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AVIATION MEDICINE FAA—1966

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By P. V. Siegel, M.D.

The health and safety of more than 80,000,000 aircraft passengers, approximately 500,000 active civilian pilots and other civil aviation personnel is the concern of the Federal Aviation Administration's Office of Aviation Medicine.

In the civil aviation system, involving 98,000 aircraft, which accumulate 20,000,000 flying hours per year, there are numerous and varied opportunities to apply the principles of preventive medicine.

The Federal Air Surgeon, Peter V. Siegel, M.D., directs the nation-wide program which: establishes the standards of medical fitness for pilots, air traffic controllers, and other personnel connected with civil aviation; provides a certification program which involves the periodic medical examination of these personnel; provides medical investigation for aircraft accidents; conducts medical research on a variety of subjects of importance to civil aviation safety; operates an occupational health program for the agency's 44,000 employees; and provides for the education of civil airmen on medical subjects of importance to safe flying.

Doctor Siegel was appointed Federal Air Surgeon in October 1965, after previously serving as Chief, Aeromedical Certification Division. In the ensuing year he, along with the rest of the agency and the aviation industry, has seen civil aviation activity grow at a more rapid rate than any of the previous predictions had indicated. Among other things this has meant an estimated 12 percent increase in the number of pilots medically examined for the calendar year 1966 over the calendar year 1965. The ability to handle, in a timely manner, the increased work load of processing, reviewing, and tabulating results of this greater number of examinations has demonstrated the real value of the computerized system which was installed and perfected by Doctor Siegel while he was Chief of the Aeromedical Certification Division.

Medical Certification

The key element of the program for periodic medical examinations and issuance of medical certificates to airmen is a group of private practicing physicians. These are the 6,000 designated Aviation Medical Examiners (AMEs). This calendar year they are expected to examine approximately 400,000 airmen, including new applicants as well as renewal applicants. Fees for these examinations are paid directly to the physician by the airmen. The AME has authority, delegated by the Federal Aviation Administration, to issue a medical certificate on completion of an examination. The AME also has authority to make a preliminary determination that the airman applicant is not qualified under the existing medical standards and to issue an official notice to this effect to the applicant, who then has the right of appeal. In 1967, AMEs are expected to find approximately 6,000 airmen not qualified to receive medical certification.

Basically, any qualified physician may apply for designation as an AME. However, the agency requires that he demonstrate an interest in the program and agree to participate periodically in training seminars designed to enhance his effectiveness as an Examiner. Need for an Examiner in an area in which the physician is located is also a factor in the designation. In addition, the agency gives weight to current or prior familiarity with aviation or aviation medicine. Actual experience in aviation medicine, such as service as a former military flight surgeon, is given greatest weight. Sixteen percent of AMEs have such experience. FAA next likes to see Examiners who are themselves qualified pilots. Forty-seven percent of the AMEs fit this criterion. There is also a preference for physicians whose type of practice is such that they would ordinarily be equipped to conduct a complete and comprehensive examination. Representation by specialties is as follows: general practice, 55.9%; internal medicine, 16.4%; gen-

eral surgery, 10.6%; ophthalmology, 7.6%; miscellaneous, 5.3%; aviation medicine, 2.4%; industrial medicine, 1.4%; psychiatry, 0.4%. The relatively large representation of ophthalmologists can be explained by the fact that in the earlier years of military aviation medicine greatest attention was focused on the eye, near, nose, and throat part of the medical evaluation. Therefore, those who are former flight surgeons (a preferred group) are somewhat more likely to be ophthalmologists. As a matter of fact, examination of the eyes is still an important part of the pilot examination, and for this reason most general practitioners, internists, and general surgeons, upon accepting a designation as an AME, find that they must purchase certain eye examination equipment which they ordinarily would not use in their practice.

To keep AMEs abreast on matters of importance to their service as FAA representatives, the Federal Air Surgeon uses a variety of instructional media. Each AME is given a set of the Federal Aviation Regulations which contains the medical standards by which he makes judgments of medical fitness. In addition, the Federal Air Surgeon has published a "Guide" which elaborates on the standards and informs the AME of the various procedural and administrative practices relating to his work. Periodically, the Federal Air Surgeon also issues a Medical Bulletin on the most recent developments of interest to Examiners in the field of aviation medicine.

