Space Programs and the Future

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THE DEVELOPMENT of the rocket as a vehicle has placed man in a position to explore space. The recent Russian achievement emphasizes the reality of space as an operational medium. The entire theme of this program has been aerospace medical support. The many problem areas already discussed certainly indicate the necessity for proper aerospace medical support of any space missions whether they be exploratory or more purely military. The purpose of this paper is to carry our theme to its logical conclusion by discussing the role of the flight surgeon in space programs. Further, even though such attempts are fraught with danger of obsolescence before utterance, I feel some attempt must be made to guess the future.

A word about terms seems apropos here even though one would think this group would be in less need of same than any other. There are still flight surgeons and others who speak of space and thus space medicine as things entirely new and quite different. I feel we do the specialty of aviation medicine and its pioneers an injustice when we speak thusly. The environment of space is certainly "more hostile" in that the changes in pressure, partial pressures, temperatures, radiation, etc., are more severe than those observed at lower altitudes. The familiar "space equivalent" altitudes of Strughold dramatically illustrate the continuum of aerial and space environments. The USAF concept of aerospace as the operational medium extending from the earth's surface upward also emphasizes this continuum and shows the need for the use of the term aerospace medicine rather than aviation medicine.

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SUPPORT OF CURRENT SPACE PROGRAMS

The significant factor determining the extent and value of aerospace medical support and participation in space programs is whether they involve manned space flight. I hope that the members of this association are all convinced of the necessity of manned space flight and are dedicated to convincing the necessary authorities that an aggressive and imaginative program in this regard is imperative.

It should be obvious that the military and peaceful uses of this medium go hand in hand and that the military aerospace medical group possess the most "know how" in this area. They must therefore be utilized in any such support programs. This has been the pattern in current programs such as the X-15 and Project Mercury. Certainly in any such programs the trained aerospace medical specialists should be utilized to the fullest extent possible and any additional training necessary should be given these people rather than trying to give limited aerospace medical knowledge to other physicians. There are now too many instances in advisory groups, etc., of the ignoring of aerospace medical training and acceptance of any physician at all levels in both Federal and civilian aerospace programs. I doubt the omnipotent transfer of knowledge in one area to all other areas and such practices may work to the detriment of projects.

Let's look at the support of a current program—Project Mercury. Though it is a civilian operation under NASA, the Department of Defense and thus the Surgeon General of the

USAF have been directly concerned with providing personnel for support of this program on both a long and short term basis. There are four USAF, and one each Army, Navy, and civilian physicians devoting their full time to the aeromedical support of this project in the Space Task Group (since renamed the Manned Spacecraft Center). In addition to the full time physicians there are numerous physicians of the USAF, Navy, Army, and Public Health Service involved in extensive support on a part time basis. In this presentation, however, we are concerned with USAF support and will thus limit further discussion to those so involved. In addition there are veterinarians, administrators, technicians, etc., also involved in its support. As we are here concerned principally with flight surgeon activities little more will be said of the important contributions of these members of the medical team who are so necessary in any support of aerospace projects or operations. The flight surgeons and aeromedical specialists are involved in the over-all medical planning and design, in monitoring tasks, and in recovery operations.

The early stages of this program required many medical decisions and advice to and coordination with engineers. Even preceding these activities there were large numbers of USAF personnel occupied in our various aerospace medicine laboratories producing the basic and applied research information so important to the support of any aerospace medical program. Design and selection of vehicle and personal equipment or life support systems is a vital role played by the flight surgeon. While these decisions were being made it was necessary to select the individuals who would become astronauts. While it was a new program, it drew heavily on aviation medicine experience and utilized the facilities and personnel of several of our laboratories. Details of this selection program have been published and will not be repeated here.[5] Suffice it to say that this is an important function of the trained flight surgeon.

The inflight monitoring task is one of the most interesting and involves the greatest number of flight surgeons and aerospace medicine specialists. The prospect of placing an astronaut in orbit 100 miles above the earth called for transposing the monitoring of patients and subjects in altitude chambers, centrifuges, et cetera, to the astronaut in orbit. As an initial step in this program a USAF flight surgeon was assigned to the astronauts. He not only served the traditional roles of advisor, confidant and practitioner, but also gathered valuable baseline data to be used in later monitoring. A world-wide network of monitoring stations was established and the monitoring task outlined by NASA was as follows:

1. To assist the astronaut through recommendations and answering his questions.
2. To evaluate the medical situation from voice, telemetry and message sources.
3. To make medical recommendations to the other flight controllers and Mercury Control Central.
4. To report medical situations including post-flight reporting and analysis.
5. To function as NASA medical representative in contingency recovery operations.
6. To provide emergency medical care during station deployment.
7. To provide backup of the capsule systems by men knowledgeable in the environmental control system.

