ORGANIZATION, MANAGEMENT AND FUNCTION OF INTERNATIONAL SPACE STATION (ISS) MULTILATERAL MEDICAL OPERATIONS

J. Michael Duncan, Valery V. Bogomolov
Filippo Castrucci, Yu Koike
Jean-Marc Comtois, Ashot E. Sargsyan

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A Multilateral Operational System

ISS is unique and highly successful in terms of creating an international operational medical system

Purpose of Space Medicine

For every mission / crewmember

- Protecting and improving health and performance
- Preventing long-term health consequences
- Responding to trauma or illness

Long-Term

- Improving medical capabilities in microgravity
- Advancing knowledge in space medicine
- Advancing the practice of medical telemetry and telemedicine
- Preparing for future missions

Over 40 years' Experience

- In search for solutions, space medicine has been developing, using, and promoting advanced technologies to deliver health care.
- During the last decade, space medicine experts from several nations have shared a common goal of supporting the ISS Program

Salyut, MIR, Skylab Stations
Short-Duration Missions

Submarine, Antarctic, and Other Isolated Crews

Isolation Experiments

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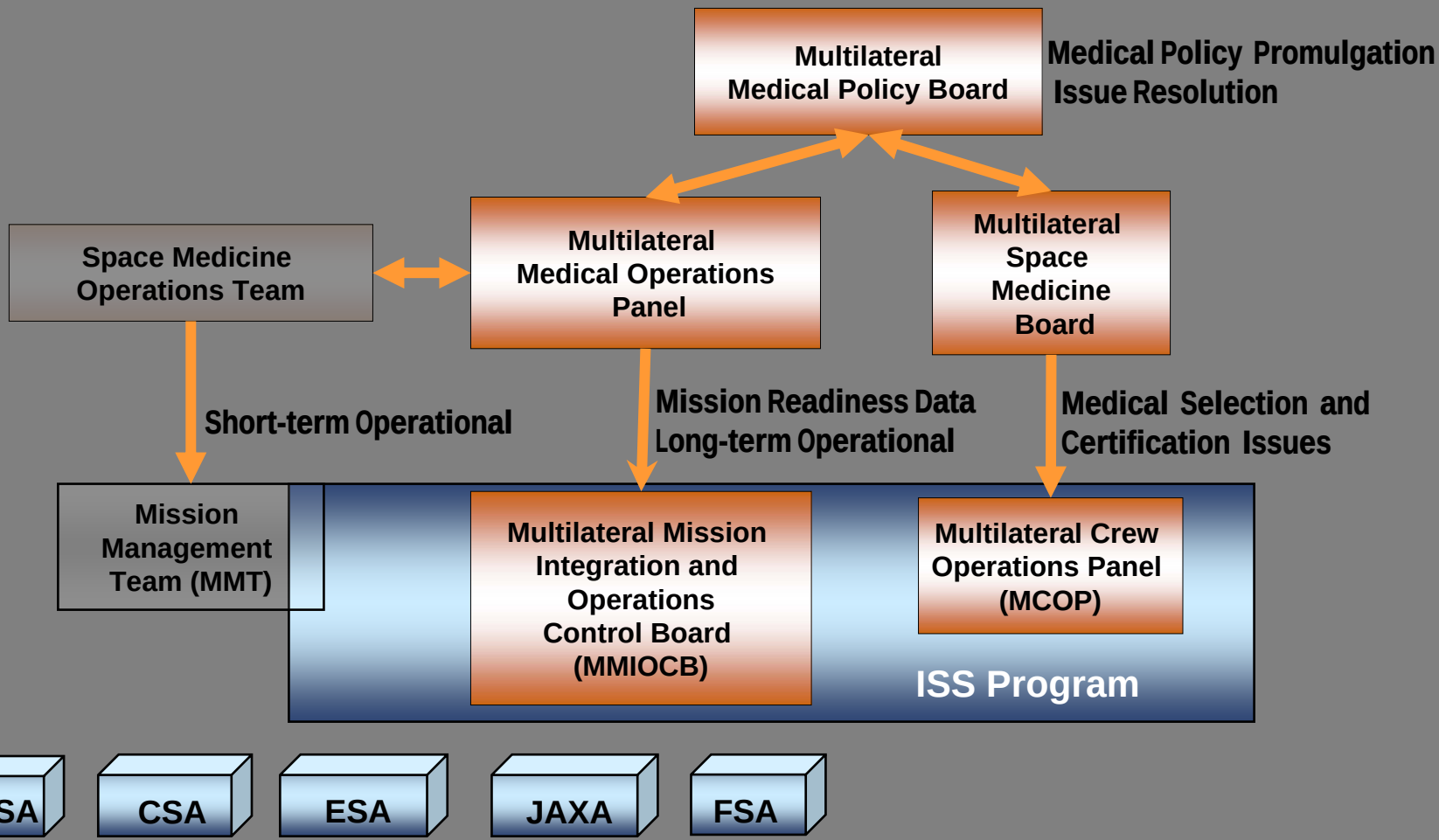
Growing own experience base

SECTION I: ISS MEDICAL ORGANIZATION

ISS Medical Authority Structure

- Multilateral Medical Policy Board (MMPB)
- Multilateral Space Medicine Board (MSMB)
- Multilateral Medical Operations Panel (MMOP)



