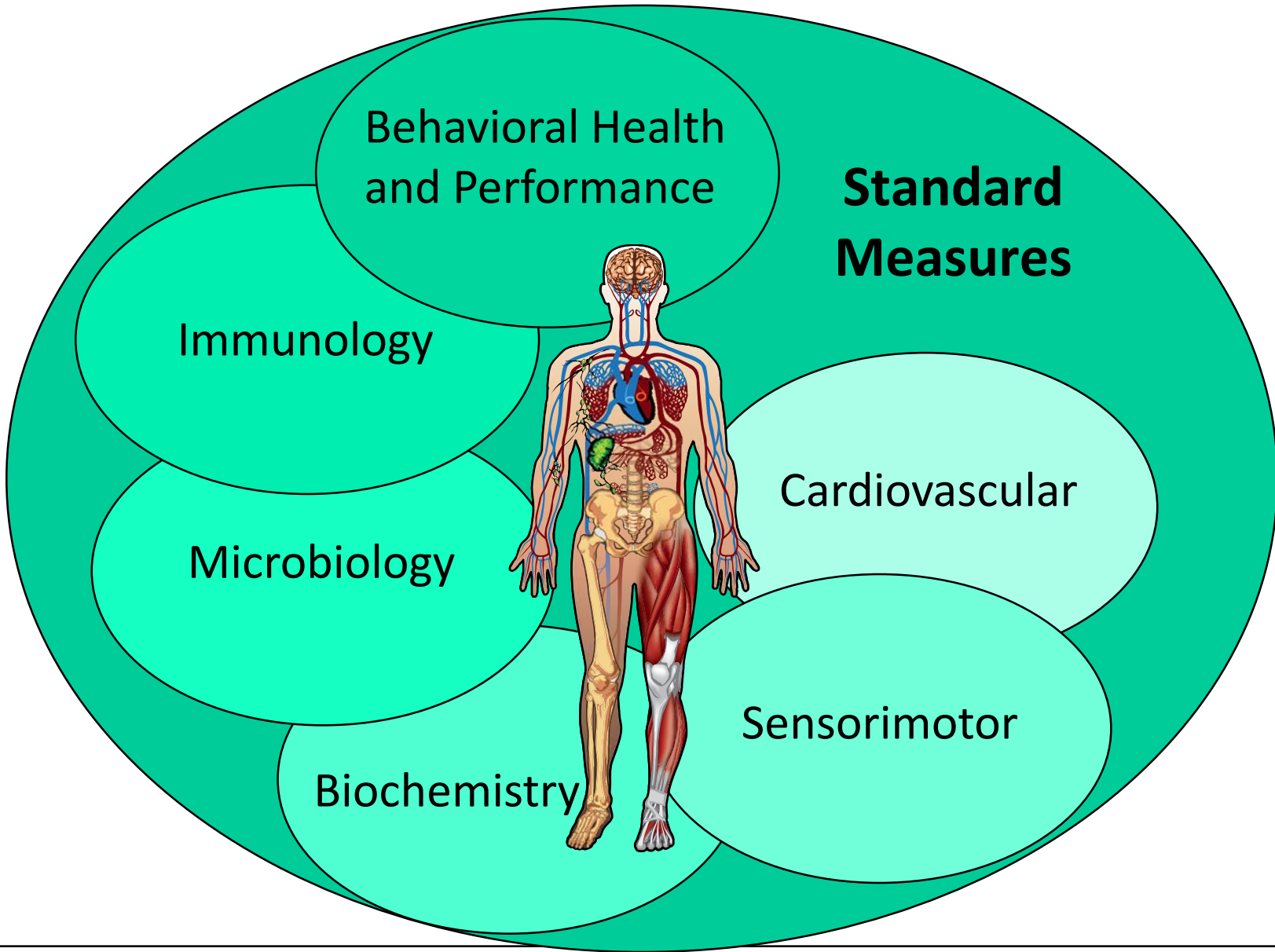
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# Objective

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The main goal is to ensure that a minimal set of measures is consistently captured from all ISS crewmembers until the end of ISS to characterize the effects of space. The data from these measures will be placed in an archive managed by HRP and can be made available to studies via data sharing agreements.



