

NASA Astronaut Health Care System Review Committee
February – June, 2007
Report to the Administrator

Background

Psychosocial health of astronauts has been a concern for over a decade. Several major studies, including the 1997 National Academy of Engineering *Advanced Technology for Human Support in Space*, and the 2001 Institute of Medicine's *Safe Passage: Astronaut Care for Exploration Missions* identified the requirement to address human factors in selection, training and support for spaceflight. Behavioral health was specifically identified as an area that posed a significant vulnerability to the success of long duration space flight.

In a memo dated 7 Feb 2007 (Attachment 1), the NASA Administrator directed the NASA Chief Health and Medical Officer (CHMO) to coordinate a review of the medical and behavioral health services for NASA astronauts, focused on space medicine operations at the Johnson Space Center (JSC). The tasks to be accomplished by the review were expanded in the charter provided by the CHMO (Attachment 2) at the first meeting of the committee.

In order to accomplish the directed review, the NASA CHMO contacted the senior medical officers of various federal agencies, such as the Department of Veterans Affairs (DVA), Department of Defense (DoD), and Federal Aviation Administration (FAA) and solicited nominations of "appropriately credentialed physicians and mental health professionals, employed by the Federal government or on active duty in the military services, and experienced in medical and behavioral health support to organizations and personnel engaged in critical or hazardous operations," including at least one expert in aerospace behavioral health for review committee membership. The CHMO selected members from the pool of nominees based on professional credentials, operational experience and availability. Assignment and notification to the committee members occurred in late February 2007.

Committee Membership

Chair - Richard E. Bachmann, Jr., Colonel, USAF, MC, CFS, Commander, USAF School of Aerospace Medicine, specialist in aerospace medicine

Timothy W. Sowin, Colonel, USAF, MC, SFS, Chief, Aviation Neuropsychiatry Branch, USAF School of Aerospace Medicine, specialist in psychiatry and aerospace medicine

James P. Bagian, Colonel, USAFR. MC, SFS, Chief Patient Safety Officer, Department of Veterans Affairs, specialist in aerospace medicine and former NASA astronaut-physician

Mark S. Bauer, Professor of Psychiatry, Brown University & Providence Veterans Affairs Medical Center

James R. Fraser, Captain, MC, USN (ret), Deputy Federal Air Surgeon, specialist in aerospace medicine

Sandra A. Yerkes, Captain, MC, USN (ret), Director, NAVMED Medical Accessions, psychiatrist

Elizabeth K. Holmes, Captain, MSC, USN (ret), Stockdale Center for Ethical Leadership, clinical psychologist
Paul M. DeLaney, Captain, JAGC, USN, Chief of Staff, Office of the Judge Advocate General, Dept of the Navy, medico-legal advisor

Ex officio members:

James M. Duncan, NASA Chief of Space Medicine Operations at JSC
Wayne R. Frazier, NASA Office of Safety and Mission Assurance

Consultant:

Ellen S. Baker, current NASA astronaut physician

Executive Secretary:

John R. Allen, NASA Program Executive, Crew Health and Safety

Purpose

To provide rapid objective assessment, problem identification, and recommendations for action or further study of the following specific areas to the Chief Health and Medical Officer and NASA Administrator:

1. Medical evaluation for acceptance to the Astronaut Corps, to include psychological testing
2. Annual medical examination and certification of astronauts for flight duty
3. Periodic medical and psychological evaluation and testing of astronauts
4. Astronaut certification for space flight, from a medical and behavioral health perspective
5. Professional qualifications of health care providers
6. Quality/adequacy of medical practice relative to expected standards of care and
7. Administrative considerations of health services, including:
 - a. Provider credentials and privileging
 - b. Recordkeeping
 - c. Communication and reporting
 - d. Disposition of aeromedical concerns; and
 - e. Privacy considerations
8. Behavioral health considerations within the context of the NASA Personnel Reliability Program (PRP)

These criteria were provided to the committee to help focus the review, but did not constrain or limit the review.