Multilateral Medical Operations Panel (MMOP) - 4 Phases

1. Initial period: Oct. 1995 – 1996
2. Pre-Operational period: 1997 – 2000
3. ISS Early Operations: 2000 – Assembly Complete
4. ISS Routine Operations: 2008 – Lifetime

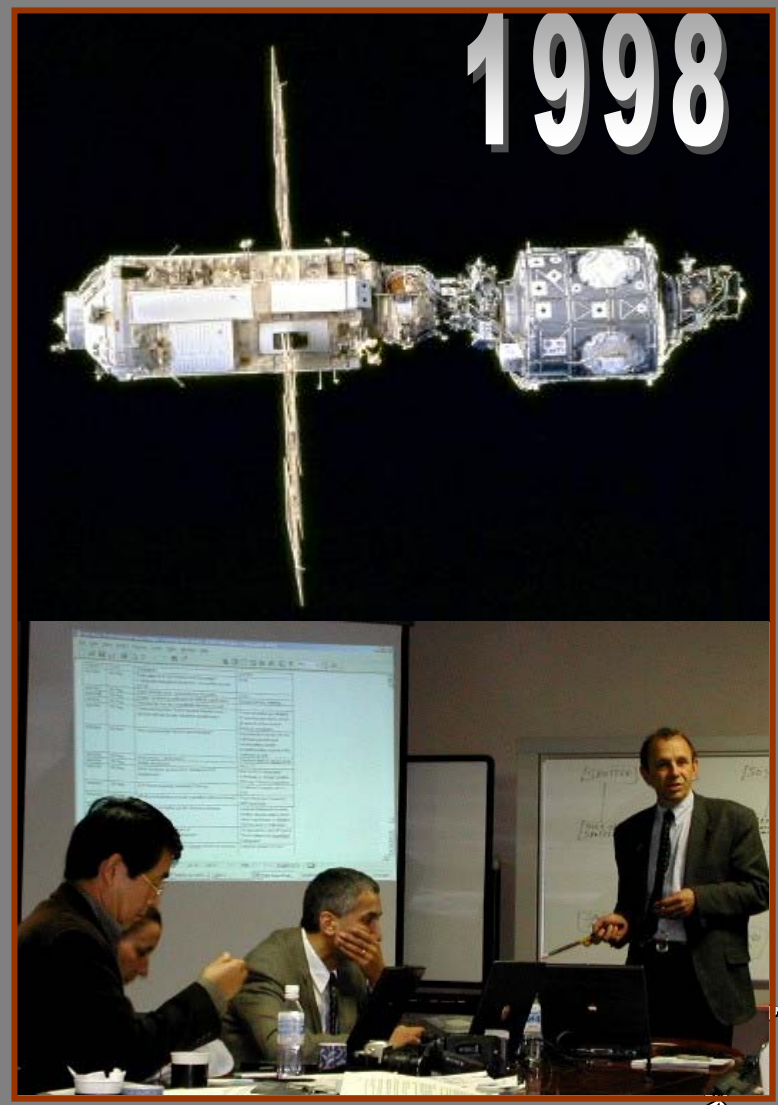
Initial Period 1995-1996

- **Challenges**
  - Different medical cultures and standards of care
  - Diverse medical backgrounds, training, and experience
  - Different expectations about ISS medical system
  - Different management structures
  - Variable funding levels
  - Expected to operate by consensus

Pre-Operational Period (1997-2000)

