Abstracts of Current Aerospace Medical Literature

The fate of eyewear in aircraft ejections. O'Connell SR, Markovits AS. Aviat Space Environ Med 1995;66:104-7.

Ejection from jet aircraft has been exhaustively studied from many perspectives; e.g. causes of ejection, types and causes of ejection injuries, etc. Curiously, no reports exist describing the fate of eyeware in ejections. Many pilots wear required corrective lenses during flight operations, and many wear tinted lenses. What happens to these during ejection? What injuries are a result of the eyewear? What factors can be identified that influence retention of the eyewear and severity of related injury? Do contact lenses provide significant advantages? There were 48 ejections occurring between 1977 and 1990 that involved corrective or tinted lens use that were retrospectively examined using Naval Safety Center records and personal questionnaires. There were five contact lens wearers included. Retention rates were calculated as functions of several variables. Although 37 of 46 lost all lenses, each instance of retention occurred with visor down, oxygen mask on, helmet properly secured, and at lower ejection speeds. Related injuries were minor and occurred in only 20%. The utility and need for enforcement of standard operating procedures (i.e. mask on, helmet secured, and visor down) was clearly demonstrated. Only 19 of 46 clearly met all three criteria. Contact lens users were too few to allow meaningful conclusions.

Evaluation of integrated night vision Goggle (NVG) helmets under sustained +Gz. McClosekey K, Easken RL. Aviat Space Environ Med 1995;66:118-25.

Three integrated night vision goggle (NVG) helmets from different manufacturers were evaluated under high G conditions. Structural and operational integrity, as well as neck forces in pounds, were determined via instrumented mannequin testing before human exposure with the helmets during sustained +Gz. Results of the mannequin testing showed that the helmets could withstand the rigors of high-G, and that the helmets could withstand the rigors of high-G, and that predicted forces (using helmet weights and centers-of-gravity) matched those obtained experimentally from load cells in the z-axis of the mannequin's neck. After mannequin testing, 10 subjects were randomly exposed to four different high-G profiles on the Dynamic Environmental Simulator (DES) man rated centrifuge located at Wright-Patterson AFB, OH: gradual onset to +8 Gz, a simulated aerial combat maneuver (SACM) profile, and two +4 Gz profiles, one with the mask dangling from the helmet and the other with the mask removed. Fit assessments were conducted before high-G exposure, and one helmet was affected significantly by failure of fit. The degree of migration of the NVG intensified image away from the eyes was affected most by the following helmet characteristics: design of the nape strap, size of the NVG image provided by each helmet system, goodness of helmet fit, and the use of the mask as a stabilizer. Although neck strength of each subject was measured and compared to the degree of head stability while wearing each helmet no effects were found. However, subjects were not allowed to perform fast, high-amplitude head movements in the centrifuge for safety reasons. Further research needs to be conducted to address the relationship between neck strength and helmet weight in a more operationally relevant environment.

Inflight arterial saturation : continuous monitoring by pulse oximetry. Cottrell JJ, Lebovitz BL, Fennell RG, Kohn GM. Aviat Space Environ Med 1995;66: 126-30.

The ability of newer airliners to fly at higher altitudes has resulted in an increased altitude

exposure to both airline crews and passengers. This increase in altitude exposure has the potential to place some individuals at risk for desaturation. Using pulse oximetry, the arterial oxygen saturation of 42 airline crew members was continuously monitored on 22 regularly scheduled commercial flights. Mean nadir arterial oxygen saturations fell from 97.0% preflight to 88.6% at cruising altitudes. Pulse oximetry results revealed large variations between individuals. Individual nadir saturations ranged from 93% to 80%. Modern aircraft flight may result in desaturations even among healthy aircrew. The effects on human performance remain unknown.

The crash of the Partnair Convair 340/580 in the Skagerrak : Traumatological aspects. Gregersen M, Knudsen PJT, Jensen S. Aviat Space Environ Med 1995;66:152-7.

In September 1989 an aircraft carrying 55 people crashed into the sea north of Denmark. There was no warning of the crash. The medicolegal investigation of the accident concentrated on finding clues to the cause of the accident, and identifying the victims, all of whom perished. These were found in two groups- 31 were immediately recovered from the surface of the sea and 19 were collected from the sea or shore during the following months. The injuries in the two groups differed, indicating that the aircraft broke up in mid-air. One group probably fell into the sea after a free fall, while the other probably remained in the wreckage until hitting the surface. The victims' injuries showed no evidence of fire or explosion. The technical investigators concluded that the aircraft broke up due to a structural failure in the tail.

The crash of the Partnair Convair 340/580 in the Skagerrak: Identification of the deceased. Gregersen M, Jensen S, Knudsen PJT. Aviat Space Environ Med 1995;66:158-63.