During the first committee meeting, the CHMO asked the committee to provide opinions on the following additional questions:

9. To what extent are disorders of conduct indicative of underlying mental health pathology?
10. To what extent can regular psychological testing or psychiatric evaluation predict a disorder of conduct or 'act of passion'?
11. What systemic procedures could be put in place to predict disordered conduct?

Methodology

The committee convened for its first meeting at NASA Headquarters in Washington DC on 28 March 2007 and received informational briefings from a wide variety of NASA functional experts. Areas covered included an overview of NASA's health care system (both medical and behavioral health), health and medical policies, aeromedical certification system, healthcare audit system, approach to medical standards, medical risk mitigation, the occupational health program and other topics. The CHMO provided the committee with an extensive set of policy documents and reports for review and future reference.

After several weeks of document review, research, and meetings via teleconference, the committee met at Johnson Space Center (JSC) from 23-26 April 2007. During this period, JSC personnel presented informational briefings on standard operating procedures and were interviewed by the committee. The committee members then divided into small teams and conducted onsite reviews of the flight medicine clinic, family support office, behavioral health facilities, credentials/peer review records, Electronic Medical Records and minutes of the Aerospace Medicine Board meetings. These reviews consisted both of document reviews and interviews with the staff, including all behavioral health providers, all clinic assigned flight surgeons, and 8 of 21 space medicine division flight surgeons. The committee requested and received support from the Astronaut Office and family support office to solicit astronaut and family member volunteers to be interviewed by the committee. Although they do not represent a random or exhaustive sample of the larger population of astronauts and family members, the issues raised were remarkably consistent and compelling and deserve focused action. All interviews were open-ended and unstructured.

Astronauts and family members continued to contact committee members following conclusion of the JSC visit and additional telephone interviews were conducted. Fourteen astronauts (all but one of whom had participated in at least one space flight) were interviewed. This total comprises a substantial portion of current astronauts who have flown in space. Additionally, five family members were interviewed.

The committee met at the USAF School of Aerospace Medicine from 30-31 May 2007 to review and finalize the draft report. The draft report was delivered to the NASA CHMO on 21 June to allow NASA functional areas an opportunity to provide comments and correct factual errors or misstatements. Comments were forwarded by NASA to the committee on 3 July. These comments were reviewed by the committee members, discussed and incorporated, as appropriate, into the final report. The committee chair and several members presented a summary of the report's findings to the NASA Administrator and other senior NASA officials on 16 July 2007.

Committee Deliberations

The focus of the committee was to review the medical and behavioral health system to determine where potential system vulnerabilities exist. Primary deliberations of the committee involved focusing the report to most effectively communicate areas of concern to NASA leadership. As the review progressed, it became apparent that major vulnerabilities, underlying root causes, and contributing factors extend well beyond the specific medical aspects of NASA operations.

Many of the cultural and structural issues identified in this report as problematic have existed for many years, and some have existed since the earliest days of the astronaut program. The current medical and operational leadership at NASA inherited most of the cultural and structural issues identified in this report. These issues are so ingrained and longstanding that it will take senior leadership action to remediate them.

The findings and recommendations expressed in this report represent the unanimous opinion of the committee.