# Specific Aims

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- The data from these measures will be utilized to:
  - Generate metrics (non-identified) for human system risk assessments to enable:
    - Monitoring of countermeasure effectiveness
    - Interpretation of health and performance outcomes (standards)
  - Inform and support future hypothesis-driven, mission-enabling research



# Points of Interest

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- The data from these measures will be placed in an archive managed by HRP and can be made available to studies via data sharing agreements.
- All measures vetted in previous ISS flight studies
- Standard Measures is not hypothesis-driven
- How a study can request Standard Measures data:
  - Only IRB-approved studies
  - Data request must be approved by IRB
  - Data must be relevant to study
  - Data sharing must be approved via standard Data Sharing Agreement



# Experiment Design Overview

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Pre flight	In flight	Post flight
Actigraphy w/ sleep logs (2 weeks each) (L-270 & L-180)	Actigraphy (continuous)	Actigraphy w/ sleep logs (2 weeks) (R+0)
Personality survey (anytime preflight)	Sleep quality/team questionnaires (monthly)	
Cognition (L-120 fam & L-90)	Cognition (FD30 & R-30)	Cognition (R+10 & R+30)
Cellular Profile (L-270 & L-90)	Cellular Profile (FD30 & R-30)	Cellular Profile (+ Survey) (R+30)
Biochemical Markers (L-180)	Biochemical Markers (blood only) (FD30 & R-30)	Biochemical Markers (R+30)
Microbiome (L-90)	Microbiome (FD30 & R-30)	Microbiome (R+30)
Carotid Intima-Media Thickness (cIMT) (L-180)		cIMT (R+5 & R+30)
Sensorimotor Measures (L-225 fam & L-90)		Sensorimotor Measures (R+0 at JSC & R+9)



# Actigraphy

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Risk of Performance Decrements and Adverse Health Outcomes Resulting from Sleep Loss, Circadian Desynchronization, and Work Overload (Sleep)

**Test Sessions:** Worn for two 2-week sessions pre-flight (L-270, L-180), continuously in-flight starting before first scheduled sleep on station, and one 2-week session post-flight (R+0)



### Actiwatch

- Tracks movement and light data
- Worn snug against the non-dominant wrist, similar to a wrist watch.

### Questionnaire

- A brief post-sleep survey daily during the two-week periods when actigraphy is collected on the ground

### Measures:

- Activity level (per minute)
- Light exposure patterns



## Personality Survey & Sleep Quality/Team Questionnaires

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Risk of Performance and Behavioral Health Decrements Due to Inadequate Cooperation, Coordination, Communication, and Psychosocial Adaptation within a Team (Team)

Risk of Performance Decrements and Adverse Health Outcomes Resulting from Sleep Loss, Circadian Desynchronization, and Work Overload (Sleep)

**Test Sessions:** Personality Survey – anytime pre-flight;  
Sleep quality/team questionnaire monthly in-flight

### Personality Survey (one time pre-flight):

- International Personality Item Pool, Neuroticism-Extraversion-Openness (IPIP-NEO)
- Contains questions related to the way one tends to think and act
- Paper-based survey

### Sleep quality/team questionnaire (monthly):

- Completed monthly during the mission before and after sleep
- Contains questions related to sleep (e.g., amount, quantity, quality), mood, affect, team cohesion and performance, and crew living/habitability
- Completed in DCT in-flight





# Cognition

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### Risk of Adverse Cognitive or Behavioral Conditions and Psychiatric Disorders (BMed)

Test Sessions: L-120 fam, L-90, FD30, R-30, R+10, and R+30

#### A brief computerized neurocognitive test battery

- 10 brief tests that cover a range of cognitive domains relevant for spaceflight including:
  - Memory
  - Attention
  - Abstraction
  - Spatial orientation
  - Emotion recognition
  - Abstract reasoning
  - Scanning and visual tracking
  - Risk decision making
  - Sensorimotor ability
  - Vigilant attention

<b>1</b> <b>Motor Praxis (MP)</b> Sensory-motor ability	<b>2</b> <b>Visual Object Learning Task (VOLT)</b> Visual object learning and memory	<b>3</b> <b>Fractal 2-Back (F2B)</b> Attention and working memory	<b>4</b> <b>Abstract Matching (AM)</b> Categorical Thinking	<b>5</b> <b>Line Orientation (LOT)</b> Spatial Orientation
<b>6</b> <b>Emotion Recognition (ER)</b> Emotion recognition	<b>7</b> <b>Matrix Reasoning (MRT)</b> Abstract reasoning	<b>8</b> <b>Digit Symbol Substitution (DSST)</b> Scanning and visual tracking	<b>9</b> <b>Balloon Analog Risk (BART)</b> Risk decision making	<b>10</b> <b>Psychomotor Vigilance (PVT)</b> Attention/Alertness



# Cellular Profile

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### Risk of Adverse Health Event due to Altered Immune Response (Immune)

**Test Sessions:** L-270, L-90, Undock of eligible return vehicle closest to FD30, Undock of your return vehicle, and R+30; Cellular Profile Survey R+15

#### Blood Sample

- 2 tubes totaling 10 mL are collected at each session
- In-flight, the blood collected as close as feasible to a Soyuz undock so that live blood cells may be quickly returned to ground.