In 1989, a Norwegian Convair aircraft crashed into the sea near the northwest coast of Justland. Apparently, the aircraft had disintegrated in midair. On board were 50 passengers and a crew of 5. There were no survivors. Immediately after the crash 31 bodies were found. During the next 10 days, 11 bodies were recovered from the seabed and within the next 6 months, a further 8 bodies were found. Five bodies were never recovered. All the bodies found were positively identified based on personal effects combined with medical and dental findings. Different models for cooperation between the Primary ID-group, who were responsible for the final identification, and the ID-terms, who performed the examination of the bodies, were tested. It was concluded that the fastest and most reliable results were obtained when the ID-terms responsible for the examination of the bodies also took part in the reconciliation sessions.

Acute effects of cigarette smoking withdrawal : A review of the literature. Sommese T, Patterson JC. Aviat Space Environ Med 1995;66:164-7.

Smoking among commercial and military aviators is a health hazard in the cockpit. Pilot who are required to abstain before and during flight may suffer cockpit performance decrements. This study reviews the physiological, cognitive, behavioral, and psychological effects of smoking withdrawal as they relate to flying performance. The variety of research designs, methodologies, and subject groups is discussed. Findings suggest that heart rate, arousal, vasoconstriction, vigilance, concentration, and energy increase with nicotine use; stress and irritability are reduced with smoking. Withdrawal, on the other hand, produces a decrease in carboxyhemoglobin, digit recall, serial addition/ subtraction, and job satisfaction; blood pressure, depression, absenteeism, caloric intake, craving, aggressiveness, confusion, and impulsivity increase with withdrawal. Severity of withdrawal symptoms varied, but most studies report psy-

chological, and/or physiological responses to nicotine withdrawal. The conflict between health and performance is discussed and suggestions for future directions are offered.

Nathan Zuntz (1847-1920) - A German pioneer in High Altitude Physiology and Aviation Medicine, Part I : Biography. Gunga HC, Kirsch KA. Aviat Space Environ Med 1995;66:164-7.

Nathan Zuntz (1847-1920) was a key person in the history of high altitude physiology and aviation medicine. As a professor of animal physiology at the Landwirschaftliche Hochschule (Agricultural University) in Berlin form 1881 until 1918, he carried out laboratory studies on the changes in metabolism at rest and during exercise. To this end he, together with August Julius Geppert, developed the famous "Zuntz-Geppert's" schen Respirations-apparat"" (Zuntz-Geppert respiratory apparatus) in 1885. In the early 1890's, Zuntz extended his research to the field of high altitude physiology. In view of the variety of questions, and despite considerable methodological problems, Zuntz first studied the effects of lowered PO_2 on the human body in a Pneumatischen Kammer (hypobaric chamber). In 1983 the newly completed Capanna Regina Margehrita, an international research station at the top of Monte Rosa, Itla (4,500m), became the site of Zuntz's extensive field studies, where he worked together with his close co-worker Adolf Loewy (1862-1936), the Italian Angelo Mosso (1846-1910), and the Austrian Arnold During (1872-1961). For their investigations Zuntz invented the transportable Gasuhr (a gas exchange measuring device). In 1902 Zuntz and the Austrian Hermann von Schroetter (1870-1928) made two balloon ascents up to 5,000 m in Berlin. A synopsis of these studies was published by Zuntz in 1906: his famous book "Hohenklima and Bergwanderungen" (High altitude climate and mountain-touring). A few years later Zuntz undertook further expeditions to the Canary Islands (Pico de Teide), conducting studies in airships and planes until 1914. Zuntz retired in 1976 and died in Berlin on March, 22, 1920.

Nathan Zuntz (1847-1920) - A German pioneer in High Altitude Physiology and Aviation Medicine, Part II : Scientific Work. Gunga HC, Kirsch KA. Aviat Space Environ Med 1995;66:172-6.

For over 52 years, the work of Nathan Zuntz (1847-1920) covered an amazingly wide spectrum of research fields: metabolism, nutrition, respiration, blood gases, exercise, and high altitude physiology were the main themes. Zuntz achieved fame for his invention of the Zuntz-Geppert respiratory apparatus in 1886 and the first Laufband (treadmill) in 1889. To this experimental setup Zuntz later added an X-ray apparatus in 1914 to determine the changes in heart volume during exercise. Moreover, he constructed a climate chamber to study exercise under varying and sometimes extreme climates. For field studies Zunz invented a transportable Gusher (dry gas measuring device). Zuntz was the first to describe the difference between laboratory data gained in a hypobaric chamber and the measurements at high altitude. He found that the barometric formula is not applicable in the field. Two balloon expeditions in 1902 by Zuntz and his pupil, v. Schroetter, marked the step from terrestrial physiology towards aviation medicine. An outline of the development of scientific aviation in Berlin from 1880-1918 elucidates how closely the aviation union, army, and scientific departments were connected with and dependent upon each other. In cooperation with these institutions Zuntz and v. Schroetter constructed an oxygen supply system and planned a pressure cabin for extreme altitudes above 10,000 m, a forerunner of modern systems in aviation and astronautics. In 1912, Zuntz and v. Schroetter each published papers on aviation medicine, both publications internationally unique in style and extent. Zunt's work in its empirical approach was the counterpart to the established formal mathematical-physical reductionism of the German Physio-

