
INTRODUCTION. Studies were conducted on a static copper model of the foot, which is sectioned into twenty-nine heat transfer regions. This foot model is used to determine the dry insulation properties of commercial and prototype cold weather combat boot systems (CWCS). The heat flux through the boot sole is an important criterion in selecting CWCS. The insulation of air (I), between the foot and the boot sole is the key variable in the amount of heat flux through the sole. I, which incorporates both the radiative heat transfer (I), and the convective heat transfer (I), coefficients, is reduced as the boot sole is compressed, thus increasing the heat flux through the sole. The heat flux from the boot sole may be due to convective heat transfer in the dry environment conditions, and the wet, compression test method to (simulate standing in cold, wet environmental conditions) and a wet compression test method (to simulate standing in cold, wet environmental conditions) the test methods: a free suspension (FS) control test, a cold/dry environmental test, and a wet compression test method (to simulate standing in cold, wet environmental conditions). METHODS. Eight CWCSs were evaluated on the model foot according to three test methods: a free suspension (FS) control test, a cold/dry environmental test, and a cold/dry environmental test (CWC test). Across all test conditions, the temperature was kept at 30°C. For the CWC test, 5 °C; 50% RH with and without cooling for 90 min. Heart rate, blood pressure, and skin and rectal temperatures were monitored before and during heat exposure. Additionally, sweat rate and subjective thermal sensations were recorded in the heat. Subjects performed 30 min of continuous submaximal work on a cycle ergometer (50 W for 10 min, 100 W for 10 min, 150 W for 10 min). Oxygen consumption, metabolic rate, and rate of perceived exertion were determined during exercise in the heat. Venous blood samples were drawn before and after each test. RESULTS. Body systems effectively reduced the heat strain with the shirt-type system providing the greatest benefit in physiological and subjective response both at rest and during exercise. Thermal sensation ratings were cooler with the shirt. The decrease in serum concentration of lead shot were interposed through the boot sole of approximately 25 min of fire fighting. However, the magnitude and rate of the just described for these trials were terminated for heat stress. Trials were net statistically significant (p>.05). End of test temperatures in the adjoining fire fighting compartment ranged from 40-100°C.

RESULTS. As expected, significant (p<0.05) heat strain occurred during approximately 25 min of fire fighting. However, the magnitude and rate of the just described for these trials were terminated for heat stress. Trials were net statistically significant (p>.05). End of test temperatures in the adjoining fire fighting compartment ranged from 40-100°C.


INTRODUCTION. Effective thermoregulation during heat exposure is partially dependent on maintenance of plasma volume (PV). Navy engineer personnel, who typically work 4-6 hour shifts in thermal environments exceeding 32°C, are constantly subjected to heat strain. This study investigated the effects of a microclimate cooling on PV conservation during exercise in the heat following a baseline acclimation (AC) protocol. METHODS. Eight engineer personnel underwent an 8-day acclimation protocol (35°C, 70% RH) followed by 6 simulated enginework sessions. Two weeks later, two sessions of 120 min were performed on a passive ice vest (IV), were performed in three thermal conditions: EW1=43.3°C, 60% RH; EW2=50.6°C, 30% RH; EW3=57.2°C, 24% RH. During AC, a 2-hr exercise protocol (exercise 25-min, rest 5-min) alternated treadmill walking with stationary cycling. The EW protocol consisted of a 20-min treadmill walk (3 min, 34°C, 25% RH) and 40-min of seated rest each hour to a maximum duration of 6 hrs or volitional withdrawal. PV changes were determined from seated (20-min) blood samples obtained prior to entering and exiting the heat chamber. RESULTS. PV changes (%) across day-1, day-3, day-5 and day-8 (p<1.3, 1.7 and 0.6 respectively) of AC showed a trend towards conservation but were not statistically significant (p>.05). None of the PV changes showed a trend towards conservation but were not statistically significant (p>.05). End of trial PV changes (day-8) were 0.7% and 0.9% for IV and EW2, respectively. CONCLUSION. PV was conserved during trials and was less in the four IV conditions for EW1 and EW2. EW3 PV findings may be the result of a considerably lower IV test duration in combination with the high heat. When expressed relatively to test duration IV losses were twice those in the IV exposure. These results suggest that heat acclimation will conserve PV and microclimate cooling can provide continued support of PV conservation during exposure to high heat.