- Build a unified team
- Establish relationship with the engineering community

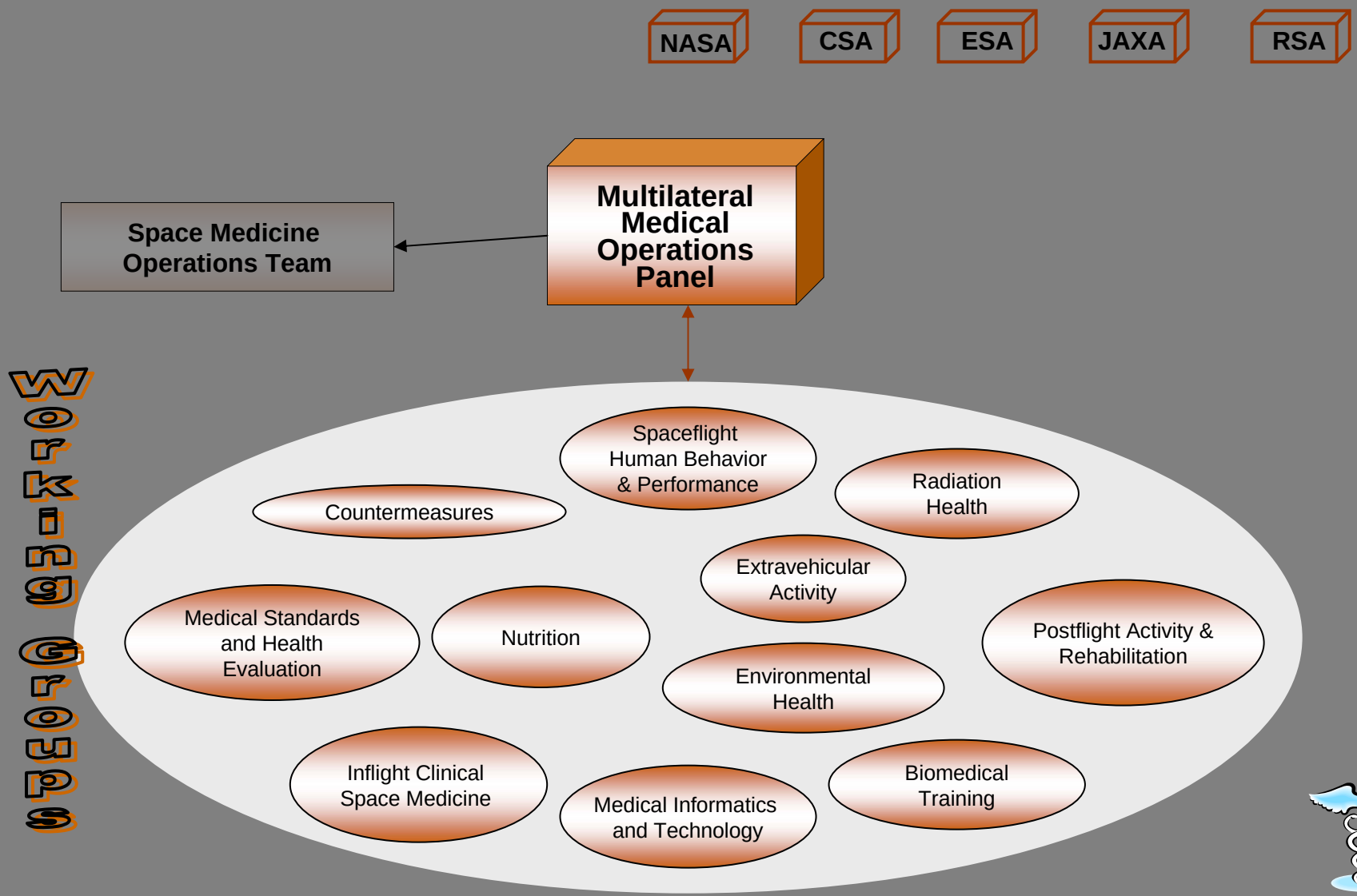
- Develop joint operational concepts
- Develop requirements and standards acceptable to all partners and the ISS Program management
- Develop implementation plans and other documentation
- Activate MMOP working groups
- Share experience and knowledge



Operational Period

- MMOP functions as a Working level body for coordinating partner inputs for ISS medical operations
- Develops medical standards and requirements
- Establishes medical operations implementation plans
- Establishes crew biomedical training programs
- Establishes flight surgeon training programs
- Oversees medical data handling issues

Multilateral Medical Operations Panel Structure

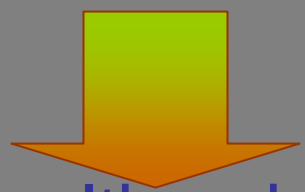


MMOP in ISS Operations

- Management of further integration of all partners
- Multilateral consideration of Partner-initiated input into ISS medical operations
- Development of multilateral consensus medical position on programmatic issues (e.g., on planning of missions > 180 days)
- Development of multilateral inputs into ISS medical or medically relevant documentation, and multilateral document control
- Provision of medical input into the ISS Program on a regular basis; regular reports to ISS MIOCB

MMOP Products

- ISS requirements documentation
  - Medical (operations, medical evaluation, etc.)
  - Pertinent sections of other space station documents
    - ISS ground rules and scheduling constraints
    - ISS operational flight rules
    - Increment – specific requirements
- Implementation plans and other documentation



- Crew health and safety
- Medical risk mitigation

Supervision and Adjustment of Routine Operations

Weekly Space Medicine Operations Team (SMOT)

Weekly coordination and status/issues

- Crew health and well-being, work/rest schedule
- Hardware, medical procedures, environment, radiation
- Data management and exchange
- Generation of medical input for the ISS Mission Management Team (MMT) and short-term planning
- Any urgent matters and announcements, problem resolution
- Readiness for events, “look-ahead” reviews

Has taken place >330 times (as of May 2006)

Medical Certification: ISS Multilateral Space Medicine Board

- Review and approval of medical certification for duty on ISS
- Credentialing and certification of physicians to practice space medicine on ISS