logical Society. Outside of Germany, applied or integrative physiology was regarded as equally important as the so called basic physiology. Zuntz was one of the most productive authors of physiological works in the German-speaking countries. His scientific universality was matched by a decided accuracy to detail. His conviction that an integrative research approach is as necessary for a biological system as an analytical-mathematical one, his methodological strokes of genius and the extraordinary interpretation of his results may be considered as exemplary till today for working methods in applied physiology.

Use of personal characteristics in the selection of astronauts. Fogg LF, Rose RM. Aviat Space Environ Med 1995;66:199-205

Which personal characteristics are used in selecting astronauts? We decide to examine this question using National Aeronautics and Space Administration (NASA) archival data collected on 2288 applicants. Undergraduate grade point average, graduate grade point average, and several facets of aviation experience were the best predictors of who was interviewed and then selected to be an astronaut. Adjustments were made to insure that a sufficient number of women and minority group members were selected, while still maintaining high selection standards. The selection process seems well-designed, and follows explicit NASA guidelines. We suggest simplifying the selection process by using a single discriminant function as an interview and/or selection criterion.

A simple emergency underwater breathing aid for helicopter escape. Tipton MJ, Balmi PJ, Bramham E, Maddern TA, Elliott DH. Aviat Space Environ Med 1995;66:206-11.

Experiments were undertaken to determine whether a simple rebreathing system, termed "Air Pocket" (AP), could, when integrated into an immersion dry suit, extend the underwater survival time of individuals when compared with their maximum breath hold time (BHTmax). Eight healthy male subjects undertook a series of resting submersion and simulated simple helicopter underwater escapes in water at 25°C and 10°C. During the submersions the subjects breath-held maximally and then rebreathed using an otherwise empty AP. The BHTmax times of subjects and the total time they could remain underwater (RBT) were recorded. The results showed that the ability to rebreathe following a BHTmax extended the time all subjects could remain below. The average BHTmax during simulated helicopter underwater escapes in the cold water was 17.2 s. It is concluded that the ability of subjects to rebreathe immediately following maximum breath holding extends the time they can remain submerged in cold water to as much as 60 s. Further, if used unprimed, a simple rebreathing system will not introduce any additional dangers such as a pulmonary over-pressure accident.

Post-traumatic stress disorder in airplane cabin crew attendants. Marks M, Yule W, De Silva P. Aviat Space Environ Med 1995;66:264-8.

Six cabin crew attendants who survived an airplane crash in which 47 passengers were killed were assessed for post-traumatic stress disorder and other psychological problems. Each was interviewed 8 months after the crash and completed questionnaires measuring intrusive thoughts, avoidance, depressed mood, anxiety, and fear. Questionnaires were repeated 10 months later. All six met DSM-III-R criteria for post-traumatic stress disorder, reported a wide range of symptoms, and developed a fear of flying 8 months after the crash. Depression scores were normal 18 months after the crash, but all other measures remained unchanged, showing a continued high level of traumatic stress. Results point to the potential for crash survivors to develop chronic psychological problems. The highest levels of distress were reported by the three most senior members of

staff with the most responsibility on board, who had also suffered the most severe physical injury. Clinical implications of the result are discussed, and the need for predisaster training of cabin crew and postadisaster treatment is emphasized.

G-related musculoskeletal spine symptoms in Japan Air Self Defense Force F-15 pilots. Kikukawa A, Tachibana S, Yagura S. Aviat Space Environ Med 1995;66:269-72.

The introduction of the F-15 Eagle to the Japan Air Self Defense Force (JASDF) in the early 1980s seemed to increase musculo-skeletal problems of the spinal column among pilots. The neck is the body part most vulnerable to high-G force injuries, and serious cases of neck injury have been reported. we surveyed 129 F-15 pilots from different air bases by means of a questionnaire. The occurrence rate of musculoskeletal problems in different types of aircraft was analyzed according to the pilots' flying experience. Of the surveyed pilots, 115 (89.1%) reported muscle pains related to flying. Of those who experienced pain, each averaged 7.6 events, 95% of which occurred in the F-15. Of these 115, 30% experienced pain in the F-4 and 15% in the F-1. The "checking six" position was the most common posture at the time of injury, followed by "forward bend." Of the 115 pilots, 44 stated that their symptoms adversely affected flight duty performance, and 50 pilots stated that their symptoms adversely affected daily life. The effectiveness of muscle training as a preventive measures was supported by 62%. Some oriental therapeutic methods (acupuncture, moxa cautery, and finger pressure massage) were preferred by pilots for pain treatment. G-related problems of the spinal column still exist as a major medical concern in JASDF.

