Medical Issues for Commercial Suborbital Space Flight Crewmembers

Aerospace Medical Association

Commercial Space Flight Working Group
Medical Issues for Commercial Suborbital Space Flight Crewmembers

Working Group was formed at the request of the AsMA in May 2009
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Working Group Composition -26 Individuals
14 Aerospace medical professionals
3 Astronauts
1 Lawyer
2 NASA, 4 Wyle
2 FAA
8 Academic
7 Commercial Spaceflight Industry
Previous Studies – Commercial Orbital Space Flight Participants


Previous Studies – Commercial Suborbital Space Flight Participants


- Guidance for Medical Screening of Commercial Aerospace Passengers” FAA. 2006.
Previous Studies – Commercial Suborbital Crewmembers

Design Reference Mission
Virgin Galactic - SpaceShipTwo Profile

Two pilots, six passengers. Total mission duration 150 mins.
Pressurized cabin. 21% O2
Horizontal launch at 50,000 ft
70 sec - Gx 3.8g boost to apogee of 360,0000 ft
4 minutes of 0g with restrained pilots and unrestrained passengers
Re-entry 6.0 Gx for passengers but 6.0 Gz for pilots (short duration)
Glide beginning at 80,000 ft for 30 mins with pilot controlled unpwered landing
Operational Suborbital Space Flight Experience Limited

Mercury-Redstone - 1961
  MR-3
  MR-4  Loss of capsule on recovery
X-15 – 1963
  199 flights, but only 2 flights above 100 km
Soyuz 18a - 1975
  Inadvertent on abort during launch
SpaceShipOne – 2004
  Three flights above 100 km
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X-15 Program

Total of 199 Flights 1961-1968
Only two flights above 100 km altitude
Flight 191 – 1967 - Only fatality (Michael Adams)
- Vertigo
- Spatial disorientation
- Panel misinterpretation
- Distraction / Work overload
Medical Issues

Acceleration/Weightlessness
+Gx – Launch
0-G for four minutes
+Gx or +Gz – Entry

Rapid Acceleration-0g-
Deceleration Profile
- Push-Pull Effect
- Little operational experience
- Can not be simulated
Medical Issues

Cardiovascular

- Launch has 4-6 +Gx
- Acceleration-0G-Deceleration
- Entry has 6 +Gz

Neurovestibular

- Vertigo
- Spatial disorientation
- Pilot performance

Space Motion Sickness

Entry Sickness

Post-Flight Medical Problems

Multiple flights per day
Environmental Issues

Space Craft Cabin
Temp/Pressure/Humidity
Composition – O2, CO2
Pressure Suit use advantages
Ionizing Radiation
Noise
Vibration
Concerns

- Minimal operational experience with suborbital flights above 100 km
- X-15 Program fatality
- Rapid acceleration – weightlessness - deceleration effect
  - Push-pull effect described by high performance fighter pilots
  - Minimal experience
  - Cannot be simulated
Conclusions

FAA First Class Certification
Pre-Flight Medical Evaluation
  (esp. early flights)
Post-Flight Medical Debriefs
  (esp. early flights)
Independent data repository of medical data for analysis
Periodic re-evaluation of medical standards
Conclusions - Training

Emergency egress training
Physiologic (altitude chamber) training to recognize hypoxia and depressurization
Centrifuge or other G training
Parabolic flight (acceleration-weightlessness-deceleration)
Conclusions – In-Flight Equipment

Passive ionizing radiation dosimetry
Auditory protection (helmet/headset)
Anti-G Suit (esp. early flights)
Pressure Suit

Tremendous controversy
- Weight, expense, thermal loading, and decreased pilot performance
- No redundancy for depressurization

Soyuz 11
Pre-Challenger Shuttle
Conclusion

- Further investigation should be conducted on the effects on pilot performance from the rapid changes in the acceleration - microgravity - entry deceleration flight profile as this can not be simulated or trained for and there is little operational experience. Especially of concern is the impact on an individual involved with repetitive flights. Current data suggests that this may be well tolerated, but only actual flight experience will show if this is actually true.
Medical Issues for Commercial Suborbital Space Flight

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