Perhaps the most effective means of keeping AMEs informed is by training seminars. Each Examiner is required to attend a three-day seminar every five years. Expenses of attendance are covered by the FAA.

When first established in 1961, the seminars were conducted at medical schools, using a combination of the postgraduate training faculties and FAA personnel. Within the past year there has been a transition to seminars which are conducted wholly by the Office of Aviation Medicine with lectures about equally divided between FAA staff, aviation industry medical specialists, and a select group of lecturers from a number of medical teaching institutions. Considering the fact that Examiners, in order to attend, must be absent from their practices for at least three days (for which they are not compensated) their response and enthusiastic participation in these seminars indicates their keen interest in aviation and in making a contribution to its further safety. Seminars have been scheduled for San Francisco, Dallas, Omaha, Kansas City, Durham, Philadelphia, Seattle, Minneapolis, New Orleans, and Washington, D.C., for the coming year.

Among the results of these instructional efforts are improvements in the quality of AME decisions as to which pilots are certified as fit to fly. An equally important benefit is the improvement in the quality and completeness of medical reporting on pilot applicants. This contributes greatly to the value of the data which are taken from the reports and stored for future analytical studies.

When the AME has finished his examination, he sends his report to the Aeromedical Certification Branch at FAA's Aeronautical Center in Oklahoma City. There all significant information relating to the examination is entered on computer tape. By using a set of preprogrammed reviewing criteria, the computer then proceeds to check on the quality and completeness of the AME's case report and the appropriateness of any action taken. In the past year, between five and six percent of the cases required some further action to bring them to proper completion.

The stored information provides a valuable data bank describing the status of medical fitness of all active civil airmen. The nature of planned analytical studies based on this information will be discussed later in this report. Many special tabulations can be quickly made. It has been found, for example, that there are 7,500 active pilots over the age of 60 and more than 700 who are older than 70 years. The tabulations also show that of the 500,000 total active pilots, 20,000 are women. More than 44,000 pilots wear glasses, 2,500 wear contact lenses, 1,250 have no useful vision in one eye, 600 have an amputation of one or more extremity.

From the preceding, it can be seen that some pilots with significant medical defects are permitted to fly. In many of these instances, certain limitations are placed on their certificates, restricting them to flying under certain specified conditions designed to protect the public as well as the airman.

Medical Standards

Three levels of medical standards have been established, applicable to the three categories of pilots, classified according to level of pilot responsibility.

Medical standards and related procedures have been established according to certain basic policies. For FAA certification purposes, concern for medical fitness extends only over the period during which an issued certificate will be valid—six months for airline transport pilots, one year for commercial pilots, and two years for student and private pilots. This contrasts with the concern of employers such as airlines and corporations and the military services, which measure and attempt to predict pilot fitness for extended periods—the useful life of a pilot. The level of fitness demanded is, therefore, somewhat higher than the FAA standard. Another basic consideration is that members of the public have a certain entitlement to a certificate if they can demonstrate that they can fly safely despite the existence of a physical defect. This policy applies mostly to those fixed or "static" defects such as visual deficiencies, amputations, etc., which can be demonstrably compensated for in non-commercial piloting. It does not apply to organic or functional disorders which have a potential for sudden incapacity, progression, or recurrence, or which, even though medically controlled, would present a hazard because of the nature of the medical treatment required.

In accordance with this policy, individual consideration and waivers of medical standards for defects beyond certain limits may be given in the case of certain "static" defects. However, certain specified organic or functional disturbances are not subject to waiver. Among these are (1) history of a psychotic disorder, (2) history of chronic alcoholism, (3) drug addiction, (4) epilepsy, (5) disturbance of consciousness without satisfactory medical explanation of the cause, (6) history of myocardial infarction, (7) diagnosis of angina pectoris or other evidence of coronary heart disease, and (8) diabetes requiring hypoglycemic medication for control.