Patent foramen ovale and hypobaric decompression. Powell MR, Norfleet WT, Kumar KV, Butler BD. Aviat Space Environ Med 1995;66:273-5.

Gas microbubbles were detected in the left ventricle of a supine subject being screened for an atrial septal defect as a participant of a hypobaric decompression study. This determination was made using the saline echocontrast procedure. We found provocation by a Valsalva maneuver not to be necessary in this individual for right-to-left passage of contrast microbubbles into the left heart and middle cerebral artery. When this same individual underwent hypobaric decompression to a simulated altitude of 21,000 ft numerous gas microbubbles were detected in the right heart, but no gas bubbles were detected in either the left ventricular outflow tract or in the middle cerebral artery. This observation appears to be a novel finding, not previously reported.

Cardiovascular pressures with venous gas embolism and decompression. Butler BD, Robinson R, Sutton T, Kemper GB. Aviat Space Environ Med 1995;66:408-14.

Venous gas embolism (VGE) is reported with decompression to a decreased ambient pressure. With severe decompression, or in cases where an intracardiac septal defect (patent foramen ovale) exists, the venous bubbles can become arterialized and cause neurological decompression illness. Incidence rates of patent foramen ovale in the general population range from 25-34% and yet aviators, astronauts, and deep-sea divers who have decompression-induced venous bubbles do not demonstrate neurological symptoms at these high rates. This apparent disparity may be attributable to the normal pressure gradient across the atria of the heart that must be reversed for there to be flow patency. We evaluated the effects of: a) venous gas embolism (0.025, 0.05 and 0.15 ml. kg^{-1} for 180 min.); b) hyperbaric decompression; and c) hypobaric decompression on the pressure gradient across the left and right atria in anesthetized dogs with intact atrial septa. Left ventricular end-diastolic pressure was used as a measure of left atrial pressure. In a total of 92 experimental

evaluations in 22 dogs, there were no reported reversals in the mean pressure gradient across the atria; a total of 3 transient reversals occurred during the peak pressure gradient changes. The reasons that decompression-induced venous bubbles do not consistently cause serious symptoms of decompression illness may be that the amount of venous gas does not always cause sufficient pressure reversal across a patent foramen ovale to cause arterialization of the venous bubbles.

Graded exercise testing for space flight. Siconolfi SF, Lemoine SL. Aviat Space Environ Med 1995;66:408-14.

We developed and validated a graded exercise protocol suitable for operational use on space station. The new treadmill protocol has three level-grade states (3-min each) at 70, 80, and 90% of estimated $VO2_{peak}$. The protocol maintains the third stage speed while grade increases each minute to produce work rates equivalent to 100, 107, and 115% of the estimated $VO2_{peak}$. We compared the new protocol's peak and submaximal responses to those observed during a NASA graded exercise test. All mean protocol differences, including peak work rate (-1.8%), $VO2_{peak}$ (-6.4%), HR_{peak} (-2.4%), and VE_{peak} (-9.7%), were not significantly different from the expected measurement errors. We observed similar results for indices (the oxygen uptake at a HR of 150 and the HRs at 70, 80, and 90% of $VO2_{peak}$) of the submaximal HR-VO_2 relationship. The new protocol is an acceptable graded exercise test for periodic operational fitness tests.

A system for recording electrophysiological signals in flight. Le Menn M, Bigard X, Bouron F, Serra A. Aviat Space Environ Med 1995;66:443-8.

A special preamplifying system was designed to record electrophysiological signals on fighter aircrew in flight. The system is composed of two elements worn by the pilot in a specially designed jacket. The first element is a preamplifying device for ECG or EMG signals, which includes one or two accelerometer channels, according to the needs of the studies. All recorded signals may thus be correlated with the accelerations actually sustained by the pilot. Accelerometers are new generation equipment. Accelerometer and preamplifier performances have been measured and are reported. The recorder performance has been tested on a centrifuge under high acceleration. The results show that up to +10 G, no frequency shift and no change in the harmonic distortion between acceleration and resting stages have been measured. An example of surface EMG recording on two neck muscles during head movements under high-G loading in flight is given.

Diabetes mellitus in aircrew - Type I diabetes in a pilot. Gray GW, Dupre J. Aviat Space Environ Med 1995;66:449-52.

Diabetes mellitus has traditionally been considered disqualifying for flying duties. Increasingly, our understanding of both Type I and Type II diabetes permits identification of subgroups of diabetics with an acceptable aeromedical risk. A case is presented of a Canadian Forces pilot with Type I diabetes who continues on restricted flying duties. The pathophysiology of Type I and Type II diabetes is discussed, as well as aeromedical considerations for returning a diabetic to flying status. Within an envelope of defined geographic and operational flying limitations, diabetic aircrew may be safely and usefully returned to restricted flying duties.