INTRODUCTION. Rescue of the astronaut flight crew from a contingency landing may risk exposure of the rescue crew to toxic propellants spilling from potentially ruptured equipment. The purpose of this project was to evaluate the cooling performance of five commercially available personal cooling systems during heat exposure. The five systems included one ice vest, two liquid cooling vests (one with a hood), and a whole-body liquid cooling suit with hood configured two ways (as a portable system and as a tethered system). Acquired data has been in service by the rescue team to preclude exposure, especially in the water rescue scenario. Heat stress has become a factor of concern in recent years when older and less-physically fit team members work in this suit. METHODS. Five CWCSs were evaluated using a test protocol. The high as indicated by average rectal temperatures (Trev) of 38.28°C (100.9°F) after the 45 min protocol. Slopes of the regression equations describing the increase in Trev with time were greater (P<0.05) with a 0.073 _+ 0.008) compared to the 0.073 _+ 0.006) for hypothermia. One in the normal (N) configuration and one with a chest cooler (C). Results: These temperatures were determined from the sensors located on the chest, arm, and back. Air temperature was set at 32°C and 100% RH. Average heat rate was higher (P<0.05) in N (33.33 _+ 1.15°C) compared to C (35.34 _+ 6.67°C) when the skin temperatures were monitored for the duration of fire fighting (n=4 per day). Each subject wore the standard Navy fire fighting ensemble (fire retardant suit, gloves, boots, flash hood, helmet and breathing apparatus). Peak fire temperatures reached 600°C, while temperatures in the adjoining fire fighting compartment ranged from 40-100°C.

CONCLUSION. The CWC test method would be more responsive than either the FS or the CWC test method, but it was not. Further studies are needed to develop more quantitative methods for evaluation of I, as a means of discriminating between CWCS.
INTRODUCTION. Operational demands placed on naval aviators during sustained or continuous operations continue to be an area of intense laboratory research. The recent Gulf War provided a unique opportunity to collect data examining aircrew work/rest cycles and operational tasking in a combat environment.

METHODOLOGY. For four consecutive weeks during Operations Desert Shield and Desert Storm, nine A-6 and nine F-14 pilots onboard the USS America (CV-60) provided detailed daily activity data while conducting operations from the Red Sea. The pilots completed daily work/rest logs to a resolution of one-half hour. In addition, flight data was obtained including 1) takeoff and landing time, 2) flight duration, 3) mission type, 4) consecutive days, and 5) landing signal officer (LSO) scores, 6) arresting wire engaged on landing, and 7) subjective reports of the need for nap time before an air-to-ground strike mission could be flown (a measure of subjective readiness).

RESULTS. Data analysis indicated that the amount of sleep obtained varied from 6, 12, 18, and 24 hours prior to a combat mission may influence LSO scores and subjective readiness. Mission type, the number of consecutive days in which a flight occurred, time of day, and flight duration also were related to LSO scores and subjective readiness.

CONCLUSIONS. These data provide valuable information for air wing commanders and senior mission planners when tasking carrier-based aviators. These data also provide an essential database for aircrew and air wing flight surgeons to draw upon when assessing aircrew readiness.
AN INVESTIGATION OF MIDDLE CEREBRAL ARTERY BLOOD FLOW VELOCITY AND ARTERIAL OXYGEN SATURATION UNDER SUSTAINED POSITIVE +Gz. S.L. Johnson*, D.L. Triggs*, and D.W. Repperger*, Department of Aerospace Medicine, Wright State University, Dayton, Ohio 45401.

INTRODUCTION: The purpose of this study is to evaluate and compare the physiologic parameters of middle cerebral artery blood flow and eye level oxygen saturation with peripheral light loss in sustained +Gz gravitational forces. METHODS: This experiment was conducted with the Dynamic Environment Simulator (DES) in Wright Patterson Air Force Base. Seven subjects, three women and four men, were tested in the advanced prototype retrograde inflation anti-G suit (RIAS) and standard CSU 3BP anti-G suit. The subjects were instrumented with an Edan Medical tonometer and a CardioVersus 7000 monitoring system (Texas Medical Center, Inc.) in Nelcor pulse oximeters. The middle cerebral artery blood flow velocity and eye level oxygen saturation were monitored continuously and blood lactates sampled periodically during +Gz testing. +Gz-endurance time, (SACM) until fatigued, light loss criteria were reached, or protocol/medical reasons required subjects to stop the +Gz exposure. CONCLUSIONS: In sustained +Gz the pulmonary system (due to ventilation-perfusion mismatch and shunting) may be the limiting physiologic parameter in pre-GLOC, with the percent oxygen saturation of the blood reaching the cerebral circulation being a critical factor. Therefore, maintaining adequate blood flow to the cerebral circulation alone is not sufficient for developing countermeasures to optimize G-tolerance and preventing and/or improving G-induced visual loss during combat maneuvers.

ABSTRACT OF A PHYSIOLOGICAL MODEL OF G STRESS IN THE OPHTHALMIC ARTERY PRESSURE. A. Gonzales and F. Rios*. Biophysics and Bioengineering Lab, Faculty of Medicine, University of Buenos Aires and SAF Aeromedical Center (C.I.M.A.), Arturo Soria 82, 28027 Madrid, SPAIN.