In establishing medical standards by regulation, the Federal Air Surgeon must give public notice of any proposals for changes in the standards and give consideration to any comments which result from this notice. In effect, this requires the Federal Air Surgeon fully to justify his actions to the public, presenting convincing evidence that the changes are required because of safety considerations.

In the past year the Federal Air Surgeon's regulatory actions have focused on changes in procedural requirements to provide improved and expedited service to airman applicants or to clarify long-standing procedures which, for various reasons, were subject to misinterpretation. In addition, the distant visual acuity standards for first and second class medical certificates were changed, permitting pilots to obtain those classes of certificates if their uncorrected vision is no poorer than 20/100 in each eye, so long as it can be corrected to 20/20. The prior standard for uncorrected vision was 20/50. This change resulted from experience over the years which indicated that, without exception, pilots with the lower level of vision could demonstrate ability to fly safely and qualify for a waiver.

In another regulatory action, the Office of Aviation Medicine prepared and circulated a notice proposing that pilots not be permitted to fly within eight hours of consuming an alcoholic beverage. This proposal resulted from the results of medical investigation of fatal aircraft accidents which indicated the presence of alcohol in blood specimens drawn from pilots, sometimes in very high concentrations. In lieu of this proposal, an educational program, pointing out the hazards involved in flying after drinking alcoholic beverages, has been implemented.

The Federal Air Surgeon also issued a proposal (later adopted) which declares a medical certificate to be a student pilot certificate. This has the effect, in the case of 90,000 student pilot applicants a year, of eliminating the former requirement to file another application with one of the agency's field offices.

A notice has just been issued which suggests the need for better ways of detecting coronary heart disease in pilots. FAA hopes to get suggestions from medical experts and other interested people. At present, airline pilots are required to have a standard EKG at age 35 and annually after age 40. The notice solicits views on the possible use of exercise tolerance and other tests in addition to the standard EKG.

In addition to inviting written comments, a public hearing was held in Washington on February 15, 1967, to permit the fullest possible exploration of this subject.

In addition to evaluating and revising pilot fitness requirements, regulatory actions are also taken to insure that appropriate man-machine relationships exist for airmen and that safe environmental conditions exist for airmen and passengers. In this connection, in the past year, the Office of Aviation Medicine has, as a result of research studies, participated in regulatory actions to specify requirements for oxygen flow regulators, oxygen mask fit and efficiency, crash fire protection, and conditions that speed up passenger and crew evacuation in the event of an accident to air carrier aircraft. Research continues in other areas looking toward improvements in the safety of aircraft operations.

Aeromedical Research

Medical research in FAA is aimed at eliminating, insofar as possible, the human factors that are the causes of accidents and at developing means by which persons involved in accidents can survive or be protected from injury.

The research is carried out in a building specifically designed for medical research at the FAA Aeronautical Center in Oklahoma City, Oklahoma.

The following are examples of research work done in the past year.

1. The injury potentials of aircraft instrument panels, when struck by the head during crashes, were precisely determined. Manikins, instrumented to measure force of impact, were used to simulate what would happen to a human in the event of a crash. Instrument panels from a variety of light aircraft (non-air carrier aircraft) provided the surfaces struck by the head of the manikin. It was demonstrated that the injuries resulting from the head striking these instrument panels with the forces that are ordinarily associated with potentially survivable accidents would be fatal. As a result of these findings, an impact-absorbing device was fabricated. Tests with this device indicated that the impact force to the head in survivable accidents could be reduced to the point where fatal head injuries would not occur. It could be installed at minimal expense and without interference to the operation of the aircraft.

2. Studies similar to the above were made of the effect of a passenger's head striking airline passenger seat backs. From data previously developed concerning the tolerance of the head to impact, it was determined that, in otherwise survivable accidents, in 30 percent of the cases fatal head injuries would have resulted. About 80 percent of the cases would have received facial fractures; 97 percent would have lost consciousness. Only 3 percent would have received no injury or loss of consciousness. Suggestions were made for improving survivability under these conditions. These include the recommendation that (1) tubular construction should be used only in areas where it cannot cause injury, (2) serving trays and seat backs should be molded of light aluminum sheet or other metal that will deform at loads less than 30 G and contour itself to the head and face, (3) all exposed areas should be padded with sufficient slow-return foam to aid distribution of the impact force over the contour of the face, (4) the forces necessary to break the seat back forward should be reduced, and (5) the potentially lethal characteristics of seat arms should be eliminated.