Explanatory factors for the geographic distribution of US civil aviation mortality. Ungs TJ. Aviat Space Environ Med 1995;66:522-7.

Purpose: The purpose of this study was to ascertain important explanatory factors that account for the geographical distribution of morality.

Methods: National Center for Health Statistics sources were used to calculate state-specific, age-adjusted mortality rates. Fatalities studied were those attributed to select civil aviation-related causes (ICD-9 E-codes 840.2-6, 842.2-6) that occurred from 1979-89. State-specific information on a variety of selected variables was obtained form census, commerce, and Federal Aviation Administration (FAA) sources. Multiple linear regression techniques were used to assess the relationship between selected variables and state-specific mortality rates.

Results: There were 13,048 deaths for a US 11 year mean mortality rate of 4.9 deaths/1,000,000 general population. Mountainous state of the western US had the highest 11 year mean mortality rates (range 8.6- 79.6/1,000,000). Mid-Atlantic states had the lowest rates (range 1.6-2.9 deaths/1,000,000). Regression analysis identified pilot density (number of pilots per 1,000,000 general population), top elevation (highest point of land within state boundaries), and flight intensity (number of general aviation flight hours flown per pilot) as important factors in explaining 92% of state mortality differences.

Conclusion: Highest aviation-related mortality rates are found in states with expanses of mountainous terrain, and relatively high pilot densities and flight activity levels.

Relationship of diet to airsickness. Lindseth G, Lindseth PD. Aviat Space Environ Med 1995;66:537-41.

The descriptive, correlational study examined meal frequencies and dietary intakes as they related to airsickness in a population of novice civilian pilots. Food and nutrition intakes and dietary patterns of pilots prior to flight were measured for association with airsickness. A 24 h dietary recall was used in recording dietary intake and meal frequencies during a typical flight day. Correlation analysis was used to determine relationships between dietary intake and airsickness. Of the female pilots, 75% experienced airsickness; and 24 % of the male pilots experienced it. Female pilots' mean 24 h dietary intakes of vitamins A, C, and iron were low. The findings indicate eating high sodium foods ($r=0.33$, $p = 0.02$) such as preserved meats, corn chips and potato chips, and eating foods high in thiamin ($r = 0.35$, $p = 0.01$) like pork, beef, eggs or fish correlated significantly with increased airsickness. Consumption of foods high in protein such as milk products, cheeses and preserved meat by the males correlated significantly ($r=0.28$, $p = 0.05$) with increased airsickness. The frequency of meals eaten during the day also correlated with increased airsickness. Of the airsick pilots, 75% consumed three or more meals in the previous 24 h, as compared to 41% of the non-airsick pilots. Higher density foods (more kilocalories) also increased the airsickness occurrences of both the male and female pilots.

Characteristics of the venous hemodynamics of the leg under simulated weightlessness : Effects of physical exercise as countermeasure. Louisy F, Berry P, Marini JF, Guell A, Guezennec CY. Aviat Space Environ Med 1995;66:542-9.

In order to test the hypothesis that increase in calf venous distensibility in microgravity are partly due to the changes affecting the surroundings skeletal muscles (muscular atrophy), 12 healthy volunteers were exposed for 28 to microgravity simulated by -6° head-down bed rest. Half these subjects were exposed to countermeasures during bed rest: (a) repeated LBNP (Lower Body Negative Pressure) sequences starting on the 15th d with one 15 min sequence at -35mb, every other day from the 15th until the 21st d, and then every day until the end of bed rest; b) physical training including isotonic type exercise and isometric or isokinetic work by all muscle mass of upper and lower limbs (from the 8th until the 28th d). The other six subjects forming the control group were not subjected to any countermeasure. Calf venous

hemodynamics were determined by mercury strain gauge plethysmography with venous occlusion. Distensibility (V max) and venous emptying (venous outflow at the 6th s of emptying; VO2, half-emptying time: T 1/2, maximum venous outflow (MVO) could also be measured. Nuclear magnetic resonance (NMR) was used to study changes in volume of calf muscles. Plethysmographic measurements made for each subject prior to, during (once a week), and after bed rest show a parallel increase in calf venous distensibility in both groups of subjects until the 20th d of bed rest. Filling and emptying times then tended to stabilize in the group treated with countermeasures (group CM) whereas high venous distensibility was observed until the end of bed rest and 5 d thereafter in the control group (group C). A significant correlation was shown to exist between the increased venous distensibility and the decrease in calf muscle mass for both groups. This observation tends to confirm the role of the skeletal striated muscle in the control of distensibility of calf capacitance vessels and confirms the involvement of skeletal muscles in the increase of venous distensibility under conditions of prolonged exposure to simulated microgravity.