INTRODUCTION: The purpose of this work is to provide a computational tool to assess the tolerance for +Gz acceleration using a digital simulation model, including the visual effects induced by the caudalward shifting of blood volume. A parametric model of the cardiocirculatory system is developed to predict the effects of high Gz acceleration (HSA) in the ophthalmic circulation (OPC). The computer model used was designed to test the model's efficiency in simulating the HSA in the cranio-caudal direction by a computer model constituted a practical way to optimize the HSA in a lab. RESULTS: Tolerance to positive acceleration in a cranio-caudal direction by a computer model constitutes a practical way to optimize the HSA in a lab.


INTRODUCTION: While available information suggests the metabolic basis for tolerance to high sustained G (HSG) is primarily anaerobic capacity and the ability of the body to use that capacity, little is known about the role of aerobic metabolism and its influence on +Gz-duration time. Understanding that role is necessary to determine the importance of supplemental oxygen for operational use. METHODS: Utilizing the Armstrong Laboratory (Brooks AFB) Centrifuge, 8 human subjects were exposed to +Gz's from 4 to 7 Gz. (300+50 Gz's from 4 to 7 Gz) to determine the effects of oxygen availability on +Gz tolerance. RESULTS: O2 flow and lactate levels were monitored continuously and blood lactates sampled periodically during the centrifuge exposures. A positive relationship between anaerobic times and inspired oxygen (FiO2) was detected in subjects breathing 12% to 20% O2 gas mixtures; no change in duration time was detected between the 20% and 60% O2 flow rates. Although fatigue and light loss were the end points of interest, only about 50% of the +Gz runs were terminated on those reasons. Heart rate was negatively related and SaO2 positively related to FiO2. SACM resulted in increased heart rates but decreased SaO2; these SACM effects were additive to effects of high Gz. A positive relationship was observed for +Gz duration time. CONCLUSION: Whereas +Gz-duration time is limited by reduced SaO2, it may not be enhanced by hyperoxia.


INTRODUCTION: While it is generally accepted that +Gz-duration tolerance is primarily an anaerobic activity, the degree of aerobic involvement has not been successfully quantified. On the other hand, the static Anaerobic Task (SAT) exercise task directly related to a simulated aerial combat maneuver (SACM) contribute profile has been shown to be used in military and athletic environments. The purpose of this study was to compare the physiological response to SATS with that of the SACM. METHODS: Following SATS and SACM training, subjects (N=7) performed either SATS or SACM while exposed, in random order and with 45 min between tests, to either hyperoxia (60% inspired oxygen (FiO2)), normoxic (21% O2) or hypoxic (12% O2). Heart rate and blood oxygen saturation (SaO2) were recorded continuously. Blood was sampled via fingerprick for lactate determinations pre- and post-SATS, post-SACM, post-SACM. RESULTS: The level of inspired oxygen was directly related to the degree of heart rate during SACM, but showed no relationship with maximum heart rate during SATS. Blood lactate level at 3 min post-SACM was related to post-SACM blood lactate level. CONCLUSION: The increased SACM endurance time and the lower HR in the forward lean position demonstrate that subjects using forward leaning have greater G tolerance than when in the full upright posture.

INTRODUCTION. CRAF-AESS utilizes civilian airframes to transport DS patients in contingencies when military airlift assets are required for other operations. In March 1991, a commercial Boeing 767-300 was configured with 111 litter beds and 118 ambulatory seats and flew test flights with 96 simulated patients and test personnel onboard. The operational test was conducted to determine the effectiveness and capability of the system and to collect the data necessary to make the final production decisions.

METHODS. Development of CRAF-AESS was a five year project. Two flight tests were performed using AECMs from operational active duty and Air Reserve Component (ARC) units to test nine critical operational issues identified by the USASAF Airlift Center (USASAFCENT). RESULTS. The test demonstrated that AECMs can use the B-767 CRAF-AESS successfully and provide safe in-flight care to a large number of patients. However, AECM expressed concern that training prior to the flight would have increased their confidence and ability to perform with greater efficiency on the B-767.

CONCLUSION. The Boeing 767 CRAF-AESS provides the capability to reduce dependence on the C-17A, C-141B and other USAF aircraft. CRAF-AESS provides safe and expedient movement of patients in a contingency environment. Proper training of AECMs will assure minimal transition time from military to civilian airframes.

