Operations to Research:
Communication of Lessons Learned

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Space Medicine Constellation Integration Lead

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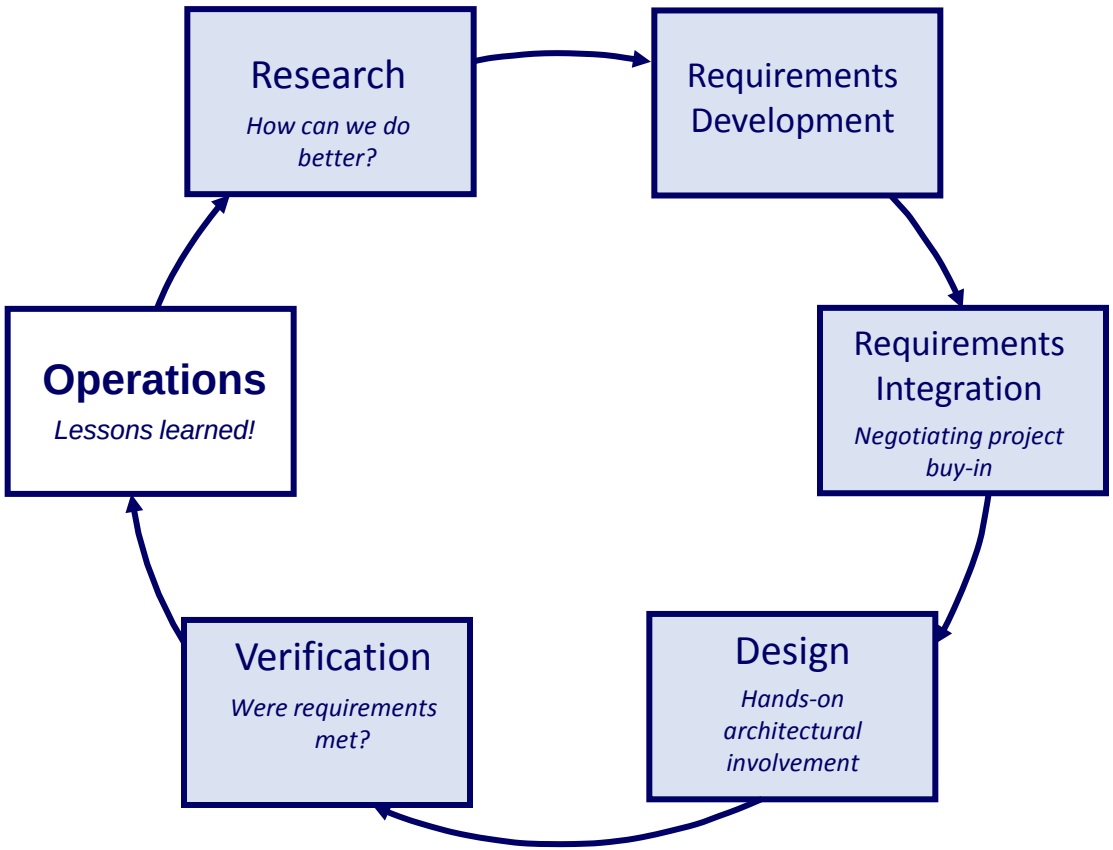
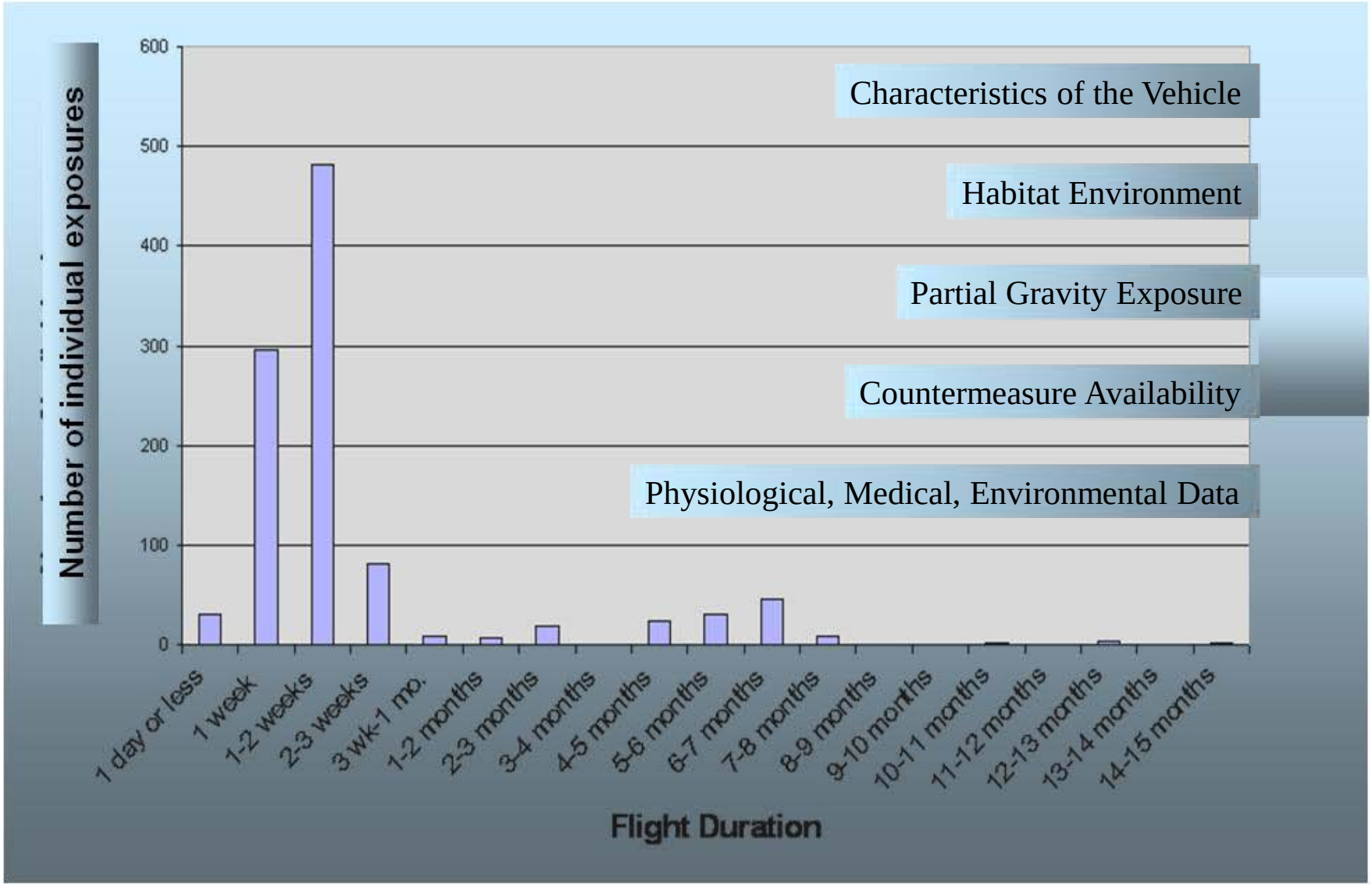
Human/System Integration Process