Spatial disorientation-implicated accidents in Canadian Forces, 1982-92. Cheung B, Money K, Wright H, Bateman W. Aviat Space Environ Med 1995;66:579-85.

In a recent survey of CF18 aircrew human factors, 44% of pilots reported experience with spatial disorientation (SD), of whom 10% had experienced more than 3 episodes. In order to investigate further, we have completed a retrospective study of SD-implicated category A accidents (where an aircraft is destroyed, declared missing, or damaged beyond economic repair) in the Canadian Forces (CF) during 1982-92. An overview of all SD occurrences (including accidents and incidents) across aircraft types is also presented. Information was gathered concerning the genesis and severity of disorientation so that research effort and pilot training could be appropriately implemented. Mishap investigation summaries involving category A accidents where SD was implicated were obtained from the CF Directorate of Flight Safety and reviewed. We also examined in detail the Board of Inquiry Reports of these accidents. The role of disorientation in these accidents was assessed. There were 62 category A accidents between 1982-92 and, in 14, SD had been assigned as a possible cause factor in the accidents records. When divided into the categories of Recognised SD (RSD), Unrecognised SD (USD), and Incapacitating SD (ISD), all but two fell into the category of USD (the pilots were unaware of the disorientation). Of the SD accidents, 11 involved a total loss of 24 lives. The majority of the accidents happened during the day, and pilots' cumulative flying experience did not appear to be a significant factor. According to our assessment, there were two episodes of vestibular origin, involving the somatogravic illusion. Three episodes of disorientation occurred over frozen lakes, one over glassy water, and one over ocean. Two accidents occurred during tactical training involving more than one aircraft. The causes of two accidents remain undetermined, with SD listed along with other possible causal factors. The suggestion follows that more research effort and pilot education and training should be placed on somatogravic illusion and visual limitations under adverse flying conditions, and pilots should be made more aware of these 14 accidents scenario.

The effect of varying time at -Gz on subsequent +Gz physiological tolerance (push-pull effect). Banks RD, Grisset JD, Saunders PL, Mateczun AJ. Aviat Space Environ Med 1995;66:723-7.

Previous studies have demonstrated decreased +Gz tolerance when preceded by +0 Gz or -Gz, referred to as the 'push-pull effect." The purpose of this experiment was to observe the effect of varying time duration at -Gz on the push-

pull effect. During single sessions, six subjects (three men, three women) were subjected to five relaxed exposures to +2.25 Gz on the NAMRL Coriolis Acceleration Platform (CAP). The first and last exposures were control runs that were preceded by +1 Gz. Each experimental run was preceded by -2 Gz for 2,5, or 15 s. Blood pressure (BP) was monitored using the Finapres at the level of the clavicle. Visual light loss was assessed at +2.25 Gz exposures were preceded by -2 Gz. Following 15 s of -2 Gz, mean BP decreased more and was slower to recover than for 2 and 5 s of -2 Gz. Reported incidents of visual light loss were: 1 following 2 s, 2 following 5 s, and 4 following 15 s at -2 Gz. There were no reports of visual light loss during control runs. During relaxed conditions, the push-pull effect is augmented by increasing duration of the preceding -Gz.

Factors affecting differences in supine, sitting, and standing heart rate : The Israeli CORDIS Study. Kristal-Boneh E, Harari G, Weinstein Y, Green MS. Aviat Space Environ Med 1995;66:775-5.

Measuring postural changes is among the simplest methods to elicit basic cardiovascular responses from patients who should not be subjected to treadmill stress testing. We attempted to clarify the individual factors that may affect these changes in resting heart rate (HR). In a cross-sectional study, 6016 employees in Israeli industries were screened during 1985-87 for cardiovascular disease risk factors (The CORDIS study). Measures of resting HR (supine, sitting, and standing) were obtained from 5428 subjects. The association between the HR differences for different postures and age, sex, height, body mass index, blood pressure level, health related habits, environmental temperature, and time of the day was analyzed.

The difference among women than men (12.7 vs. 11.6%, $p<0.03$). It was independently positively associated with height ($p < 0.0001$), cigarette smoking ($p < 0.0001$), and coffee drinking ($p < 0.0001$), and inversely associated with age ($p < 0.0002$), blood pressure level ($p < 0.0005$), and physical activity at work ($p < 0.0001$).

The inter-individual variability in HR response to different postures is partially explained by individual variables such as age, sex, height, blood pressure level, and health related habits.

Comparison of airline passenger oxygen system. Byrne NJ. Aviat Space Environ Med 1995;66:780-3.