In order to accomplish this task an attempt was made to select flight surgeons with both operational and research experience and previous monitoring of some sort. A rather extensive training program was undertaken including detailed briefing on the Mercury systems and mission, experience with the astronauts in training programs, electrocardiography, etc. The deployment of monitors to the world-wide network for further communications and flight control training or for actual missions is a time consuming effort for all are involved on a part time basis and continue in their primary duty assignments. This pattern of short notice assignment for uncertain periods to remote sites

may become a way of life for our aerospace medicine specialists.

The activities of the flight surgeon in support of another current program, the X-15, have been discussed by Bratt[2] and Rowen.[1] These authors have discussed details of the program which essentially again involves planning for the life support systems, physiological monitoring and evaluation of data obtained for use in current and future projects. The objective of the aeromedical portion of the X-15 program is to "assure quantitative evaluation of the pilot's response to speed, altitude, temperature and pressure just as carefully as the aeronautical engineer can examine the quantitative performance of the airframe and power plant."[2]

Another activity in support of current programs is the constant instruction in the current aspects of aerospace medicine carried forward to provide the trained flight surgeons needed to furnish the required support.

In summary then, the following duties are being performed by aerospace medical specialists and other flight surgeons in current space programs: (1) basic and applied research, (2) early planning of life support systems, (3) selection and (4) maintenance of the crewmen, (5) inflight monitoring, (6) recovery operations, and (7) teaching.

The parameters monitored are body temperature, pulse, respiration rate, electrocardiogram, blood pressure, and several environmental factors in Mercury, and body surface temperature, respiration rate, electrocardiogram and soon blood pressure and respiratory volume in the X-15.

THE FUTURE

USAF and Space Programs.—During the next five years small changes are anticipated in our structure characterized by some decrease in aircraft and flying personnel and increases in the number of active missile squadrons. Further in the future the role of manned aircraft such as the B-70 remains in doubt. The role given the Department of Defense in future space programs will of course determine the extent of our activity. I look to increased responsibilities being assigned the Department of Defense and the USAF. In any case the military services will continue to serve as a source of trained aerospace medical personnel and thus even further co-operation or amalgamation is forecast.

Dyna-Soar, a USAF project, will become operational within the next ten years and thus provide a true rocket launched aerospace vehicle capable of maneuvering in both environments. Gemini and Apollo, NASA projects, will provide multi-crew vehicles for longer flights in space and an orbit of and landing on the moon in approximately the same time period or shortly thereafter. The aerospace medical support of these programs will probably be similar to that used in Project Mercury with perhaps more effort at remote evaluation of inflight data. Within approximately a decade we should be orbiting a space station and press on thereafter to moon operations.

Role of the Flight Surgeon.—It is anticipated that the next decade will still require squadron or base level flight surgeons as we now know them. These general practitioners of aviation medicine are principally non-career reservists and their role will be changed very little.

The aerospace crew effectiveness program is and will continue to be the primary job of the flight surgeon at all levels. The objective of this program is the maintenance of a combat ready Air Force. Details of the program are found in current regulations and manuals[3,4] and have been discussed in various form by previous speakers. New developments in the program will be more emphasis on the responsibilities of the Surgeon General in the form of increased priority for the program, maintenance of even a higher level of aviation medicine professional capability among our flight surgeons and closer monitoring of training utilization and flying status. These activities will be centered in the Aerospace Medicine Division. A program has been developed for appointment of regional aerospace medicine consultants, as well as appointment of consultants at Surgeon

General level. In addition to general problem consultations and administering senior flight surgeon rating examinations, these consultants will serve as chiefs of five U. S. and two overseas aviation medicine problem case consultant services.

The duties of the flight surgeon or aerospace medicine specialist in future space programs will include those discussed under current space programs and will place even more emphasis on research. Teaching will also occupy large numbers of flight surgeons for an active, progressive education program is the foundation of an adequate aerospace crew effectiveness program. In future programs flight surgeons should and will serve as members of the development team with engineers and others. They must enter these programs at an early date and such has not always been the case in the past. The flight surgeons will also serve as scientific observers and crew members in future projects.