3. Studies were made to simulate the conditions in an air carrier aircraft cockpit in which a decompression occurs while flying at 41,000 feet. Forty-one thousand feet is the maximum altitude at which crewmembers are permitted to operate without at least one of them wearing an oxygen mask continuously. Up to that altitude, under present requirements, neither crewmember need wear an oxygen mask continuously so long as they are equipped with quick-donning masks.

In the simulated situation, decompressions, of a type that might occur in air carrier aircraft, were produced. The results indicated the environmental and operational conditions which pilots can expect under such circumstances. The most extreme rate of decompression which could occur under ordinary operating conditions was chosen for this experiment. There have been no decompression incidents of this magnitude in air carrier operating history. The study results, when considered along with the operational integrity of pressurization systems, demonstrated the soundness of the present requirements dealing with the wearing of oxygen masks.

Other studies conducted during the year included measurement of fatigue effects, effects

of chemicals used by pilots for aerial application and the effect of various amounts of alcohol on pilot performance; evaluation of devices intended to prevent stalls and inflight spatial disorientation; and refinement of passenger evacuation procedures for air carrier aircraft.

In all of this work, an effort was made to confine the studies to those matters directly related to making civil aviation safer. It is readily apparent that the kind of problems studied have features significantly different from problems relating to military aviation, and that they are problems for which complete answers cannot be expected from prior studies conducted by the military.

Medical Investigation of Aircraft Accidents

Since late 1959, there has been a complete medical investigation of all fatal air carrier (airline) accidents. In addition, beginning in 1960, fatal general aviation (non-air carrier) accidents have been medically investigated with increasing frequency. At the present time, approximately 60 percent of the general aviation fatal accidents receive some form of medical investigation.

Medical investigations are conducted for three basic reasons. First, the possibility of physical incapacity as the cause of the accident must be considered. Second, the mechanisms by which impact forces produce death and injury are studies for the determination of possible survivability factors. Third, medical evidence which is accumulated is added to the other evidence obtained during the investigation in order to attempt a reconstruction of the events leading to an accident.

Primary responsibility for accident investigation and determination of probable causes of accidents has rested with the Civil Aeronautics Board,* an agency separate from the Federal Aviation Administration. However, the Board does not have a medical department and utilizes the services of the FAA Office of Aviation Medicine and its consultants for this aspect of the investigations.

In numerous air carrier accidents, a study of injury patterns, evacuation sequence, and the concentration of inhaled combustion products in the bodies of accident victims has led to a fuller understanding of factors which affect survival or escape following the occurrence of accidents. Information obtained from these investigations is used in the design of specific research studies to develop equipment or procedures which will increase the probability of survival and escape.

In discussing air carrier accidents and medical investigations of them, it must be kept in mind that approximately 80 million passengers a year fly some 60 billion passenger miles and that there are, on the average, only 200 to 300 passenger deaths per year, involving only 8 or 10 fatal accidents. This gives a safety record for air carriers equal to or better than other forms of common carriage.

In general aviation (non-air carrier) flying, there are about 500 fatal accidents per year and approximately 1,000 fatalities. As previously stated, there is some form of medical investigation in about 60 percent of these accidents. For these investigations, the FAA flight surgeons are assisted by Aviation Medical Examiners. AMEs, because of their geographic distribution and acquaintance with local authorities and resources, are ideally situated for the purpose of participating in the early phases of accident investigations. They are in a position to arrange for autopsies to be performed and toxicological studies to be conducted. In addition, the AME, where possible, visits the scene and documents the evidence of importance to the medical phase of the investigation.