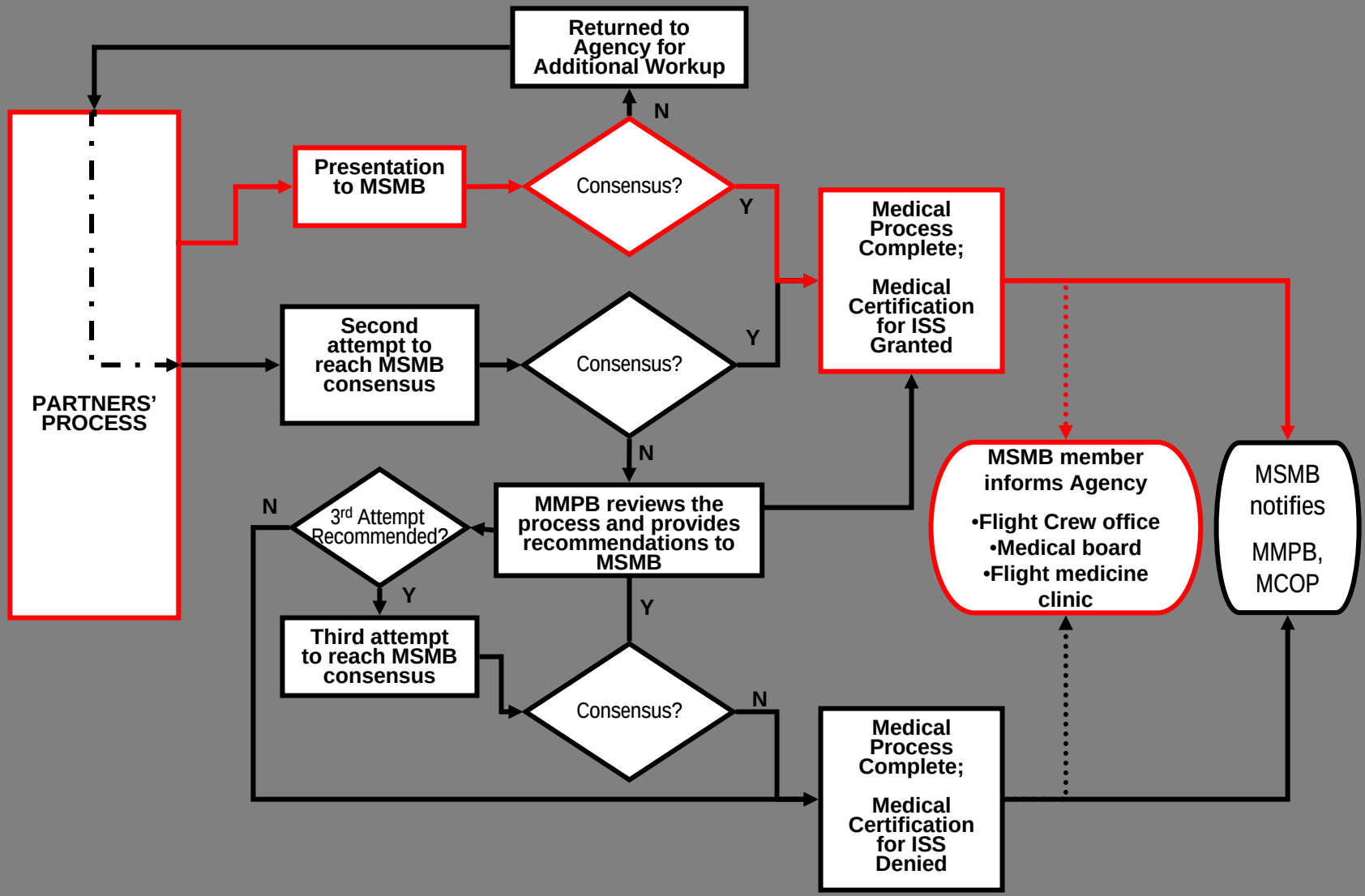
ISS has joint Medical standards are common for all

- **Space flight eligibility standards**
- **Medical selection and periodic evaluation requirements**
- **Pre-, in- and postflight evaluation requirements**
- **Medical standards and evaluation requirements for Space Flight Participants**