The principal sources of oxygen for inflight passenger use, scheduled and unscheduled, are examined. Present practices of assessment of the passenger's "fitness to fly" are described. Three partner airlines, British Airways, US Air, and Qantas, catering for more than 8000 oxygen requests annually, are compared. Analysis of customer use suggests that medical oxygen requests are frequently not clinically justified. The growth in demand, for both scheduled and unscheduled use of an expensive resource, supports the need for a "recommended best practice" among carriers. Passengers with respiratory disorders who will most benefit from inflight oxygen are vulnerable either to hypoxia or asthma.

Inadequacy of visual alarms in helicopter air medical transport. Fromm RE Jr, Campbell E, Schlieter P. Aviat Space Environ Med 1995;66:784-6.

Air medical programs use medical equipment primarily designed for hospital and/or ground transport settings. Many of these medical devices are equipped with auditory alarms of malfunction or deteriorating clinical status. The high ambient noise requires visual scanning of medical devices to detect alarm conditions in the helicopter cabin.

Purpose : To evaluate the adequacy of visual scanning for alarm conditions in the helicopter air medical environment.

Methods : The helicopter transport program used in this study is staffed with two medical

crew members. Flight nurse response time (RT) to a visual alarm was assessed during 25 air medical patient flights. RT was measure during a battery powered dual timer device with a red LED visual alarm placed in a fixed position among the medical instruments. The devise was activated at a random time point unknown to the medical crew during each patient flight. RT was defined as the elapsed time from activation of the alarm until it was physically switched off by the flight nurse.

Results : RT was surprisingly lengthy population with a mean RT of 81.2 ± 78.4 s (95% CI 48.8-113.5 s). The variability of RT was also surprising ranging from 3 s to >5 min.

Conclusion : RT to visual alarms in the air medical environment is lengthy and quite variable. Recognition of malfunction of medical equipment or early signs of clinical instability prior to clinical deterioration cannot be assured by visual scanning for alarm conditions. Alternative alarming systems should be considered and investigated for air medical transport.

Ultrashort microwave signals : A didactic discussion. Adair RK. Aviat Space Environ Med 1995;66:792-4.

As a consequence of the variation with frequency of the attenuation and phase velocity of electromagnetic waves in tissue, the shape (variation of the electric field with time) of short electromagnetic pulses incident on tissue changes with depth of penetration. We show that a conjecture that such well-known and long understood changes in pulse shape may generate harmful biological effects is not credible. We also consider the suggestion that such pulses may be useful in medical imaging and the mapping of the electrical properties of complex tissues and show that such use is impracticably difficult for fundamental reasons.

Cardiovascular effects of varying G-suit pressure and coverage during +1 Gz positive pressure breathing. Goodman LS, De Yang, Kelso B, Liu P. Aviat Space Environ Med 1995;66:829-36.

With the continued evolution of anti-G suits, used to counter the cardiovascular dysfunction arising from +1 Gz hypoxia protection positive pressure breathing (PPB), it was hypothesised that full-coverage anti-G suits would offer equal protection while using lower inflation pressures than the traditional 4:1 ratio. Nine experienced subjects were exposed to 2 min of 70 mm Hg PPB while wearing either the COMBAT EDGE (CE) and Tactical Life Support System (TLSS) garments with the G-suit inflated to 4 x breathing pressure, and the Advanced Tactical Anti-G Suit (ATAGS) at 4, 3, 2 and 1 x the breathing pressure. All subjects were measured with impedance cardiography (IC), and six were measured simultaneously with both IC and the Cardioscint^{TM} nuclear probe. IC-estimated stroke volume, relative left ventricular (LV) end-diastolic volume, LV ejection fraction, and peak filling rate were depressed most in the CE and ATAGS1 conditions ($p<0.001$). Heart rate and mean arterial blood pressure changes were highest and lowest, respectively, using the CE and ATAGS 1 garments ($p<0.0001$). There were no differences in these variables between the TLSS and ATAGS 2-4 conditions. Thus, protection against the PPB-induced fall in LV preload and cardiovascular function may still be adequately afforded by lower G-suit inflation when using full-coverage anti-G suits during PPB intended for high altitude-protection.

Cockpit-cabin crew interaction : Satisfaction with communication and Information exchange. Skogstad A, Dyregrov A, Hellesoy OH. Aviat Space Environ Med 1995;66:841-8.

There were 1240 members of flight deck crews (F/D) and cabins crews (C/C) in SAS Norway who responded to a questionnaire that included issues related to communication between crews. The response rate was 84%. Possi-

ble differences between F/D and male female C/C concerning evaluations of information exchange and communication between crews were examined. A multifaceted questionnaire containing 250 questions concerning organizational and psychological issues, safety questions, and subjective health was employed. Regression analysis were applied to examine predictors of satisfaction with information and communication. One half of aircrew members were dissatisfied with information exchange and cooperation between the cockpit and the cabin in general. About 70% were dissatisfied with interaction related to debriefing and stop. Differences between F/D and C/C were significant concerning debriefing. Cabin crews, and especially females, reported being inadequately informed about specific operational procedures and technical matters. Nine of ten female C/C wanted better information about technical aspects of the airplane or flying. Pilots reported inadequate information about how emergency procedures influence C/C and passengers. Between 72% and 94% were satisfied with interpersonal relationships, while 53% expressed satisfaction with supervision and social support. A majority (86%) confirmed that frequent changes between crews were stressful. Regressional analyses yielded significant relationships between frequencies of meetings, supervision and support issues, and scheduling schemes and satisfaction with information exchange and cooperation. Results suggest a strong need to provide more open, continuous and effective communication between the cockpit and the cabin. Several practical suggestions for improvements are discussed.