Findings and Recommendations

1. Medical evaluation for acceptance to the Astronaut Corps, to include psychological testing

- a. **Finding:** Medical evaluation for acceptance is rigorous and appears to be in accordance with NASA standards.
- b. **Finding:** Psychiatric interview is used as a mechanism to exclude candidates with a previous or current psychiatric diagnosis (i.e. “select out”). Psychiatric disqualification of an astronaut candidate is an extraordinarily rare event.
- c. **Finding:** Psychological testing evaluation is conducted, and is intended to identify applicants who can adapt most readily and perform effectively in the extreme environment of spaceflight (i.e. “select in”). However, this information is rarely and inconsistently used. Details of methods, criteria used, and normative data either do not exist or were not made available to the committee for review.
 - i. **Recommendation:** NASA should charter an expert panel to determine what, if any, psychological testing should be performed and how it should be used to select astronaut candidates suitable for space operations.
 - ii. **Recommendation:** The extensive behavioral health data already collected should be analyzed to determine if the data can be applied to future candidate selection and potentially guide astronaut selection for flight.
 - iii. **Recommendation:** If behavioral health information is found to be useful, it should be fully integrated into the final selection of astronaut candidates.
- d. **Finding:** The use of any behavioral health selection and patient data is a matter of concern for astronauts, family members, and medical and behavioral health personnel.
 - i. **Recommendation:** NASA should ensure that the use of all psychiatric and psychological data, both patient and research related, is explained to astronaut candidates, astronauts, and family members. Appropriate privacy and human subjects considerations should apply to the use of these data.

2. Annual medical examination and certification of astronauts for flight duty

- a. **Finding:** Annual medical examination of astronauts is extensive. Several astronauts expressed concerns regarding the purpose of some of the testing. Although some policies exist to communicate this information, several astronauts stated that they were not always clear as to the purpose of the testing in which they were asked to participate. They desire information regarding which tests are for safety monitoring and medical care and which are to obtain research data.
 - i. **Recommendation:** NASA should ensure that policies and procedures to communicate the purpose of medical tests performed prior to, during, and after flight on astronauts are in place and properly implemented. These policies should clearly indicate which tests are intended for medical or safety monitoring and which gather research data. Any protocols gathering

research data require appropriate informed consent. Including astronauts in this process will result in more complete information to enhance cooperation between the medical and astronaut communities.

- b. Finding:** Interviews with both flight surgeons and astronauts identified some episodes of heavy use of alcohol by astronauts in the immediate preflight period, which has led to flight safety concerns. Alcohol is freely used in crew quarters. Two specific instances were described where astronauts had been so intoxicated prior to flight that flight surgeons and/or fellow astronauts raised concerns to local on-scene leadership regarding flight safety. However, the individuals were still permitted to fly. The medical certification of astronauts for flight duty is not structured to detect such episodes, nor is any medical surveillance program by itself likely to detect them or change the pattern of alcohol use.
 - i. Recommendation:** NASA should ensure that specific policies, procedures, educational efforts, and disciplinary actions are in place to foster a culture that holds individuals and supervisors accountable for safe and responsible use of alcohol.
 - ii. Recommendation:** NASA should ensure that specific policies regarding alcohol use, including but not limited to a mandatory alcohol-free time period prior to flight and the availability and use of alcohol in crew quarters are in place and enforced.
 - iii. Recommendation:** NASA should institute a mechanism to monitor and ensure that concerns raised by crewmembers, flight surgeons, and other involved individuals are evaluated and acted upon.
- c. Finding:** Several senior flight surgeons expressed their belief that their medical opinions regarding astronaut fitness for duty, flight safety and mission accomplishment were not valued by leadership other than to validate that all (medical) systems were “go” for on-time mission completion. Instances were described where major crew medical or behavioral problems were identified to astronaut leadership and the medical advice was disregarded. This disregard was described as “demoralizing” to the point where they said they are less likely to report concerns of performance decrement. Crew members raised concerns regarding substandard astronaut task performance which were similarly disregarded.
 - i. Recommendation:** NASA senior leadership must ensure and support policies and procedures that allow flight surgeons, trainers, astronaut peers and others to raise concerns to leadership, who in turn respond explicitly and transparently.

3. Periodic medical and psychological evaluation and testing of astronauts

- a. Finding:** Periodic medical evaluation and testing is administered in accordance with NASA standards. (See discussion of testing concerns in paragraph 2.a. above.)
- b. Finding:** Astronaut medical and behavioral health care is highly fragmented and based on a medical disease model. Care is provided at the flight medicine clinic by clinic staff physicians or operational flight surgeons. Unscheduled care can be given to astronauts by flight surgeons on an ad hoc basis outside the normal clinic environment. Astronauts also receive care from civilian providers, either by direct referral from NASA physicians or self-referral. The ratio of flight surgeons to astronauts is quite high due to the multiple requirements for medical skill sets owned by flight surgeons, in addition to manning the clinic. Because of this large number of flight surgeons who can potentially provide care to any one astronaut,

the current system does not promote continuity of care. A crew surgeon typically provides care and physicals to his assigned crew, but that relationship normally does not predate the assignment and does not persist beyond the immediate post-flight period. Research indicates continuity of care over time with a single provider increases the quality of medical care and increases the detection of behavioral and psychosocial issues.