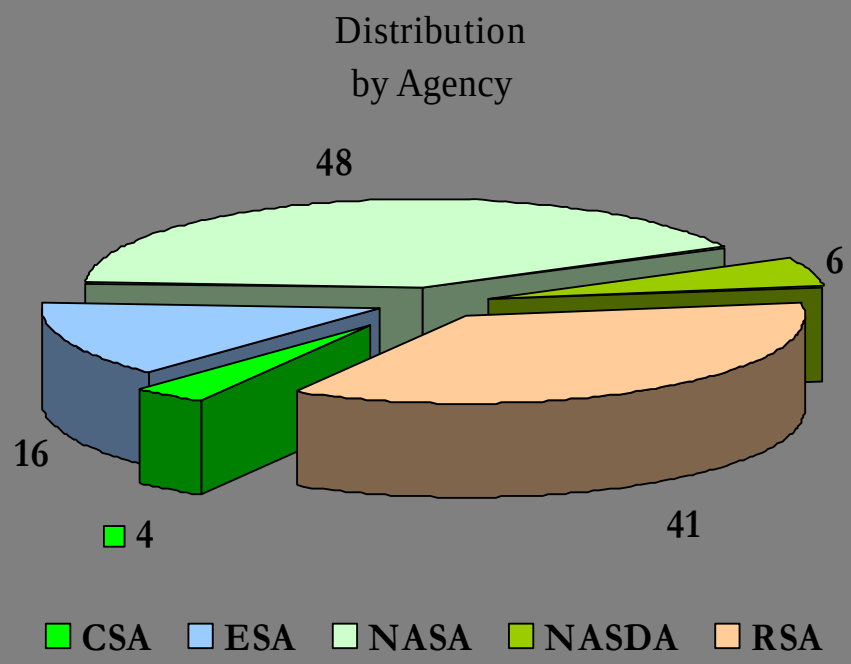
Principles of ISS Certification

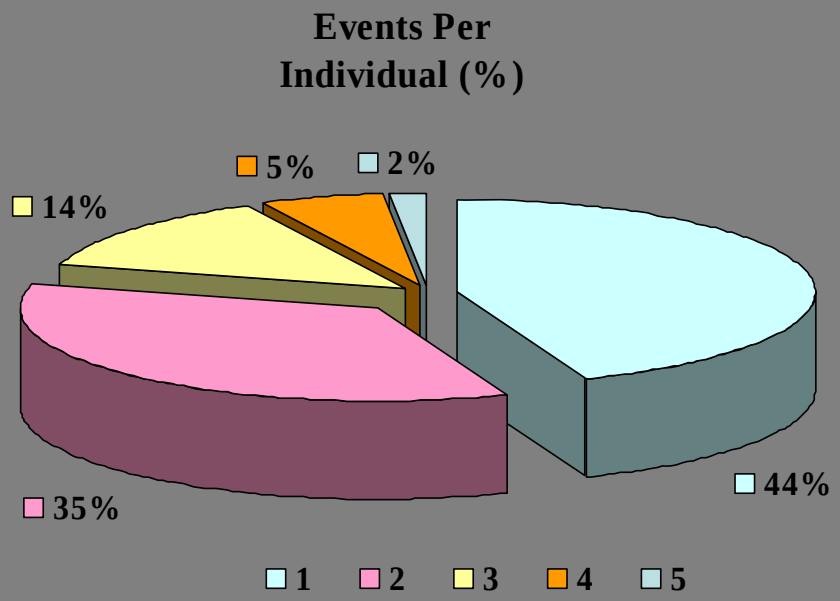
- Common standards and evaluation requirements
- Common responsibility for health and well-being of crews and mission success
- Independence of administrative influence
- Common presentation format
- Full disclosure of available data
- Meticulous clinical review / discussion
- Increasing use of terrestrial and space evidence
- Multilateral decision-making **by consensus**
- Building new knowledge through learning from each other and sharing expertise

Multilateral Certification Process



Crew Certification Data (to be updated)

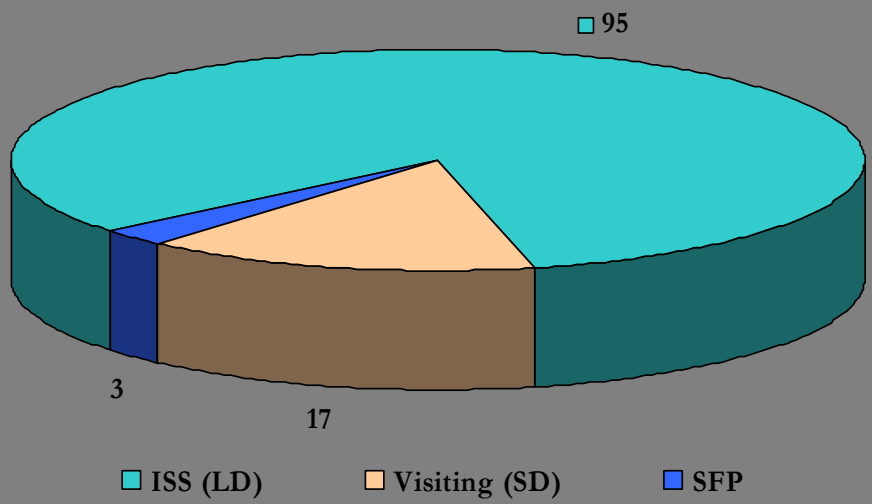




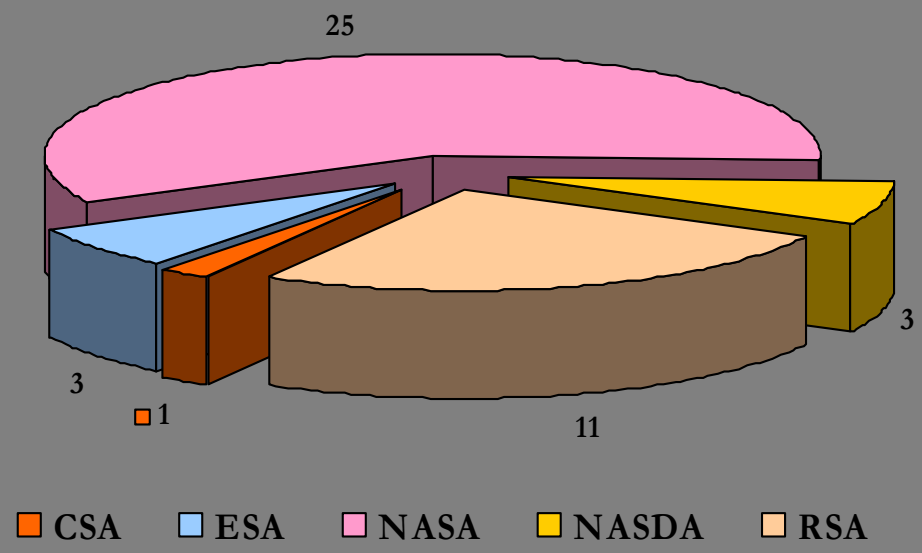
- Total number of individuals: 115
- Total number of certification events: 210
  - *Average : 1.83 events per person*