#### Saliva Collection

- Collected at start of day on the same day the blood is collected
- One saliva sample per session
- In-flight, stow in MELFI
- Return ground samples to JSC immediately in provided cooler

#### Cellular Profile Survey (post-flight only)

- A questionnaire about experiences during flight related to immunology, such as allergies, rashes, hypersensitivities, infections and wound healing

#### Measures:

- Stress hormone levels
- Viral shedding
- Protein levels
- Blood counts
- Types of blood cells



# Biochemical Markers

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Risk of Performance Decrement and Crew Illness Due to Inadequate Food and Nutrition (Nutrition and Food)

**Test Sessions:** L-180, FD30, R-30, and R+30

### Blood Sample

- Ground: 3 tubes totaling 15.7 mL collected each session, collected early morning
- In-flight: 2 tubes totaling 10 mL collected
  - Centrifuge and stow in MELFI

### Urine Collection

- Ground only
- 24-hour urine collection -shared with medical collection when feasible

### Questionnaire

- Ground only
- Exercise log completed at time of sample collection

### Measures:

- Complete blood count
- Comprehensive metabolic panel
- Comprehensive chemistry panel



# Microbiome

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### Risk of Adverse Health Effects due to Host-Microorganism Interactions (Microhost)

**Test Sessions:** L-90, FD30, R-30, and R+30

#### Body Swabs:

- Sample forearm, forehead, nostril, and control area using pre-moistened swabs
- Stow in MELFI or home freezer

#### Questionnaire:

- Short environment, health and hygiene survey completed before each collection session

#### Saliva Collection:

- Sample every other day for 7 days (Total: 4 samples)
- Stow in MELFI or home freezer

#### Fecal Sampling:

- Ground collection using Human Stool Sampling Kit (provided)
- In-Flight collection using swab to collect sample from WHC immediately after defecation



#### Measures:

-Types and concentrations of microorganisms on the body



# cIMT

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Risk of Cardiovascular Disease and Other Degenerative Tissue Effects from Radiation Exposure (Degen)

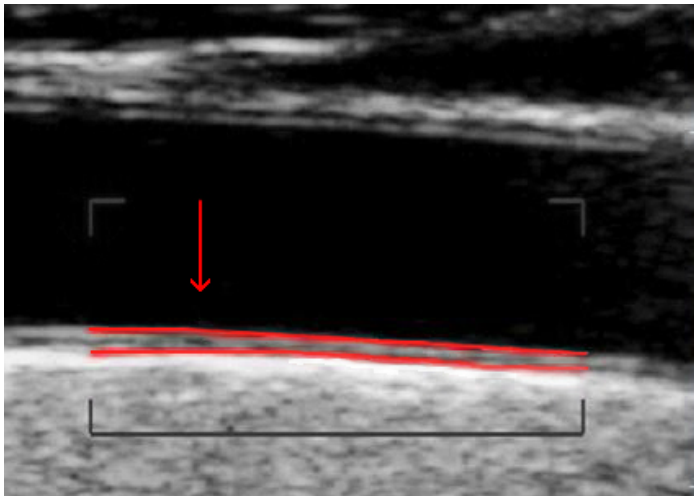
Test Sessions: L-180, R+5, and R+30

### Carotid Intima-Media Thickness (CIMT):

- Ground only
- **Ultrasound measures of carotid arterial wall thickness** (arterial structure)
- Early indicator of vascular dysfunction (oxidative stress)

### Questionnaire

- Short survey conducted during the test regarding exercise, diet, sleep





# Sensorimotor Measures

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Risk of Impaired Control of Spacecraft/Associated Systems and Decreased Mobility due to Vestibular/Sensorimotor Alterations Associated with Space Flight (Sensorimotor)

Test Sessions: L-225 fam session, L-90, R+0, and R+9

### Sit-to-Stand Test

- Rise from a seated position as quickly as you can without using hands
- remain stationary for 10 seconds

### Tandem Walk Test

- Walk 10 heel-to-toe steps across the floor with eyes closed and arms and hands folded across the chest for 3 trials
- Repeat this with eyes open for 1 trial

### Recovery from Fall/Stand Test

- Rise from a prone position as quickly as possible
- Step on a solid floor and remain standing for 3 minutes

### Motion Sickness Questionnaire

- Conducted multiple times during the test to assess motion sickness level



### Measures:

- Body kinematics
- Heart rate
- Balance





# Benefits

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HRP Spaceflight Standard Measures will provide a consistent set of validated measured parameters that document response to spaceflight as well as variation in the astronaut population in response to various duration exposures to spaceflight.

This set of measures will constitute a back stop of data for investigators to leverage off of to develop hypotheses, provide context for experimental data acquired concurrently with each unique experiment, or be analyzed for population responses to various mission durations (e.g., 6 weeks, 6 months, and 1 year).