From these investigations, numerous case histories have been accumulated in which the probable cause of the accident was some medical deficiency on the part of the pilot. In others, it has often been determined that the accident could have been survived had the pilot or passengers been properly restrained at the time of impact (by a shoulder harness, for example). In certain cases (approximately 30 percent of all fatal accidents), significantly elevated levels of alcohol were found in blood specimens from pilots. In some of these latter cases, intoxication was eventually considered to be the primary cause of the accident. In other cases, it is believed to have been a contributing factor.

Prior to the initiation of the medical investigation program, very little information existed as to the magnitude of such problems as physi-

*Effective July 1, 1967, the CAB's responsibilities in this area were transferred to the National Transportation Safety Board.

cal incapacity, fatalities in potentially survivable accidents, or the effects of alcoholic consumption by pilots.

During the past year considerable work has been done in developing an automatic data processing system which will permanently record, for future analytical purposes, comprehensive medical and other investigational data relating to aircraft accidents. The data are to be used to study the relationship between the existence of medical defects and the occurrence of accidents (both fatal and nonfatal). Such studies are particularly needed in the case of conditions such as substandard vision, skeletal defects, and psychiatric disorders, since accident investigation would be unlikely to identify the probable contribution of such defects to the accident. The statistical probability of such a relationship could be established, however, by a comparison of the operational experience of persons with such defects with the remainder of the pilot population in which defects did not exist.

Studies will also be made in an effort to determine if certain medical deficiencies, now considered disqualifying, are compatible with safe aircraft operation, perhaps under special conditions.

Where relationships of a type which indicate the need to alter present standards of medical fitness are found, changes in the standards will be made.

The findings of these investigations and studies should also help in identifying areas where improvements in the safety record could be attained through educating pilots on steps they can take to protect themselves against the possibility of accident or injury.

Aeromedical Education

The FAA has a duty to inform airmen by educational means rather than by the regulatory approach, where its safety goals can be achieved by this mechanism.

The medical education of pilots is perhaps ideally provided in the military setting by the assignment of a flight surgeon to relatively small groups of pilots in a manner which provides relatively close day-to-day contact. The large number of civilian pilots, their geographic distribution, and the unavailability of adequate numbers of medical officers make this approach impractical in civil aviation. During the past year, under an accelerated program, other means of getting the word to pilots have been devised.

Whenever it is possible, FAA medical officers meet with pilots and provide firsthand information in answers to questions at such pilot gatherings as safety seminars, "hangar flying" sessions, and other gatherings. In order to extend the coverage which can be given by agency medical officers, a program recently established utilizes the services of designated AMEs, who are provided with prepared material such as films, slide presentations, or leaflets. AMEs address groups in local areas and make themselves available for answering questions on aviation medical matters, during visits to local airports or at local meetings of pilot groups. This kind of communication is enhanced, of course, if the AME is himself a pilot. The FAA is particularly grateful for this kind of service from AMEs since it is not in a position to reimburse them for the time spent. This promises to be a very successful venture and is possible only because of the dedication and enthusiasm of individual Aviation Medical Examiners.

During the past year, a number of leaflets have been prepared for distribution to pilots through the offices of Aviation Medical Examiners. Among them are such titles as "Rx to Keep You Healthy in Flight," "IFR/VFR—Either Way Disorientation Can Be Fatal!" and "Disorientation." Since the Aviation Medical Examiner is the only agency representative with whom all active pilots are required to make contact on a periodic basis (for their physical examinations), this presents an ideal distribution point for such literature.

The Office of Aviation Medicine has also prepared a film dealing with the effect of a number of medical conditions on flight proficiency and flight safety, and a film on the effects of alcohol and drugs. There is also in preparation a film on the psychological aspects of flight. These films will be distributed to field offices for use by FAA Safety Inspectors, Regional Flight Surgeons, and other personnel in showings to pilot groups.

The Office of Aviation Medicine also communicates with the rest of the aeromedical community and the aviation industry by means of technical reports based on research efforts.