- i. **Recommendation:** Review flight surgeon task assignments and restructure where possible to enhance continuity of care. Consider empanelling each astronaut to a team of 2-3 flight surgeons who are responsible for providing or overseeing every episode of care, whether or not they are the assigned crew surgeon.
 - ii. **Recommendation:** Psychologists should be refocused from only providing “patient” care for treatment of disease and shifted to providing performance enhancement to all astronauts. The goal should be to assist astronauts in assessing areas of strength and weakness and provide skills to optimize mission success.
- c. **Finding:** There is no periodic psychological evaluation or testing conducted on astronauts. Once selected as an astronaut candidate, astronauts have no psychological evaluation for the remainder of their careers unless selected for long duration missions. There is no routine behavioral health assessment for commonly occurring issues such as depression, anxiety, relationship stress, substance use, or the cumulative effects of normal life events, all of which can lead to a decrement in performance.
- i. **Recommendation:** Behavioral health evaluations should be integrated into the annual flight physical for all astronauts, regardless of mission assignment status, whether long duration, short duration or unassigned. These evaluations should include, but not be limited to, recognized screening instruments for the above commonly occurring behavioral health issues, and should be conducted by the flight surgeon responsible for the continuity of the astronaut’s care, in consultation with behavioral health.
 - ii. **Recommendation:** Behavioral health providers should provide regular training to flight surgeons regarding behavioral health assessment and treatment.

4. Astronaut certification for space flight, from a medical and behavioral health perspective

- a. **Finding:** In general, astronauts are highly motivated to fly. Opportunities to fly in space are scarce and decreasing. The criteria for flight selection and how they are applied are unknown to the astronauts. Medical and behavioral health issues are perceived as having high potential for use to eliminate astronauts from mission assignment.
 - i. **Recommendation:** The process and criteria used to select astronauts for flight should be explicit, available to each member of the astronaut corps, and made as far in advance as possible. This will decrease the anxiety, speculation, and uncertainty surrounding astronaut flight selection.
- b. **Finding:** The National Outdoor Leadership School (NOLS) and NASA Extreme Environment Mission Operations (NEEMO) exercises represent the primary attempt at addressing group and interpersonal function among the astronauts and are principally the province of Flight Crew Operations. These exercises while popular, are perceived to be elective and not formally and explicitly

integrated into NASA's mission needs or ongoing astronaut behavioral health program.

- i. **Recommendation:** These exercises, or similar analog environments, should be further considered for usefulness in astronaut selection, evaluation, and training. Behavioral health experts should be included as an integral part of the planning, and astronaut selection, training, and evaluation team for these and other analog environment exercises.”

5. Professional qualifications of health care providers

- a. **Finding:** The health care providers appear appropriately qualified for their duties.
(But see considerations under 7.a)

