Countermeasure exercise on ISS - European Concept

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Long duration space missions on ISS

Countermeasure exercise objectives and requirements

- Maintain crew member health, wellbeing and performance (before, during and after flight)
  - Minimize impacts which could affect station systems, general safety or experimental set-ups
  - Adapt to ISS and microgravity specific requirements and maximize outcome (results, experience, systems, hardware, strategies...)
  - Explore new/better possibilities to optimize countermeasure support for long duration missions
ESA Long duration missions on ISS

Astrolab: 2006 Jul-Dec (Thomas Reiter)

E1 Columbus: 2008 Feb-Apr (Leopold Eyharts)

OasISS: 2009 May-Dec (Frank de Winne)
ESA Mission Training phases

**Pre-flight**

- **PRE-FLIGHT PHASE**
  - Status Quo
  - Launch readiness
  - Optimal fitness shape

**In-flight**

- **Adaptation**: 14-30 days
- **Main phase**: Up to 120 days
- **Prep for return**: 14-30 days

**Post-flight**

- **Acute phase R+0 - R+21**
- **Follow up phase – R+45**
Mission preparation (pre-flight)

- Maintain or develop above average fitness level of crew member

- Create overall physical stability (core/spinal stability, endurance and strength, flexibility, agility)
  - Long term (various) sports experience and fitness

- Prepare for specific ISS training (ARED, T2, CEVIS)
  - Training facilities in JSC only
  - Protocol development

- Readiness for EVA
  - Include EVA preparative exercises

- Physiotherapy - preventative treatments
  - Physiotherapist strongly integrated in all phases of mission (and outside missions on regular basis)

- Fitness Assessment
ISS Countermeasure Training (in-flight)

- **T2**: 2nd gen. Treadmill
- **ARED**: Advanced Resistive Exercise Device
- **CEVIS**: US Bicycle Ergometer
- **VELO**: Russian Bicycle Ergometer

Images: © NASA
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**Pie Charts**

- Phase 1: Strength (30%), Biking (30%), Running (20%)
- Phase 2: Strength (30%), Biking (40%), Running (20%)
- Phase 3: Strength (50%), Running (20%)
Implementation Structure

TVIS/T2  CEVIS  (A)RED

BME

EXL  ASCR

BME

FS  EE

BME

VELO

GMO

IBMP
Operational challenges

- Variability of exercise programs on ISS
- Limitations by hardware
- Technical requirements (i.e., vibration, power, noise, 3-sec-reps)
- Availability of training devices (in use/failed)
- Scheduling challenges
  - Pre/post-sleep vs working-hours (DPC-DPC)
  - Work-rest schedule operational constraints
  - Docked ops (transfer, robotic arm ops, EVA)
- Interference with experiments
- Training intensity and objective
- Crew member compliance
- Communication and data exchange
Post-flight rehabilitation

Objective: Strengthening of deconditioned systems and areas, achieve complete physical recovery and full re-integration into activities of daily life, promoting long-term health

ESA Rehabilitation consists of 2 elements:

Physiotherapy (support regeneration, individual treatments, strengthening and stabilization)

Physical Exercise (rebuild cardio-vascular, musculo-skeletal, neuro-muscular and functional performance)

Both elements cover all aspects with different methods, applying a balanced approach of various training stimuli and recovery, triggering a comprehensive physical re-adaptation
Post-flight rehabilitation

Acute Phase

Period: R + 1 - R + 21
Fitness Assessments

2nd Phase

Period: R + 22 – R + 45
Fitness Assessments

Long term follow-up

Physiotherapy

Sports-rehabilitation
Summary

...adapting to given conditions...
...improving support strategies and concepts....
...collaborating efficiently with our international partners...
...sharing knowledge and experience with the science world...
...looking ahead and anticipate future challenges....

To maintain longterm crew performance and health
...Questions....?
Back-up slides
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**Pies**

- **Phase 1**: Strength, Biking, Running
- **Phase 2**: Strength, Biking, Running
- **Phase 3**: Biking, Running
Physical Fitness Assessments

PFE/OUM

- 25% Low workload (W)
- 50% 5 min
- 75% High workload (W)
- 25% 5 min

MO-3

- Walking ~ 2 min
- Slow running ~ 2 min
- Middle range running ~ 2 min
- Fast running ~ 1 min
- Walking ~ 1 min

Workload:
- Low workload (W)
- High workload (W)
Life long physical exercise support

Platform for
- Safe data exchange
- Training protocols
- Fitness test feedback
- Sport facilities
- Health information
- Photo gallery
- Announcements
- Training documents