It must seem obvious that the many activities now included in the aerospace medicine program have some diversity worthy of segmentalization. The current and future trends of our aerospace system development indicate two more limited areas in the broad aerospace medicine field. These are *flight medicine* or the support of manned aerospace systems and *missile medicine* a special form of industrial medicine concerned with the support of unmanned missile systems. The former is merely a continuation of our current aerospace crew effectiveness program to future projects. The latter is a rapidly developing area for whose coverage there is little doubt the flight surgeon is the best currently trained medical officer. Very worthy and serious suggestions have been made for the development of a "missileer effectiveness program" also. A third area whose personnel have made great contributions in the past and will make even greater in the future is research. This subspecialized area requires more career interested flight surgeons if we are to maintain its current high level of accomplishment.

The implications of the above roles on training involve increased emphasis on industrial medicine, toxicology, bionucleonics, electronics, and research procedures.

The divisions mentioned above, flight, missile, and research, indicate another serious problem of the present and future—flying status. This topic if pursued could occupy this entire discussion. Rather direct contribution to the flying mission has and will continue to be justification for flying status. The difficulty in justifying flying status for strictly missile medicine activities is obvious. Flying status will continue to be critically reviewed and will be limited to those individuals occupied in virtually full time aerospace medicine practice or research.

Flight Surgeon Requirements.—There will undoubtedly be graded decrease in over-all numbers as our aircraft inventory and flying personnel decrease. This implies particularly reduction in our non-career flight medical officers. The trend will be toward increases in the number of career flight surgeons and aerospace medicine specialists.

Utilization.—The above trend implies manning of the aerospace medicine program with more career and specialist officers. In any discussion of utilization of flight surgeons one is immediately confronted with the fact that though the specialty is now eight years old it still receives inadequate recognition as a true specialty and therefore its members are frequently improperly utilized. Proper recognition of aerospace medicine as the specialty it is, at all levels of government, would do much to improve utilization of the board members. Within the USAF this must begin with the designation of certain jobs as requiring an aerospace medicine specialist and then manning the positions accordingly. Such a review is presently underway and priority positions are being marked at staff level, SGO, command and numbered Air Force, in research and development, teaching, consultation and as directors of aerospace medicine services at our larger bases.

This raises the question of where our aviation medicine residency graduates are now assigned. At the present time there are 46 gradu-

ates of the residency program on active duty. They are assigned as follows:

Commanders (Dispensary and Hospital)	16
Staff	24
Surgeon General's Office	7
School of Aerospace Medicine (SAM)	7
Deputy Inspector General for Safety	1
Command Chief of Aviation Medicine	6
Air Division Surgeon	1
Command Director of Professional Services	2
Research and Development	5
(Some of Staff (SAM) are also involved in Research and Development activity.)	
Base Flight Surgeons	1

At the present time there are 37 physicians in various phases of the aviation medicine residency program. Phase I—11, Phase II—9, Phase III—5, Phase IV—12. In order to fill our needs the size of the next Phase I class will be doubled. In addition there are 24 officers who completed only Phase II initially, but several have since completed formal training in public health and 10 have become board certified in aviation medicine. The majority of this group are presently assigned as directors of base medical services or in staff jobs. While it is and should be inevitable that with increasing service and rank some of our graduates will go to commander's jobs, we must develop a corps of graduates covering the primary aerospace medicine jobs and thus further increase our effective support of the USAF mission.

SUMMARY

This paper has attempted to carry our discussion of aerospace medical support to its logical conclusion by outlining the role of the flight surgeon and aerospace medicine specialist in space programs. The support of current space programs such as Project Mercury and the X-15 is discussed and the flight surgeon's duties are noted in the areas of early planning, research, selection, maintenance, inflight monitoring, and recovery.

The future is discussed in terms of the programs; the role of the flight surgeon in these programs, including training and flying; and flight surgeon requirements and utilization.

REFERENCES

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The Integrity of the Manufacturer

When a physician prescribes or a pharmacist dispenses a drug, each assumes legal responsibility for the purity, efficacy, potency, and freedom from unusual side-effects of the compound. Since neither the physician nor the pharmacist is capable of the detailed chemical and clinical analysis necessary to determine these factors, he must rely on the integrity and character of the manufacturer.—*Problems of Generic Prescribing*: D. F. Robinson, M.D., Director, Oklahoma University Student Health Service.