6. Quality/adequacy of medical practice relative to expected standards of care

- a. **Finding:** The Electronic Medical Record (EMR) was reviewed for flight medicine clinic patient care interactions. Patient care interactions were consistent with expected standards of care. However, it should be noted that the current wide access of multiple flight surgeon providers to any astronaut's EMR has a clear inhibitory effect on astronauts' presenting for behavioral or medical health care. Several astronauts were concerned that any entry into their EMR could be read by any flight surgeon, some of whom might be only temporarily or tangentially involved in their care, and some of whom may have social relationships with the astronauts.
 - i. **Recommendation:** Develop privacy policies and procedures that ensure that individual astronaut EMRs are viewable only on a strict need-to-know basis by those clinicians who are directly involved in relevant aspects of their care. Privacy policies should be consistent with civilian standards of practice and Federal privacy laws.
- b. **Finding:** The flight medicine clinic has received consultation from Joint Commission (JC), responsible for accrediting health care organizations. However, there has not been any formal external review or accreditation performed.
- c. **Finding:** No one interviewed had knowledge that an astronaut had ever sought behavioral health care for him or herself.
- d. **Finding:** No behavioral health records of family members documenting actual clinical care were made available to the committee for review due to confidentiality concerns raised by NASA. The NASA legal office rendered the opinion that any record reviewed would have to document an individual's consent, which was not obtainable during the constrained time available for the onsite review.
 - i. **Recommendation:** NASA should establish a program of external peer review of its medical and behavioral health staff, which utilizes documented policies and procedures.
- e. **Finding:** Many dependents receive medical and behavioral health care from non-government providers, funded by NASA.
 - i. **Recommendation:** NASA should establish policies and procedures which ensure that quality care is provided by community providers, as is currently done by other purchasers of healthcare.
- f. **Finding:** Only one behavioral health provider has access to the EMR, where all clinical information is recorded. The behavioral health clinic maintains paper records, entirely separate from the EMR. Flight medicine clinic providers have

no access to behavioral health information. This barrier to communication and structural limitation of information flow is a significant departure from accepted standards of care and limits the ability of providers to appropriately care for their patients.

- i. Recommendation:** All behavioral health providers should have access to the EMR. A patient seen in behavioral health should have the clinical contact recorded in the EMR, and an explicit aeromedical disposition should be made by a flight surgeon. The full behavioral health note does not need to be included in the EMR. The behavioral health provider can discuss the case by phone or in person with the flight surgeon.
- g. Finding:** As articulated in Finding 3.b, astronauts do not have the option to have a single continuity-of-care provider (e.g., primary care provider) over time, due to the multiple competing demands, often across continents, on the flight surgeons. This is not consistent with best practice in the civilian, military, and veteran communities. Several astronauts have developed ad hoc ongoing relationships over time with specific flight surgeons, who serve as informal primary caregivers. However, this is the exception rather than the rule, and there is no organizational mandate or supporting structure for such continuity of care.
 - i. Recommendation:** See Recommendation 3.b.i

7. Administrative considerations of health services, including:

a. Provider credentials and privileging

- i. Finding:** Credentials and privileging in the flight medicine clinic were conducted using a well-defined process which included peer review and primary source verification. The credentials folders were well organized and contained all required data.
- ii. Finding:** There was no documented credentialing and privileging process for the behavioral health providers. Credentials folders were established for the behavioral health providers, but there were no written instructions, policies or procedures establishing systematic peer review or evidence of a credentials/privileging committee.
 - (1) Recommendation:** Establish one credentialing and privileging authority for both the flight medicine and behavioral health providers, with documented processes for accountability, primary source verification and peer review.

b. Recordkeeping

- i. Finding:** There are no standard operating procedures (SOPs) provided for the behavioral health clinic. No SOPs govern the flow of information regarding astronaut care or how information is used. Nothing specifies how mission readiness is determined or how it is communicated to the flight clinic. Duties Not Involving Flight (DNIF) policy is not established nor is it commented upon in records. NASA psychiatrists expressed a willingness to fully correct this issue.
 - (1) Recommendation:** NASA should verify that written procedures have been developed and are consistently implemented. See also Recommendation 6.a.i.

c. Communication and reporting

- i. Finding:** Problems of communication were evident among the four areas addressed: flight medicine, behavioral health, flight medicine clinic, and the

Astronaut Office. This theme recurred in a variety of venues during the committee's visit to JSC, and also extended to communication between these areas at JSC and Headquarters. Accordingly, this theme is reflected in a variety of specific findings and recommendations throughout this report.