Human Spaceflight Experience:

The Long and the Short of it…



Operational Approach

Selection and Retention Standards

Pre-, In-, and Post-flight Monitoring

Prevention, Mitigation, or Treatment

Reconditioning, Recovery, and Reassignment

4

What do we mean by that?

Selection and Retention Standards

Screening for disease, medical history, preventive strategies

Pre-, In-, and Post-flight Monitoring

Establish degree of bone loss, skeletal muscle loss, magnitude of cardiovascular deconditioning, medical conditions, etc

Prevention, Mitigation, or Treatment

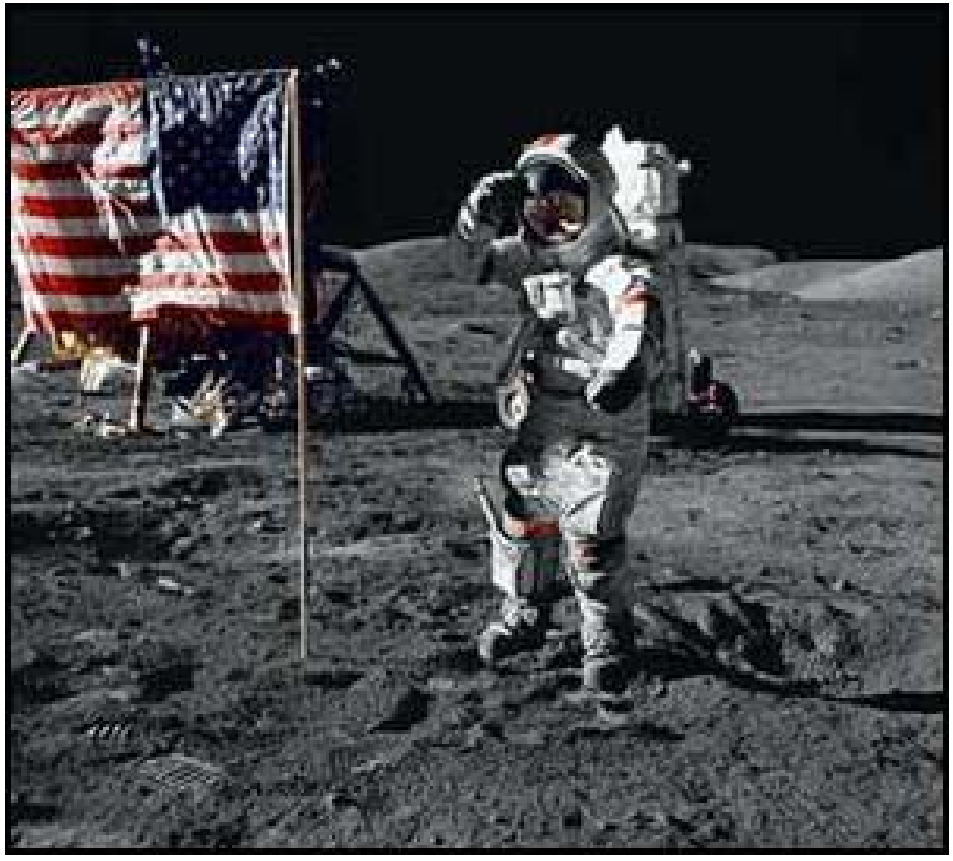
In-flight countermeasures (exercise, nutrition, pharmaceuticals)

Reconditioning, Recovery, and Reassignment

Post-flight training regimen, return to pre-flight baseline, and flight assignment

Apollo Program

- Health Stabilization Program
- Video monitoring
- Biosensor harness
  - O_2 and CO_2 levels
  - Temperature
  - Vital statistics
- Metabolic expenditure during EVA



Skylab Program

- Data down-linking (12-24 hours after experiment)
- Real-time biomedical research meetings
- In-flight medical unit