---


INTRODUCTION. The aeromedical evacuation system has a large inventory of medical equipment items for use on aeromedical aircraft. The items are designed to be secured to the NATO litter pole, but will not normally be secured to the litter pole out on the aircraft. Aeromedical Research personnel have designed four separate devices to safely secure some of the medical equipment items within the aircraft. These devices were conceived and designed by aeromedical personnel, and constructed by the Brooks AFB Fabrication Shop. Test procedures were developed that covered safety, function, and feasibility factors. Function was verified by vibration testing, form and fit on aeromedical aircraft mockups, and airborne feasibility evaluations. RESULTS. The Aeromedical Equipment Pole and the Waters Bracket were effective and safe devices for securing several aeromedical equipment items, including the Biohcm 1040A pulse oximeter, MTP 100a infusion pump, and the MiniOX III oxygen monitor. The Waters Shelf was effective for securing the same items; also the Impact 300M portable aspirator, the Propaq 106 vital signs monitor, and the NeLab N-100 pulse oximeter. The Horton Bracket was effective for securing the IMED 928 infusion pump, the MiniOX III oxygen monitor, and the Baby Bird infant ventilator. CONCLUSIONS. All four devices, which at present require local production, are safe and effective devices for securing aeromedical evacuation equipment aboard the C-9, C-130, and C-141 aircraft.
CARDIO-VASCULAR COMPENSATION IN A COMPLEX +Gz ENVIRONMENT.

N. Neblett, J.P. Cammarota*, J.E. Whitten*, USNA, Annapolis, MD, ACME LABS, Naval Air Development Center, Warminster, PA, 18974-5000.

INTRODUCTION. The body of knowledge that is available to evaluate human tolerance to +Gz was developed through experiments on human centrifuges using simple acceleration profiles. These data are not sufficient to predict the effects of complex +Gz time histories such as encountered during actual combat maneuvers. In order to gain some insight into the physiologic effects of the more dynamic acceleration environment, complex centrifuge open-loop testing profiles were developed. METHODS. Three compound +Gz profiles were developed that included combinations of rapid (ROR) and gradual (GOR) onset rate profiles. These profiles were designed to give the subject a "G preload" immediately prior to the more traditional GOR or ROR centrifuge exposures. Plateau levels were changeable in increments of 0.25Gz. The endpoint for the acceleration exposure was 60" or greater peripheral light loss sustained for three seconds, or 100% central light loss (Blackout). The subjects were in an upright seat, did not wear an anti-G suit, and did not perform an anti-G maneuver. The study involved 21 volunteer subjects who completed over 900 exposures (most exposures went to a light loss endpoint). RESULTS. The ROR preload had little effect on the G level tolerance to the GOR. The time to lightloss on the ROR to plateau segment was dependent on the level of the GOR preload segment. A moderate preload with respect to the ROC preload level increased the time to lightloss as compared to low and high preload levels. Preload +Gz levels that varied by as little as 0.25Gz had different effects on the human response to the ROR segment. CONCLUSIONS. The profiles developed, while not nearly as dynamic as an ACM environment, reveal insights into the physiologic response to acceleration stress in a way not possible with simple ROR or GOR profiles.

INDICATIONS OF DIFFERENCES IN NEUROLOGIC TOLERANCE IN A COMPLEX +Gz ENVIRONMENT. J.P. Cammarota*, N. Neblett, J.E. Whitten*, ACME LABS, NADC, Warminster PA, USA, Annapolis, MD & National Guard Bureau, Andrews AFB, MD.

INTRODUCTION. A body of knowledge that is available to evaluate human tolerance to +Gz was developed through experiments on human centrifuges using simple acceleration profiles. These data are not sufficient to predict the effects of complex +Gz time histories such as encountered during actual combat maneuvers. In order to gain some insight into the physiologic effects of the more dynamic acceleration environment, complex centrifuge open-loop testing profiles were developed. METHODS. Three compound +Gz profiles were developed that included combinations of rapid (ROR) and gradual (GOR) onset rate profiles. These profiles were designed to give the subject a "G preload" immediately prior to the more traditional GOR or ROR centrifuge exposures. Plateau levels were changeable in increments of 0.25Gz. The endpoint for the acceleration exposure was 60" or greater peripheral light loss (PLL) sustained for three seconds, or 100% central light loss (Blackout). The subjects were in an upright seat, did not wear an anti-G suit, and did not perform an anti-G maneuver. The study involved 21 volunteer subjects who completed over 900 exposures (most exposures went to a light loss endpoint). RESULTS. The preload +Gz had little effect on the G level tolerance to the GOR. The time to lightloss on the ROR to plateau segment was dependent on the level of the GOR preload segment. A moderate preload with respect to the ROC preload level increased the time to lightloss as compared to low and high preload levels. Preload +Gz levels that varied by as little as 0.25Gz had different effects on the human response to the ROR segment. CONCLUSIONS. The profiles developed, while not nearly as dynamic as an ACM environment, reveal insights into the physiologic response to acceleration stress in a way not possible with simple ROR or GOR profiles.