Distribution by Standards Applied

- Long - Duration Space Flight (ISS Crewmembers or candidates)
  - (30 – 180 days)
- Short - Duration Space Flight (Soyuz or Shuttle crewmembers) to visit ISS (up to 30 days)
- Space Flight Participants to visit ISS (Individuals who are not astronauts or cosmonauts by profession)



Flight Surgeon Certification by Agency



Total number of ISS Flight Surgeons: 31

SECTION II: ISS MEDICAL OPERATIONS

Expeditions 1 - 14

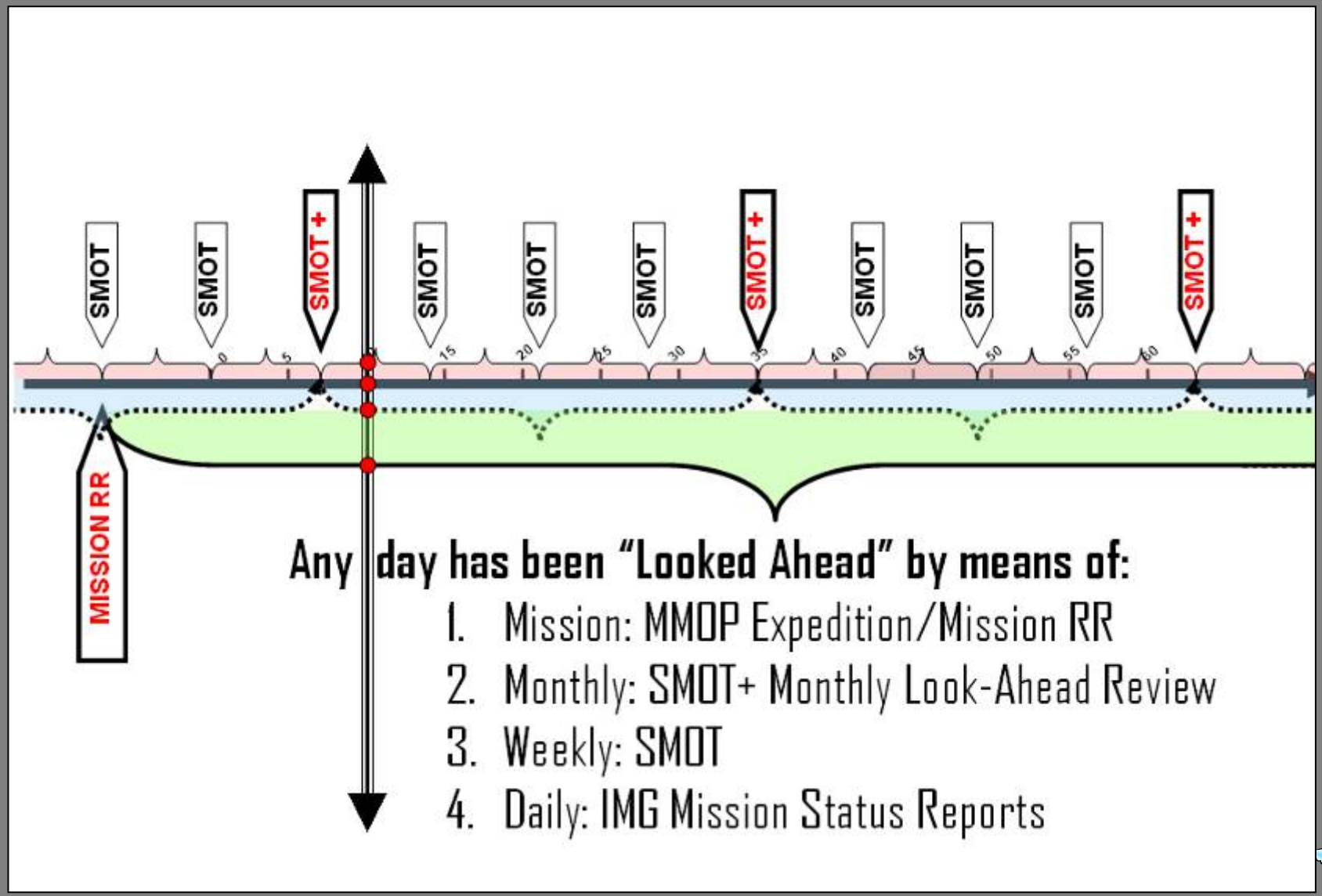
- 14 missions aboard the ISS were completed successfully
- The health outcomes of ISS missions continue to be favorable
- Nominal mission duration = 180 days

Exp.15 “core” launched in April 07

Medical Launch Readiness Checklist Areas

- Crew medical certification and clearance for launch
- Crew training
- Capabilities for evaluation and monitoring of crew health and performance
- Capabilities for diagnosis and treatment
- ISS environment and capabilities for environmental monitoring
- Capabilities for sustaining human health (in-flight countermeasures, food and water supply, compliance with crew day planning requirements and work-rest schedule limitations)