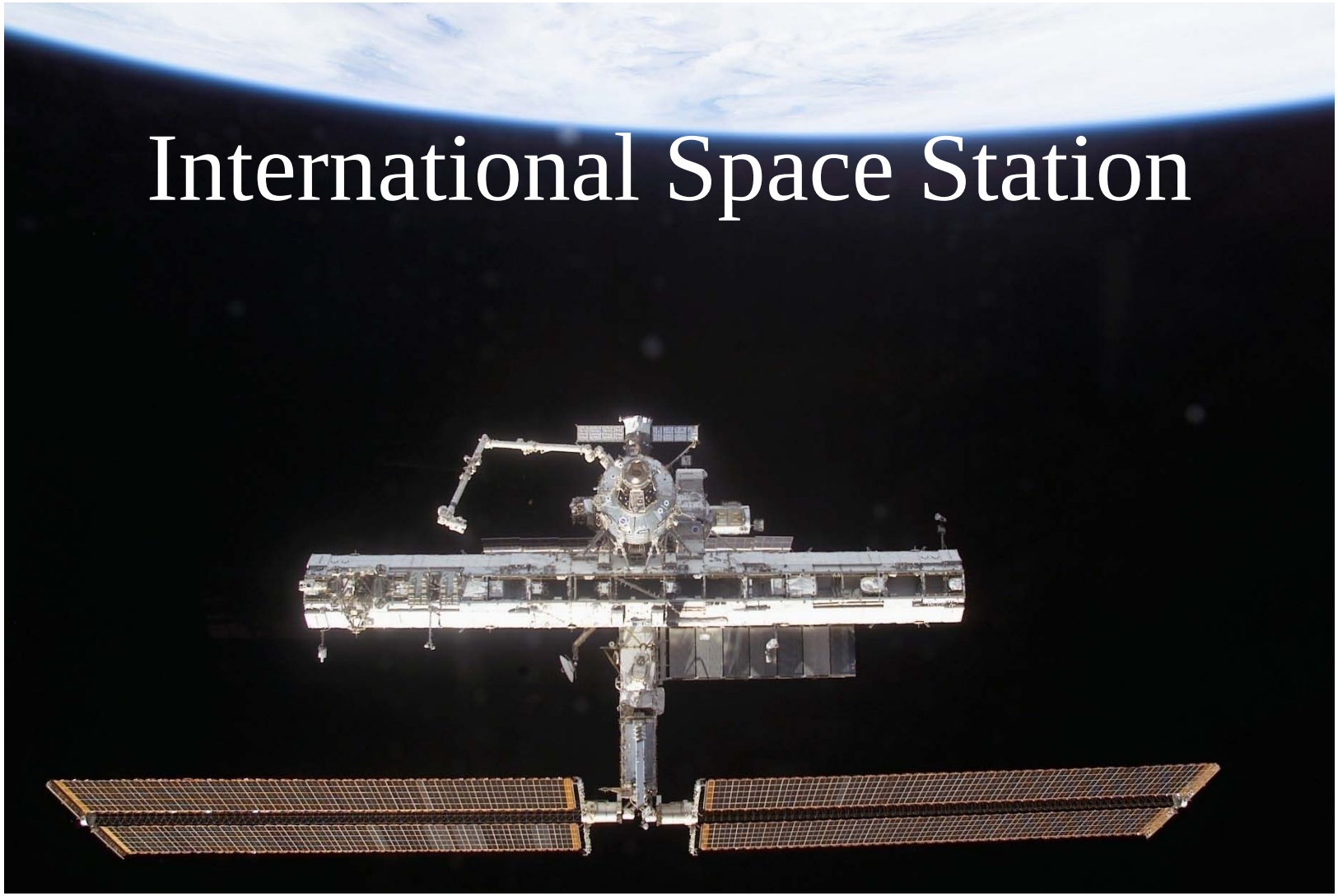
Shuttle Program

- Cardiovascular
- Neuroscience
- Musculoskeletal
- Radiation
- Nutrition
- Exercise

Shuttle-*Mir*

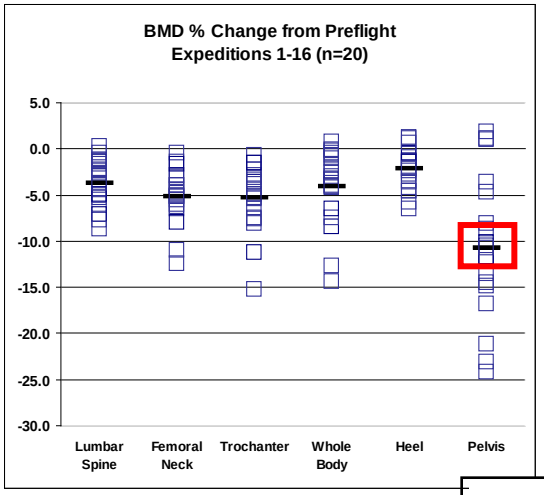
- 975 days on Mir, 7 astronauts
  - Norman Thagard – 115
  - Shannon Lucid – 188
  - John Blaha – 128
  - Jerry Linenger - 132
  - Mike Foale – 134
  - David Wolf – 145
  - Andy Thomas – 128

9


International Space Station

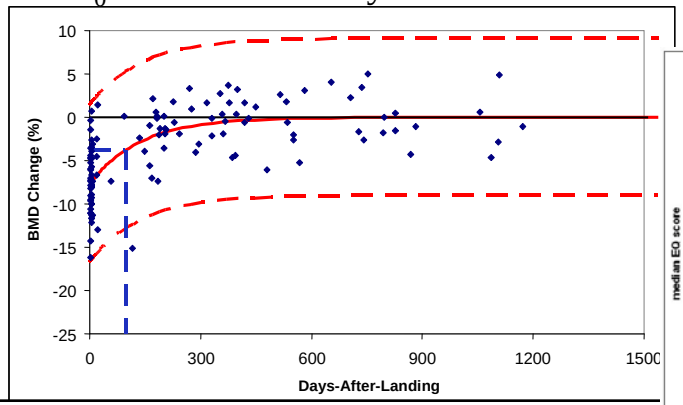
International Space Station

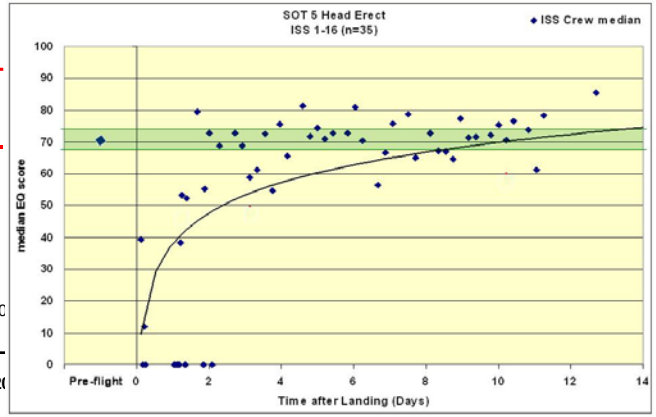
Medical Requirements collect physiological, medical and environmental data