INTRODUCTION. The G-tolerance augmenting effect of weight-lifting training on human in the Gz stress was well documented. This study is to demonstrate muscle strength co ordination training (MSCT) can significantly enhance the effect of Gz. The volunteer subjects were divided into three groups: p = 37 pilots underwent MSCT and WCT, p = 37 pilots underwent Gz exposure, p = 37 pilots underwent Gz exposure and anti-G maneuvers (Gz). The training group was designed to be representative of the each group. The final effect was evaluated on the human centrifuge. RESULTS. The G tolerance of p, during making muscle strength alone among the three groups, as compared with the quiet condition was increased on 94. 2. ± 7. 2. 71. 0. 9. 5, 0. 1. 4. 3. 0. 4. 1. 4. 3. 2. 7. 0. 1. 1 ± 0. 5. 6 (p < 0. 05). The value of p, during making anti-G maneuver, as compared with the quiet condition was increased on 94. 2. ± 7. 2. 71. 0. 9. 5, 0. 1. 4. 3. 0. 4. 1. 4. 3. 2. 7. 0. 1. 1 ± 0. 5. 6 (p < 0. 05). These results were confirmed by centrifuge runs: the G-tolerance with the subject of p, maneuver, but without Gz exposure, the pilots of Ex group p, passed 9. 0 G, 10. 0 G. No significant difference was found between them. CONCLUSION. The WCT can bring a 2 ± G G tolerance by that of Gz alone. The WCT must be taken for enhancing the G-tolerance of pilots-especial on high performance aircraft.

EVALUATION OF ADVANCED LIFE SUPPORT SUIT CONCEPTS FOR G PROTECTION. F. E. Whiteley, Aerial Combat Maneuvering Enhancement Laboratory, Naval Academy, Warminster, PA 18974-9000.

INTRODUCTION. As part of the Advanced Integrated Life Support System Program, thirteen concepts for a life support system were evaluated on the centrifuge for G protection. All systems incorporated pressure breathing for G (PB) and varying degrees of body coverage. METHODS. Seven experienced subjects who completed over 600 runs with and without anti-G G-straining maneuver. The PB duration was 30 seconds and maximum G level was 46. A 20 second, 60" of peripheral vision loss plus an 80" time duration less than 15 seconds was used as the criterion for G tolerance. The lowest mean non-travelling strain to current G-suits was 5.7 G while increased to 10.0 G for the test subjects. The experimentally approached 8.0 G. RESULTS. The lowest mean non-travelling strain to current G-suits was 5.7 G while increased to 10.0 G for the test subjects. The experimentally approached 8.0 G. A utility curve for increased body coverage was achieved. Many runs were prematurely stopped due to pain in concepts without arm coverage. Coverage of the arms, hands, and feet did not significantly increase visual tolerance but enhanced tolerance to pain in concepts which included arm mobility and comfort. Two subjects suffered lower rib injuries attributed to the abdominal bladder coverage. CONCLUSIONS. Coverage approaching the full suit is not required for maximum non-travelling G tolerance. The ideal lower body coverage has been determined. Compatible arm pain relief is required and is being pursued. Rib injury is possible with expanded abdominal bladder coverage.

PREVALENCE OF OVER EXERTION DURING SUBMAXIMAL EXERCISE TESTS USING 85% OF AGE-PREDICTED MAXIMAL HEART RATE. L. Naatzger*, L. Kaminsky, M1. Whaley, GB Dwyer, SC Glass, & LH Getchell Ball State University, Muncie, IN

INTRODUCTION. The 4th edition of the Guidelines for Exercise Testing and Prescription supports increased use of submaximal exercise testing to assess physical fitness (and to predict maximal exercise capacity). Severe exercise overexertion (i.e., to the point of actual relative effort, the purpose of this investigation was to assess the likelihood of near maximal heart rate (hrmax) at (95% and 99% of actual relative effort). We investigated the following: the relationship of near maximal heart rate (hrmax) and 95% and 99% of actual relative effort. The data for this investigation were collected on 60 male college students and 736 women (41 ± 11 yr) who participated in an adult exercise program. All subjects were not required to have any previous experience to the test, 20% of the test subjects passed 9.0 G, 10.0 G, and 11 G. Each test was included on an ECG tracing. RESULTS. Using 85% of hrmax, the prevalence of overexertion for younger and older age groups (ACSM Guidelines classification) were as follows:

<table>
<thead>
<tr>
<th>Group</th>
<th>% of Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men (≥60 yr) n=584</td>
<td>80 ± 13.7%</td>
</tr>
<tr>
<td>Women (≥60 yr) n=623</td>
<td>83 ± 13.6%</td>
</tr>
<tr>
<td>Men ≤60 yr n=579</td>
<td>23 ± 5.7%</td>
</tr>
<tr>
<td>Women ≤60 yr n=517</td>
<td>26 ± 16.6%</td>
</tr>
</tbody>
</table>

CONCLUSION. These data show that between 2-7.1% of exercise tests using the 85% of hrmax criteria may actually be near maximal efforts. This implies a safety concern due to limited monitoring. This suggests the need for identification of factors predictive of those whose true hrmax is significantly less than pHRmax.
STATE OF THE COMMAND. P.M. Moss, 9, 53rd AFS, O'Hara, ARFF, IL 60666

Within the past year changes have occurred in the Air Force at all levels which will impact the future of nursing. Desert Storm focused attention on the abilities of military nurses and serves as a model for future military conflicts. It highlighted the accomplishments and shortcomings of Air Force nursing in all patient care areas. In the future, nurses will be required to care for patients with injuries as well as those who have been injured. This panel will discuss the changes required to meet future needs and conflicts and how these changes will affect Air Force Nursing.