(1) Recommendation: See the following recommendations: 2.a.i; 2.b.iii; 2.c.i; 4.a.i; 6.a.i; 6.f.i; 7.b.i.1; 7.e.i.1; 11.b.i; and 11.d.i

d. Disposition of aeromedical concerns

- i. **Finding:** Review of Aerospace Medicine Board (AMB) records showed inconsistent attendance by members, which has the potential to result in recommendations voted on by incompletely informed members. The AMB, which is composed of all flight surgeons, has a surprisingly low number of members (4) required for a quorum at meetings when aeromedical decisions are being made.
(1) Recommendation: The AMB membership should be restructured to ensure depth of experience and consistent attendance.
- ii. **Finding:** Both Behavioral Health and Flight Medicine staff reported that there are no Behavioral Health entries in the EMR.
(1) Recommendation: See Recommendations 6.a.i and 6.f.i.

e. Privacy considerations

- i. **Finding:** Protection of privacy was an area of paramount concern to the behavioral health providers, astronauts and family members. This prevents effective communication regarding patient status between behavioral health and other providers, and severely limits the ability of the flight surgeons to make appropriate aeromedical dispositions.
(1) Recommendation: Open and regular communication must be scheduled and required between flight medicine and behavioral health. While appropriate confidentiality must be maintained, collaboration between all health care providers must take place to ensure the highest quality care, optimum mission support, and consistent astronaut performance.
- ii. **Finding:** NASA's legal department determined that review of dependent behavioral health records required individual consent for release of information, which could not be obtained in time for the committee's deliberations. (See paragraph 6.d)
- iii. **Finding:** Dependents are given the choice of seeing community behavioral health providers paid by NASA or provided directly by a NASA contractor. In all interviews, the dependents were very satisfied with the care they received under this system.
(1) Recommendation: See Recommendation 6.e.i

8. Behavioral health considerations within the context of the NASA Personnel Reliability Program (PRP)

- a. **Finding:** Astronauts and payload specialists are specifically excluded from the NASA PRP program by 14 CFR 1214.501c because they are covered under "NASA Astronaut Candidate Recruitment and Selection Program" in 14 CFR part 1214.11. Astronauts are not required to report illnesses, injuries or medication use unless they determine them to be significant. This is a major deviation from PRP programs administered in the military, where every episode of illness, injury

or medication must be evaluated by a provider qualified to make PRP fitness for duty determinations.

- i. **Recommendation:** NASA astronauts and payload specialists should be included in a formal PRP program.

9. To what extent are disorders of conduct indicative of underlying mental health pathology?

a. **Finding:** Disorders of conduct encompass a wide range of behaviors, from lapses in judgment to full-blown psychiatric disease. Disordered behavior is pervasive throughout human society and can reasonably be assumed to be at least as likely to reflect aberrant responses to current stressors as diagnosable psychopathology. Disordered behavior tends to manifest as individuals and organizations become more stressed. Disordered behavior is generally identified outside of the medical model of surveillance, and, in some instances, falls under the purview of organizational management. The absence of a code of conduct and its enforcement, and the lack of management action to limit inappropriate activity increases the likelihood of aberrant behavior occurring and decreases the likelihood of such behavior being reported.

- i. **Recommendation:** Establish and enforce a formal, written astronaut code of conduct.
- ii. **Recommendation:** See 11.b.i.

10. To what extent can regular psychological testing or psychiatric evaluation predict a disorder of conduct or “act of passion?”

a. **Finding:** Initial screening and recurrent psychological evaluation are not intended to, nor can they, predict a future disorder of conduct or “act of passion.” However, they can identify persons at increased risk, allowing proactive interventions which might mitigate the risk.

- i. **Recommendation:** Establish and enforce a formal, written astronaut code of conduct.
- ii. **Recommendations:** See Recommendation 3.c.i, 11.a.i, 11.b.i, and 11.d.i.

11. What systemic procedures could be put in place to predict disordered conduct?

a. **Finding:** Systemic procedures alone can not predict disordered conduct, but human factors concerns or issues that arise in one realm could be more effectively shared with others, and potentially result in earlier intervention.