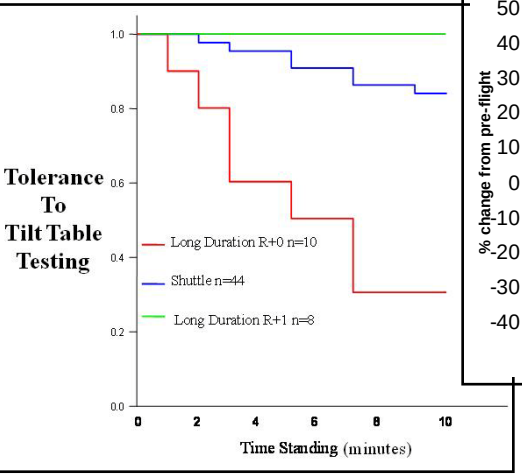


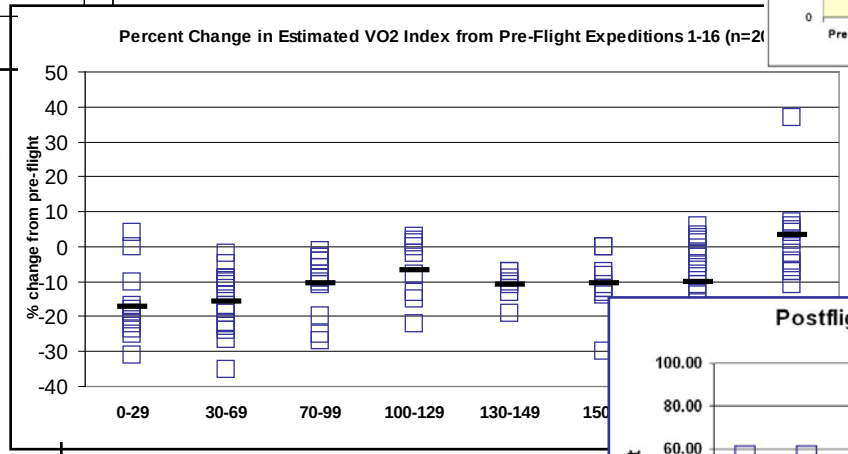
Pelvis

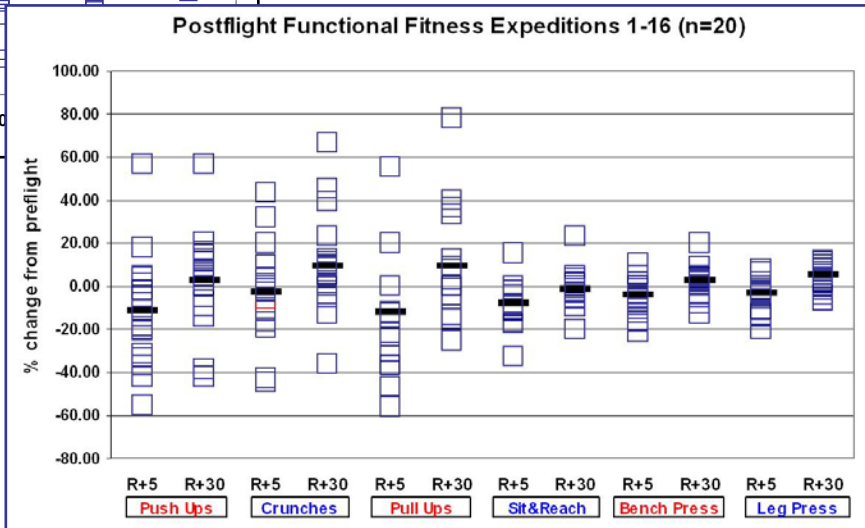
$Loss_0$=7.7% Recovery Half-life=97 d





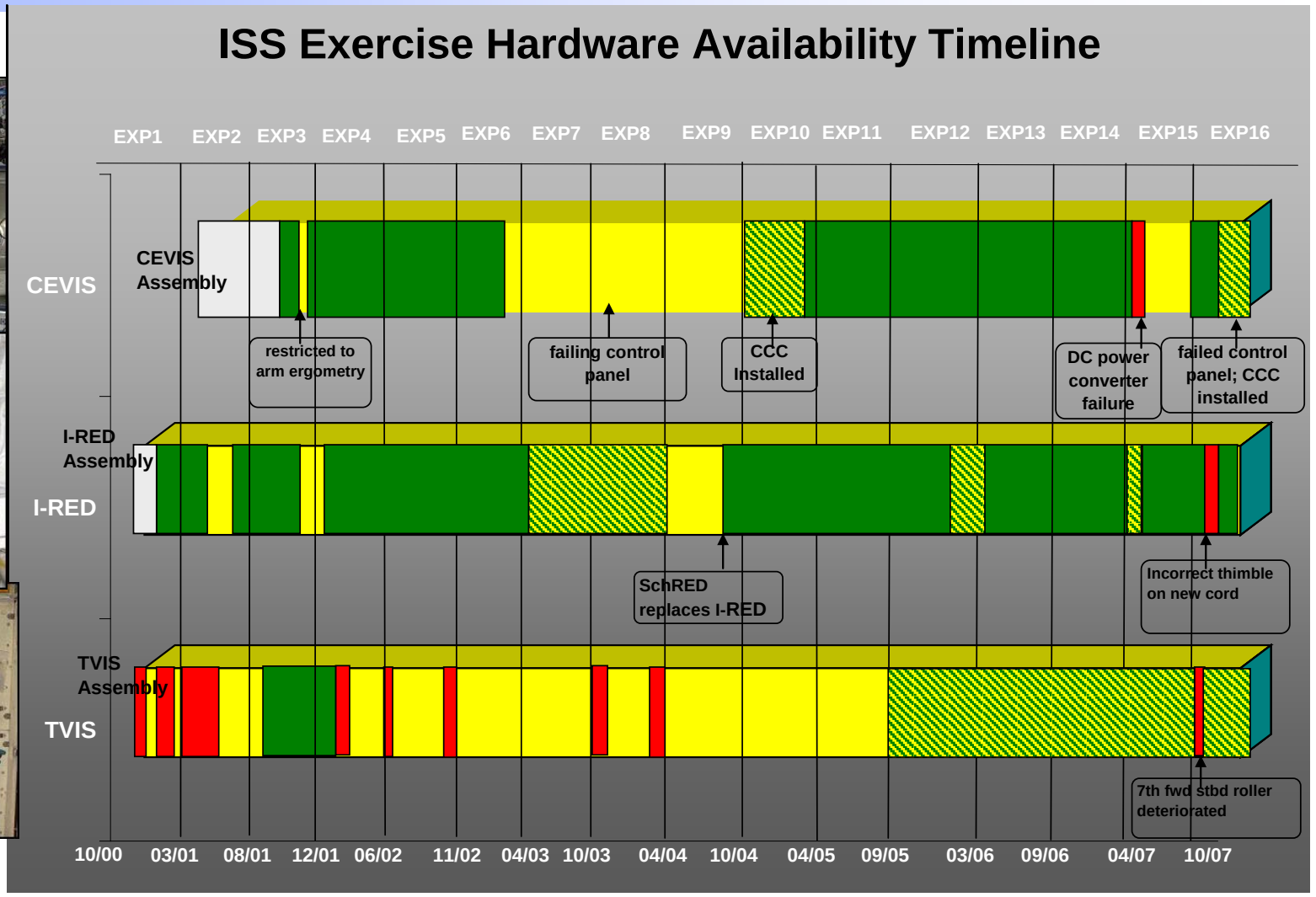






Data can be used to assess the individual or the population

International Space Station



T1 → T2

iRED → SchRED → ARED

Constraints: Time; Money; Mass; Power; Volume

12

Orion Support to ISS Missions

- Transport up to 6 crew members on Orion for crew rotation
- 210 day stay time
- Emergency lifeboat for entire ISS crew
- Deliver pressurized cargo for ISS resupply

Orion Missions

More questions than answers

- How do we use previous experience to prepare for future exploration?
- Can we simply extrapolate or is the future more complex than that?
- What types of analogs are appropriate?