PILOTS SELECTION: BEHAVIORAL MEASURES AS PREDICTIVE OF FLIGHT TRAINING OUTCOME. VALIDATION STUDY ON 136 APPLICANTS.


INTRODUCTION: Due to safety and costs, training outcome prediction is a relevant factor in pilots selection. Behavioral assessment is found as forecasting in predict the training outcome. A double-blind implementation was conducted to validate the predictive validity of behavior observations by means of a computerized setting (CAS COPE A) based on the experimental behavior analysis.

RESULTS: The positive correlation (phi = .24, p < .05) between success in flight training and performance in CAS COPE A was observed. Better performance in CAS COPE A was associated with success in flight training. These findings support the hypothesis that CAS COPE A can be used for pilot selection.

CONCLUSION: The findings provide support for the requirement of normal color vision in initial screening. Recommendations are discussed concerning secondary color vision screening that might be used to identify those who may be able to perform without error.

VALIDITY OF CLINICAL COLOR VISION TESTS FOR AIR TRAFFIC CONTROL SPECIALISTS. N. J. Milburn, N. J. M. H. K. H. B. F. Civil Aeronautical Institute, P.O. Box 20592, Ohio, CT, 7082.

INTRODUCTION: An experiment on the relationship between clinical color vision screening test performance and color-dependent tasks of Air Traffic Control Specialists (ATCS) was replicated to expand the data base supporting the job-related validity of the screening tests. METHOD: The original experiment (n=108), and the replication (n=120) involved a total of 121 normal trichromats and 123 with varying degrees and types of color vision deficiency (anomaloscope classification). All 13 of the FAA-accepted color vision tests that are known to be in use were validated. The results of the simulations of ATCSs tasks that require color vision were compared with the performance of individuals in various color vision tests that require color vision or color vision deficiency. Simulations of color vision tasks concerned normal color coding in flight progress summary strips (at en route center), aircraft lights and Aviation Signal Light Indicator (in tower control), and color weather radar (at flight service stations and en route centers). RESULTS: Mean errors were significantly higher at every level (degree) of color vision deficiency than in normals. Approximately 6 percent of color deficient subjects were able to perform ATC color tasks without error. The six percent were all from the simple anomalous trichromat category; all extreme anomalous trichromats and dichromats were prone to errors on ATC tasks. CONCLUSION: These findings provide support for the requirement of normal color vision in initial screening. Recommendations are discussed concerning secondary color vision screening that might be used to identify those who may be able to perform without error.
CONTRIBUTIONS OF PERSONALITY MEASURES TO PREDICTING SUCCESS OF APPLICANTS IN THE FAA AIR TRAFFIC CONTROL NONRADAR SCREEN PROGRAM. D.J. Schroeder*, D. Broach, and W. Young. Human Resources Research Division, FAA Civil Aeromedical Institute, P.O. Box 25082, Oklahoma City, OK 73125.

INTRODUCTION. Reviews have consistently concluded that the validity of personality as a predictor of performance on the job or in training is low. However, Barrick and Mount's (1991) meta-analysis of job performance and job performance based on the presence of the "big five" personality dimensions demonstrated the utility of personality in predicting student success in the FAA Air Traffic Control Nonradar Screen Program (NRSP), using a personality measure (NEO) and a Biographical Inventory. Several studies have also assessed ATCS applicants scores under the Abstraction Subtest than the Vocabulary Subtest. The results of these studies were used to predict student success (NLCOMP). RESULTS. Subjects exhibited lower average scores in Neuroticism, higher average scores in Extraversion, Openness to Experience and Consciousness, and no differences in Agreeableness when compared to the normative sample. Correlations between the personality measures and NLCOMP were low, ranging from r = .08 for Anxiety to r = .92 for Fantasy. Despite the relatively low overall correlations, when used in a regression equation along with the aptitude measures, several of the personality measures proved to be useful predictors of success. This included neuroticism, anxiety, and positive emotions. CONCLUSIONS. While the overall results were not entirely consistent with the predictions of Barrick and Mount (1991), they do offer some support for the role of personality variables in predicting initial success in the ATCS. Continued research is needed to determine if the same measures are predictive of success on the job.