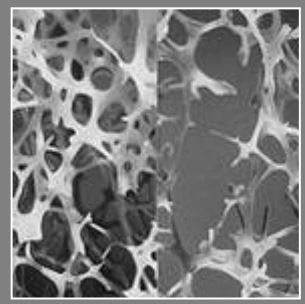
Mission Status and Readiness Reviews



The Integrated Medical System

- This concept of the Integrated Medical System (IMedS) goes beyond nomenclature; it is in fact the way ISS Medical Operations works
- All operational medical equipment and systems are considered part of IMedS, regardless of their origin
- Most medical operations equipment contributed by Partners is mutually complementary, with certain redundancy for critical systems

Example: The System of Countermeasures



Maintaining and Upgrading the Integrated Medical System

Example: OUM/PFE

- Has been used successfully for 3 PFEs

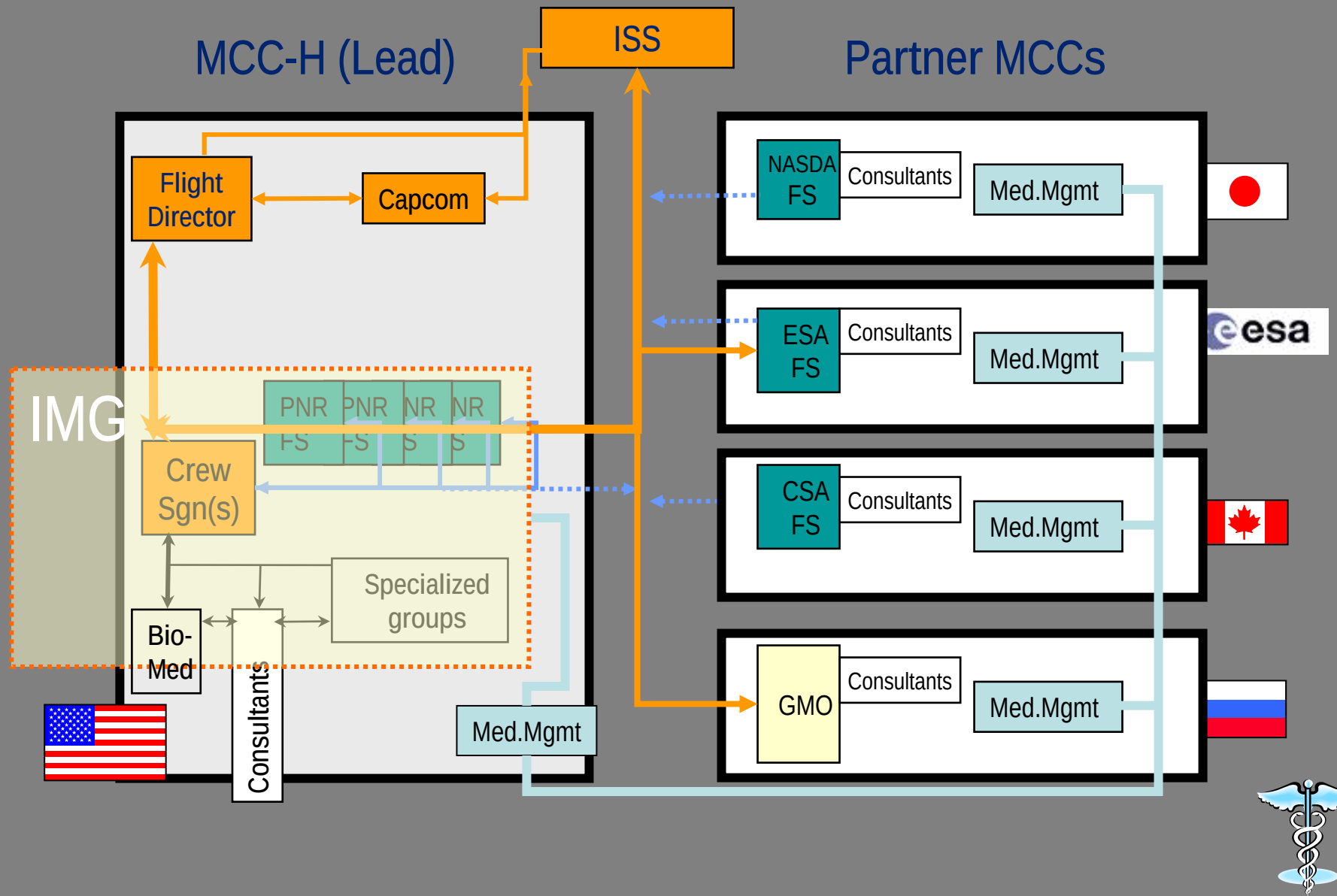
Transition to Multilateral Crews

- **STS-121 delivered an ESA astronaut to the ISS**
- **T. Reiter's / Astrolab mission marks a transition towards multilateral crews**

Partner “Concepts of Operation”

- In the foreseeable future, JAXA, ESA and CSA astronauts will serve as ISS crewmembers
- Each Agency has largely similar sets of solutions for the medical support of their astronaut
- We expect considerable expansion of the current Integrated Medical Group and contribution from other Partners into joint Medical Operations
- The expected increase in the size of the crew will pose new challenges and require efforts to revisit and re-validate many aspects of the system

