Send information for publication on this page to:
Paul Buchanan, M.D.
Director Biomedical Office
Mail Code: MD
Kennedy Space Center, FL 32899

SPACE MEDICINE BRANCH REPORT

One Possible Future ...

David K. Broadwell, M.D., practices aviation and internal medicine in Angleton, TX. He has provided in the following article some very practical thoughts on the space medicine-program philosophy dilemma.

I'm indeed grateful for his well-written input, and I solicit yours.

Paul Buchanan

As we all celebrate the past 25 years of the American manned space program, many also devote their resources toward planning for the next quarter-century. "The Mars Conference" is set for late July in Washington, DC, sponsored by NASA's Solar System Exploration Division. The National Commission on Space recently released one such timetable calling for a full-scale lunar production plant by 2012 and a manned Mars outpost by 2017. Such dates can slip and slide at the whims of fate and the political process, but those who work in the field of space medicine should set their sights on being ready to meet these challenges. Even such barely conceivable missions as a manned trip to Jupiter's Galilean moons is possible in the lifetime of our children. Barring a human cataclysm, the question is not really whether Man will reach for these goals. It is really only a question of when.

The advent of the Space Station program has offered space medicine the opportunity and stimulating assignment of planning for extended medical care in an isolated microgravity environment. The Health Maintenance Facility (HMF) aboard Space Station will be tasked with diagnosing and treating crew injuries and illnesses. Statistically, it is expected that the majority of problems handled by the facility will not be exotic space-related problems but, rather, common medical problems that occur in an exotic environment. Nonetheless, semantically at least, there is no such thing as a "mundane" medical problem when one is not on this Earth. Before we can contemplate a Lunar Base or Mars mission, the space medicine community must assure that living aboard Space Station is an acceptable medical risk.

As we reach beyond low-earth orbit (LEO), the 2-4-week lag time for "medevac" grows to years. The systems we develop now must devote large resources to scenarios of seemingly low probability, but with consequences too dire to ignore. These systems will form the basis for what will come later—allowing Man to cut the tether to Earth and still feel his medical needs will be met. Decompression sickness, burns, appendicitis, infectious diseases, and nephrolithiasis are examples from a very long list of problems that have or will occur to space travelers. The risks are difficult to calculate—the medical aspects of negligible gravity are only one of them. Space Station and future space habitations will be closed environments. Extra-vehicular activity may become a necessary, but dangerous, routine. Work will be done with co-orbiters, satellite fuels, and on-board materials processing.

The HMF will require sophisticated and innovative hardware and medical systems to fulfill its mission. These major diagnostic and therapeutic subsystems are being developed under the auspices of the Johnson Space Center Medical Division. Digital radiographic imaging systems, lab analyzers, IV fluids and nutritional support, patient restraint systems, and many other aspects of crew medical support must be evolved. Monitoring and life support equipment—such as ventilators and defibrillators—must be identified, reconfigured, and integrated into the overall system. Exercise countermeasures, as discussed in this column in May, are planned to minimize the adverse cardiovascular and musculoskeletal effects of prolonged spaceflight.

We are in the embryonic state of the science we might call "clinical space medicine"—the complete medical care of humans living more or less permanently in space or on other heavenly bodies. As noted previously in this column, medical protocols and systems will have to be finalized years before the Space Station is orbited, yet the data to develop these systems is not available. Nearly all of our long-term data comes from the nine men of Skylab, but the excellent life science studies of this program connot completely compensate for the small sample size. Skylab could only be expected to be a beginning. Its legacy taught us how to ask better questions with sharper focus about living and working in space. Solutions to skeletal osteopenia, muscle atrophy, space motion sickness, and other problems are difficult, if not impossible, to test on the ground. As space travel goes beyond LEO and the Moon, questions of radiation safety and variable/artificial gravity loom ahead. We of the space medicine community cannot be deterred by these problems, any more than the pioneers of 30 years ago were by their lack of data. They were asked, "Can man survive spaceflight in zero-G? Can he swallow?"

Despite the current hiatus in our flight programs, work goes on in the knowledge that a stronger program will emerge. The time is not far off when the length of mission and number of crewmembers will require that physician-astronauts will be routinely assigned to crews. Part of their assigned duties will be crew health maintenance. Investigations will continue into problems unique to long-term space travel. As Dr. Phil Johnson discussed at the 1986 Aerospace Medical Association meeting, how does one assure that a crewman is not going to develop a symptomatic malignancy over any given 2–3 year period of a Mars mission?

The space medicine community cannot abdicate its responsibility for crew psychological health. We must aggressively try to pin down that nebulous subject of "human factors." The goal is to maximize the human habitability of future crews' environments. An example of this is the recent Space Station productivity study performed by Lockheed Missiles & Space Co. under JSC technical management. Gerald Carr and William Pogue of Skylab IV were consultants, and over 100 unresolved issues affecting crew productivity during long-term missions were identified. It was clearly identified that crew performance support is not solely an engineering problem, but requires ample medical input.

Space medicine continues to be a fascinating specialty, and the future is bright if one takes the "long view." Emphasis on flight safety will increasingly demand we stretch our bounds to provide medical support for not only preventive, but also clinical services. To do less is ethically unacceptable. The whimsy and excitement of an environment where locomotion is by brachiation rather than pedal will not be lost, however. We can all look forward to Mars, the return to the Moon, and the development of a reliable shuttle orbiter toilet. While waiting these milestones, space medicine personnel will continue to work towards making medical care for those living in space as terrestrial as possible in its scope and quality.