Effects of Atropine and Sleep Deprivation on Human Performance. M. Williams applicants record. Higher on the Abstraction Subtest than the Vocabulary Subtest. The results of these studies were used to predict student success (NLCOMP). RESULTS. Subjects exhibited lower average scores in Neuroticism, higher average scores in Extraversion, Openness to Experience and Consciousness, and no differences in Agreeableness when compared to the normative sample. Correlations between the personality measures and NLCOMP were low, ranging from r = .08 for Anxiety to r = .92 for Fantasy. Despite the relatively low overall correlations, when used in a regression equation along with the aptitude measures, several of the personality measures proved to be useful predictors of success. This included neuroticism, anxiety, and positive emotions. CONCLUSIONS. While the overall results were not entirely consistent with the predictions of Barrick and Mount (1991), they do offer some support for the role of personality variables in predicting initial success in the ATCS. Continued research is needed to determine if the same measures are predictive of success on the job.

THE EFFECTS OF HYPOXIA ON AUDITORY REACTION TIME AND P300 LATENCY. A.F. Linden* & R. Fowler. University of Connecticut, UCI, and Civil Institute of Environmental Medicine, North Pennace, Canada; M3M 3B9. 2 Naval Aerospace Research Laboratory, Pensacola, Florida.

INTRODUCTION. The literature provides strong evidence that visual processing is slowed by hypoxia, but evidence regarding the effects of hypoxia on auditory processing is lacking. Therefore, the purpose of this study was to evaluate the effects of hypoxia on auditory reaction time (RT) as a function of stimulus frequency, and to determine whether the event-related component P300 responds to hypoxia in a similar manner to RT. METHODS. Twelve well-trained subjects performed an auditory RT task in an oddball paradigm while EEG data were collected from three electrodes (Pz, Cz, P2). In each condition, subjects were presented with 150 trials of a 50 ms tone burst that was either of high or low intensity. Subjects were tested at three different frequencies (1000 Hz, 2000 Hz, 3000 Hz). The intensity of the target tone was randomly selected from one of the following different frequency mixtures (either a tone or a low oxygen gas mixture): producing the P300 component on the EEG (p = 0.03). A prescriptive level of accuracy was maintained throughout the experiment. RESULTS. Auditory RT and P300 latency were slowed by hypoxia in a prespecified manner at all three frequencies (overlying effect of RT, 32 ms p<.01; P300 latency, 32 ms p<.0001). P300 amplitude was not affected by hypoxia. CONCLUSIONS. Since P300 is thought to index only the time to evaluate a stimulus, these results suggest that different levels of hypoxia may have different influence on the processing of auditory stimuli. They raise questions concerning the traditional view that auditory processing is relatively resistant to hypoxia. Furthermore, the frequency dependent effects of hypoxia on auditory thresholds reported in the literature appear not to influence the processing of above-threshold stimuli.

PREDICTING ALCOHOL CONCENTRATION FROM PERFORMANCE. S. Williams*, A. McLean*, S. Scott. University of Wisconsin-Madison, Department of Psychology.

INTRODUCTION. The effects of alcohol on the human psychomotor abilities; a software program was written to permit performance deficits on these tasks to be indexed to alcohol dosage. A performance-based method would permit more direct estimation of alcohol dosage from performance loss. Alcohol was examined as a standard for comparison of performance loss. Alcohol was examined in this study to determine the effects of alcohol on the performance of tasks under conditions of normal and subnormal levels of alcohol. The results of these studies showed significant differences between the control and experimental conditions. However, MCT latency scores showed significant increases with alcohol only in two of the six tests. CONCLUSION. For an aviator population, SO test evaluation provided by the Equitest appear to be effective in discriminating moderate postural dysregulation. These results justify further investigation to assess the applicability of the NEUROCOM EQUITEST SYSTEM as an operational device in the evaluation of SO.
A PROGRAM TO ADDRESS HUMAN FACTOR ISSUES RESULTING FROM A LABOUR DISPUTE

INTRODUCTION. In recent years it has become clear that corporate factors contribute significantly to human factor incidents and accidents. Further research indicates that stresses induced in pilots during a labour dispute can significantly affect their performance. This paper reports on a Human Factors training program for pilots introduced by Australian Airlines to address the corporate Human Factors airing and its potential impact on pilots.

RESULTS. Following a major industrial dispute in which almost all the 547 pilots resigned from the airline, Australian rebuilt its pilot workforce with a combination of re-hires and new hires from overseas, the military and General Aviation. A course for pilots and their spouses was built using models of decision making with emphasis on group discussions of the labour dispute and its potential flight-safety impact.

CONCLUSION. This variant of CRM training built a cohesive group from a disparate background and with a successful attempt to pre-empt human performance problems stemming from a stressful corporate environment.