- i. **Recommendation:** NASA should create a human factors council, patterned after the Navy’s model, to identify and mitigate astronaut human factors concerns. This council could bring together the disparate parts of the system into one place, with multidisciplinary representation from all organizations involved in astronaut activities and enhance leadership’s knowledge of how an astronaut is functioning in a variety of settings.

b. **Finding:** There are no enduring line reporting relationships and no regular system of overall performance evaluation beyond specific task evaluation related to specific mission completion. Thus there is no structural process by which to identify subtle deficits in duty performance or intra-office functional relationships, and no normative metric against which to identify such. In the absence of effective leadership, peer pressure, real or perceived, can discourage or encourage inappropriate behaviors. Many anecdotes were related that involved risky behaviors by astronauts that were well known to the other astronauts and

no apparent action was taken. Peers and staff fear ostracism if they identify their own or others' problems.

- i. **Recommendation:** NASA should ensure that the Astronaut Office is structurally and functionally organized to provide enduring supervisory relationships that extend over years and are not limited to technical or mission assignments. Supervisors should be senior astronauts, and each should have a manageable number of astronauts to supervise. These supervisors should report to the Chief of the Astronaut Office.
- c. **Finding:** Astronaut Office supervisors are insufficiently trained in human resource management.
 - i. **Recommendation:** Astronaut Office supervisors should be trained in the same or similar manner to other NASA supervisors, with added training and support for issues specific to astronaut function.
- d. **Finding:** It was reported that required supervisory evaluations and performance appraisals for astronauts were often not done for years and, when done, were often perfunctory and did not satisfy the intent, particularly with respect to evaluative and mentoring opportunities. This is not unexpected, since over 100 annual appraisals are supposed to be done by the Chief of the Astronaut Office. The only other evaluations of individual astronauts consist of time-limited task-specific technical assignments. The lack of enduring and comprehensive supervisory evaluations and controls represents a lost opportunity for supervisors to become familiar with the human factors issues of the astronauts, and to develop a behavioral baseline which could be used to assess future changes in behavior or performance.
 - i. **Recommendation:** NASA should ensure that all Astronauts undergo comprehensive annual and mid-year evaluations by line supervisors that integrate all available work related information in addition to task-specific technical assignment evaluations.

Summary

This report contains a wide range of findings and recommendations. Some of these recommendations will be relatively simple to implement, such as writing standard operating procedures to document processes which are already in place. Some will take substantially more time and effort to implement, such as restructuring astronaut supervisory relationships or focusing the attention of psychologists on astronaut performance enhancement. Some recommendations entail changing deep seated, long standing aspects of astronaut, flight surgeon, and safety cultures regarding alcohol use, code of conduct, acknowledgement of human performance issues, selection, training, evaluation and professional development, communication, and privacy. None of these issues lend themselves to easy analysis or correction of a single factor. All of them require further study and evaluation by NASA. Solutions will require a systems-based approach, will take time to achieve, must be tracked and assessed for progress, and require senior leadership attention. Cultural changes such as these will and must disrupt the status quo. While cultural changes are the most difficult to achieve, they are also the most significant and pose the highest risk of human failure if not adequately addressed.

Preparation for exploration class space flight requires NASA to focus much more attention on human behavior. Astronauts must be selected, trained, evaluated, monitored, and supported in order to be effective as individuals, and more importantly, so they can be effective members of a team that will be isolated and under great mental

and physical stress for a period of several years before their return to Earth. NASA's Astronaut Office and medical system should be structured to optimally execute that mission.

The committee appreciates the openness of and the assistance provided by the leadership, astronauts, medical personnel, and family members of NASA. They clearly share the overarching goal of the committee – to enhance the ability of NASA to perform its mission safely and effectively.

Attachments:

1. 7 Feb 2007 Memo from the NASA Administrator to the Chief Health and Medical Officer
2. Review of the NASA Astronaut Health Care System Charter