Medical education efforts do not stop with the airman or the aviation industry. As previously discussed, a training program has been established for the AMEs. They are required to participate in three-day seminars once each five years. In addition to the benefits previously discussed, these seminars present an opportunity for the agency medical staff to make personal contact with the Examiners. There is considerable benefit to the agency in obtaining the point of view of people who administer the certification, accident investigation and education programs in the field. Examiners gain from such firsthand exchanges a clearer understanding of their role as agency representatives.

An example of the apparent effect of specifically focused educational campaigns was the result of a recent letter from the Federal Air Surgeon to flying physicians. In anticipation of the ordinarily high accident rate over the Labor Day weekend, the Federal Air Surgeon sent a letter to physicians who fly. He called their attention to the fact that the accident record for physicians appears to be significantly worse than that for pilots in general, flying similar aircraft. He listed certain precautions that might be taken and urged physicians to exercise the same sort of care in preparing for flying and in flying as they would in caring for patients in their respective practices. Analysis of data indicates that the number of accidents in this group over the last Labor Day weekend was approximately half that which was expected from prior years' experience.

Occupational Health

FAA has a program to provide certain health services to its 44,000 employees.

In the past year, its major effort in this area has been the establishment of a comprehensive health program for its 14,000 Air Traffic Control Specialists. Control specialists occupy a very critical position in terms of responsibility for the safety of aircraft operations. From the standpoint of reliability on a second-to-second basis, few occupations are as demanding as that of air traffic control. These specialists are charged with controlling both civilian and military air traffic in a manner which will assure safe separation and expeditious flow. Judgment, intelligence, stability, and medical fitness are prerequisites for this kind of work.

After a number of years of study and the development of a set of standards of medical fitness, the agency inaugurated, in December 1965, a program of annual medical examinations, conducted in the birth month of the controller and paid for by the agency. FAA expectations from this program lie in three areas.

First, the standards of medical fitness which were developed by FAA and approved by the Civil Service Commission provide considerable leeway for giving individual consideration to persons who, despite the presence of some medical deficiency, may be considered fit to control traffic under the conditions that pertain to their particular assignments.

The second expectation is that incipient or remediable medical deficiencies will be detected at a stage when treatment may be effective in arresting or curing the condition, thus preserving the health and useful life of controllers. This preventive maintenance aspect of the program may constitute the greatest benefit to be derived from the program.

The third expected result is that to be derived from the data accumulated in the program. From information concerning the overall health status of controllers over the years, it is hoped that analytical studies will shed some light on the price paid by controllers as the result of the stress to which they are exposed on a day-to-day basis. Among other things, it is hoped that the relationship between control work and the rate of development of "stress-related" disease can be established. Further, it is expected that comparisons can be made between the controller population and similar occupational groups, leading to conclusions regarding cumulative deleterious effects, from the standpoint of health and performance, attributable to control work. The possible need for early retirement provisions for controllers, as a consequence of the unusual and prolonged demands, has concerned many people in the agency, the Civil Service Commission, and the Congress for some years. Factual data to evaluate objectively this need have, heretofore, not been available. Comparative studies, of the type indicated, may help clarify this matter.

Examinations, begun in December 1965, include a complete medical examination conducted by selected Aviation Medical Examiners. In

addition, certain ancillary examinations, including electrocardiogram, chest x-ray, and audiogram are performed. These latter tests are usually performed at medical facilities of other government agencies, such as the Veterans Administration, U.S. Public Health Service, and military facilities. In addition, psychological screening tests are administered to controllers, in groups, at control facilities.

Controllers are advised of any significant departures from the normal on any of these examinations, in which case they may be asked to obtain further specialist evaluation, again at agency expense.

Since a full year of examination results has not yet been accumulated, a complete evaluation of the effectiveness of the program in achieving its intended goals cannot be made at this time. It has, to date, however, succeeded in identifying a number of control specialists who suffer from previously undiagnosed conditions such as hypertension, diabetes, ulcer, coronary disease, hearing loss, and pulmonary pathology.

From the psychological screening program, which has been completed for one category of controllers, namely, those in the Air Route Traffic Control centers (6,231) the personality characteristics of control specialists, as compared to a standardization sample from the general population, have been identified. As compared to the standardization group, controllers possess a higher level of intelligence, greater self-discipline, and self-control, a tougher realism, greater conscientiousness, and less anxious insecurity.