Operational Integration



Summary for Section II

- The ISS Program continues to receive consensus input on the medical operational aspects of the ISS Program

- In the limited- resource environment of the ISS, a high degree of integration allows to maintain all the necessary capabilities to maintain crew health and safety and ensure favorable medical outcomes

- The ISS medical organization is building valuable evidence base for the space medicine of future

SECTION III: OPERATIONALLY ORIENTED RESEARCH, TECHNOLOGY DEVELOPMENT, AND FUTURE MISSIONS

Telemedicine Methodology for ISS: Diagnostic Imaging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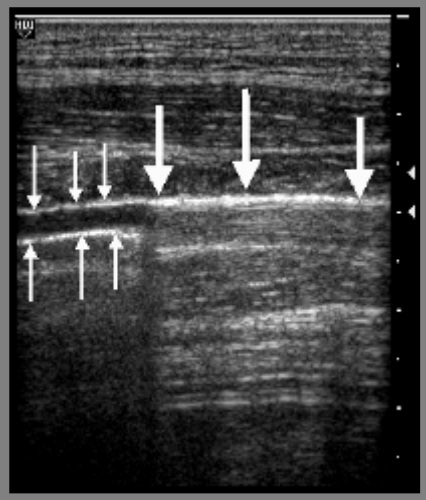
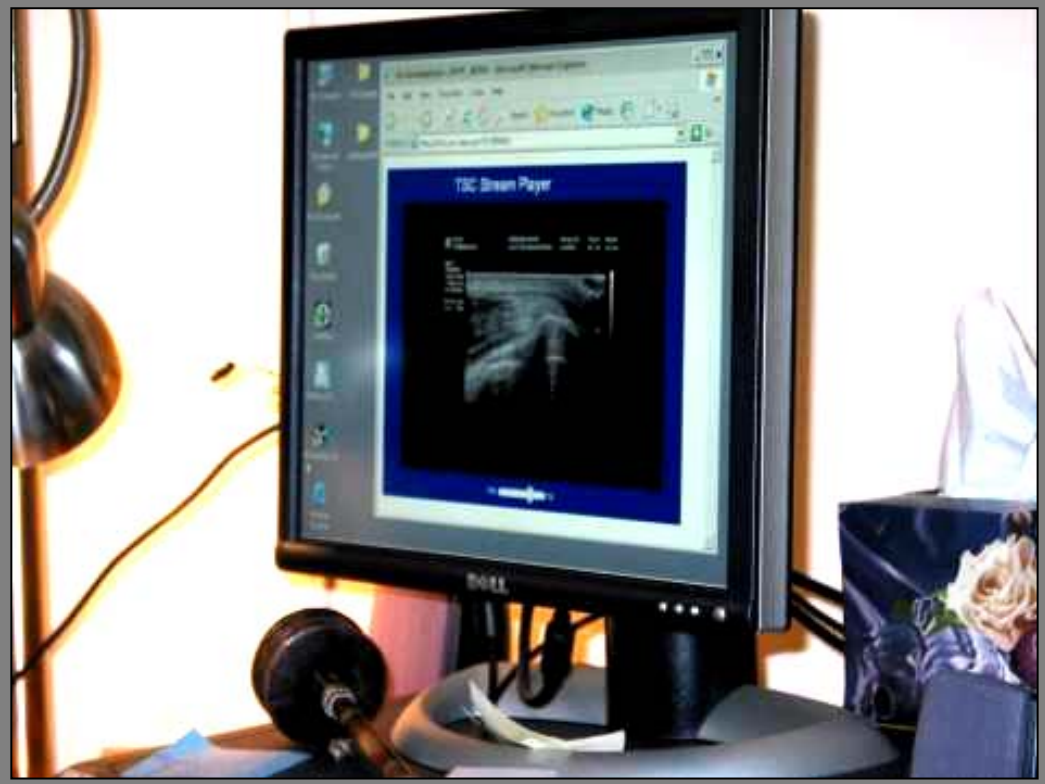
New Diagnostic Methods and Approaches

Hemothorax



Pneumothorax

Use of Internet for Remote Consultant Capability



Duration-Related Human Health Concerns

Behavioral Health & Performance

Extended duration influences human behavior and performance

Family separation , missed personal goals and milestones

Stress from multiple factors

Clinical Care Capability

Extremely limited ability to treat significant conditions on orbit, with further reduced medical care during return

Human Adaptation & Countermeasures Issues

Countermeasures not validated for deconditioning effects of extended duration spaceflight

Habitability and Environmental Issues

Radiation Effects are duration dependent (cancer and non-cancer)

Regulatory radiation exposure limits

High noise level in spacecraft may impair hearing

Environmental sample and nutrition concerns with longer resupply cycle

The Future of Space Medicine

- As part of the work for ISS and future missions, technologies are / will be adapted or created in:
  - Medical informatics
  - Smart medical and environmental sensors
  - Decision support systems
  - Medical data / image compression and handling
  - New teaching aids - enhanced training, skill retention, and just-in-time performance enhancement
  - Virtual presence technologies and adaptive expertise delivery (remote guidance) systems
  - Noninvasive and minimally invasive diagnostic and treatment procedures
  - Novel solutions in preventive medicine

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