Comparison of heart rate and arterial pressure spectra during head up tilt and a matched level of LBNP. Patwardhan AR, Evans JM, Berk M, Knapp CF. Aviat Space Environ Med 1995; 66:841-8.

Lower Body Negative Pressure (LBNP) can be used to stimulate cardiovascular regulation by including blood shifts similar to those produced during head up tilt (HUT). It is unclear, however, whether similar blood shifts produced by these two stresses evoke similar cardiovascular regulatory responses. Hence, we compared the autonomic components of cardiovascular responses to 50° HUT and a matched level of LBNP. A level of LBNP that produced changes in calf circumference similar to those produced during the first 3 min of 50° HUT was considered to be a matched level. Autonomic components of cardiovascular responses were determined by spectral analysis of heart rate and blood pressure. Results from nine subjects showed that in terms of changes in calf circumference at the end of 3 min, 50° HUT and 48 mm Hg LBNP were similar (2.13% and 1.94%). During 20-min exposures to HUT and LBNP, while blood pressure increases were similar. For heart rate and blood pressure spectra, power in the respiratory frequency region (0.25 Hz) increased and a matched level of LBNP evoked similar autonomic responses in cardiovascular regulation, with the autonomic balance shifted towards increased sympathetic and decreased parasympathetic influence.

Critical incident stress intervention following fatal aircraft mishaps. Cigrang JA, Pace JV, Yasuhara TT. Aviat Space Environ Med 1995;66:880-2.

This article offers guidelines of conducting preventive mental health interventions using a Critical Incident Stress Debriefing (CISD) model with Air Force and other aviation communities that have experienced a fatal aircraft mishap. The guidelines are based on the authors' experiences in providing assistance to several hundred active duty military personal and their families following two separate mishaps. The article outlines the basics of the CISD model, briefly describes the two mishaps, and then discusses the lessons learned.

The feasibility of collecting in-flight EEG data from helicopter pilots. Cald-

well JA Jr, Lewis JA. Aviat Space Environ Med 1995;66:883-9.

An assessment of whether valid EEG data could be collected on helicopter pilots in flight was conducted. each subject provided eyes-en/eyes-closed EEG in the laboratory and in a helicopter. During flights, EEGs were monitored on the ground in real-time via radio telemetry. Analyses were conducted on the data recorded from Fz, Cz, Pz, P3, P4, O1, and O2 from eight subjects. Delta activity at one recording site (Fz) was higher in the aircraft than in the laboratory probably because of increased eye movements. Both theta and alpha activity at several sites also were increased in the aircraft, and alpha activity at several sites showed the expected augmentation from eyes-open to eyes-closed; however, there were no interactions indicative of problems detecting normal alpha changes due to eye closure in the aircraft. Beta activity recorded from Cz and O1 was elevated during flight testing, but it was concluded that O1 was elevated during flight testing, but it was more active environment. While there were more recording artifacts in the helicopter than in the laboratory, the overall results show it is possible to telemeter EEG from helicopter pilots in flight. Follow-on studies are needed to assess whether recording can be obtained while pilots are performing flight-related tasks.

The respiratory system in a cold environment. Giesbrecht GG. Aviat Space Environ Med 1995;66:890-902.

Acute or chronic cold exposure elicits several effects on the respiratory system. Pulmonary mechanics are compromised by bronchoconstriction, airway congestion, secretion and decreased mucociliary clearance. These responses are active in cold- or exercise-induced asthma, and are possibly responsible for decreased immune function and protection against airborne pollutants. The primary ventilatory effect of cold air is to decrease baseline ventilation and respiratory chemosensitivity. Although these responses provide significant protection against heat loss in many animals, the effect in humans is minimal. Cold exposure also elicits an increase in pulmonary vascular resistance. This stimulus is synergistic with hypoxia and may mediate pulmonary hypertension and edema at altitude. Chronic exposure to cold environments result in morphological changes such as increased numbers of goblet cells and mucous glands, hypertrophy of airway muscular fascicles and increased muscle layers of terminal arteries and arterioles. These latter two factors may play a role in the symptoms of chronic obstructive pulmonary disease and bronchitis, high altitude pulmonary hypertension and edema, and right heart hypertrophy.