In addition to the Air Traffic Controller Health Program, to which greatest emphasis has been given in the past year, the agency also provides certain health services to other employees. An Executive Health Program, providing periodic medical examinations for key personnel, has been established at the Washington headquarters and at the headquarters of regional offices. About 1,200 agency pilots are also examined regularly at agency expense.

On-the-job diagnostic and treatment services are provided at places of greatest employee concentration such as Washington headquarters and regional offices. In addition, immunizations against selected diseases and disease screening programs are provided for most FAA employees.

Regional Medical Activities

To carry out the various aspects of the agency's medical programs, developed and supervised from the Washington headquarters, there are seven Regional Flight Surgeons and their staffs. They are located in New York City, Atlanta, Kansas City, Fort Worth, Los Angeles, Anchorage, and Honolulu. In the past year their work has been about equally divided between the Air Traffic Controller Health Program and the handling of problem cases in pilot medical certification. They also make selections of Medical Examiners and supervise their performance. In addition, they provide for the medical investigation of accidents which occur in their regions and serve as staff medical advisors to the directors of the regional offices. Regional Flight Surgeons can be looked on as FAA's field medical managers and its practitioners of aviation medicine.

Future Plans

Among the matters which will concern the Office of Aviation Medicine over the next several years are the following:

1. Statistical studies, relating from state of medical fitness to airman performance. Results from such studies should lead to refinements in the standards of medical fitness and examination procedures for airmen. A long-standing problem which has prevented the performance of such studies in the past is the lack of exposure data (information on the amount of time that individual pilots spend flying). To clear the way for the planned studies, action has been initiated to identify a reliable source of flight time information for all pilots.

2. As development of the U.S. Supersonic Transport proceeds into the 1970's, continuing medical monitoring and medical support will be provided by the Office of Aviation Medicine. Although no insoluble medical problems are foreseen, matters of air crew medical fitness requirements, passenger environmental protection, and man–machine accommodation will call for continuing review.

3. As data from the Air Traffic Controller Health Program are accumulated, analytical studies will be conducted to define more precisely the demands placed on control specialists and the effects of these demands in terms of health and proficiency. Controller characteristics,

as they can be described in terms of physical and psychological make-up, will be compared with controller success and tolerance to occupational stress.

4. In addition to the supersonic transport, there are certain other aircraft which must be considered part of the coming generation. Among the medical considerations in connection with these evolving machines are the following:

a. For the "jumbo jets," which are expected to be operational as early as 1969, the medical considerations deal chiefly with the large number of passengers which will be carried. Some seating configurations provide for a 500 to 600 passenger capacity. For a given flight of several hours duration, the statistical probability of the occurrence of illness unrelated to the flight environment will be significantly increased as a consequence of the increased number of persons in all age ratings and states of health. Also, as a consequence of the increased numbers, procedures for evacuation of the aircraft in the event of an accident and for providing oxygen protection in the event of a decompression incident will require special study.

b. Aircraft now being introduced in general aviation (non-air carrier) service are capable of carrying its occupants into hostile environments of great speed and high altitude, until now occupied only by air carrier and military aircraft. Because these aircraft have relatively small cabin volumes, the rapid rate at which decompression would occur in the case of a decompression incident makes more critical the need to indoctrinate pilots on the effects of altitude and the need to provide for passenger indoctrination and protection in the event of decompression. The difference between these aircraft and those of the air carriers, as far as such protection is concerned, will be studied further.

c. The Vertical and Short Takeoff and Landing aircraft (V/STOL) now under development will be studied for significant medical factors relating to their successful and safe performance. Man–machine relationships will be specifically reviewed. In addition, takeoff and landing characteristics may call for provisions for passenger protection and comfort of a type somewhat different from the requirements for present operational aircraft.

6. While awaiting technological advances which, it is hoped, will reduce the noise level currently produced by aircraft, the Office of Aviation Medicine will participate with other units of the agency, and with non-agency groups, in developing measures intended to reduce community noise exposure from this source.