INTRODUCTION. CRM continues to be a superb training context as well as a fruitful research one. Did Moreno's "Sociogram", now computerized and adapted to cockpit population, alerting the theoretical and practical design of work areas, as well as "broken" pilots couples, before they enter the flight deck, so appointing a more suited and safer cockpit crew schedule. METHODS. Authors were committed to solve serious substandard behaviors in a domestic airline. Computerized sociogram results were correlated with CRM training, in order to establish if dyadic performance could be predicted by the cross analysis of involved pilots' personality profiles. RESULTS. No statistical analysis could be made due to the reduced amount of pilots (n=23) and the huge quantity of variables, but sociogram proved to be an excellent predicting tool for cockpit dyadic behavior.

CONCLUSION. Reliability of an instrument doesn't mean necessarily adequacy. Sociogram was applicable just when pilots themselves were aware of its usefulness.

SCANNING AND MONITORING PERFORMANCE IS AFFECTED BY THE REINFORCEMENT VALUE OF THE TARGETS. A.B. Beskidt and P.D. Rambauten. Civil Aeromedical Institute, Federal Aviation Administration, Oklahoma City, OK 73125.

INTRODUCTION. We tested an hypothesis, based on anecdotal and introspective evidence, suggesting that Air Traffic Control Specialists (ATCSs) may make scanning and monitoring errors because they tend to concentrate on a high-value display sub-area (e.g., one containing large commercial aircraft) while ignoring lower-value problems elsewhere on the display. In the first experiment the Ss were rewarded for "good" (above median) performance with differing task difficulties in each workarea. The second experiment also rewarded good task performance. However, both workareas had identical task difficulty and, in one clearly marked workarea, designated "high value", the error cost the Ss 4 times as much as in the other. The second experiment was later repeated, using a "high error value" of 10. RESULTS. In the first experiment the error rates in the two workareas were similar, 60% of the Ss tended to concentrate on the higher-value task, in the second experiment, though the overall error rates in the two workareas were similar, 60% of the Ss tended to concentrate on the high value workarea, while ignoring the other.

CONCLUSIONS. About 60% of our Ss tended to concentrate on a display sub-area containing high value events, while ignoring events elsewhere on the display. The type of long term approach may have future utility for screening of ATCS candidates.

CALCULATING AIR CREW REST INTERVALS. J. Whitemore, J. French*, L. Olenick, J. Hall. Armstrong Laboratory, Brooks AFB, TX 78235.

INTRODUCTION. It is common for commercial and military aircrews to fly across several time zones, for long periods of time, at any time of their subjective day. Often, with the addition to a considerable amount of hours prior to takeoff, and often with little sleep. An equation is described which is specifically designed for predicting effective rest periods for long haul air crew. Method. Eight C-141 pilots involved in Operation Desert Storm maintained records of activities, temperature and fatigue ratings at various times of the day over a 30 day exercise. Rest periods calculated were correlated with the pilot's subjective fatigue and mood scores. Results. An equation was developed which better predicted the recorded fatigue scores than existing crew rest models. As well, fatigue rating and mood scores were found to correlate highly for each flight (r = .87). Discussion. The development of the equation illuminated those factors which most affect the level of fatigue experienced by the pilots. The rest gauge that resulted stresses recent flight history as a fatigue index for continuous operations rather than 30 day flight history. Finally, the utility of the rest gauge in calculating the amount of rest needed by pilots involved in commercial flying should be determined.

PATS: Psychophysiological Assessment Test System, Goals and Description. C. E. Williamson* AIRC/PAP and C. Oliver, LTOI, VAF-APF, ON.

INTRODUCTION. With the increased use of psychophysiological measures in aviation research, the need for a multi-function data collection and analysis device has become apparent. The areas requiring such a device include laboratory testing, design testing, simulation and flight; this requires a device which has the capability to provide appropriate functionality in all of these environments. Operator workload, fatigue, various stress environments and operator state assessment are a few of the topics that can be investigated with the PATS. We have developed a device which meets many of these needs.

METHOD. The PATS is hosted on the Macintosh IIX computer with the user Interface written in Hypercard. The PATS has the capability to present auditory and visual stimuli in several cognitive and sensory paradigms, collect and store 16 channels of analog data and 32 channels of digital I/O data, provide for editing and other manipulations of this data, reduce the data and perform statistical analysis on the reduced data. The system is designed to be user friendly so that operators not familiar with psychophysiological methods can easily use the device.

CONCLUSIONS. The design and functionality of PATS will be presented and examples of each function will be shown. Distribution arrangements and hardware requirements will also be discussed.
CONTACT LENS AND SPECTACLE USE IN NAVAL AVIATION: SURVEY RESULTS. D. L. Still and M. H. Mittelman.
G-LOC IN FIGHTER AIRCRAFT DURING TRAINING.

M. H. Harmon, J. E. Whitney* and E. M. Forster.* Aerial Combat Maneuver Enhancement Laboratory, NAVARDEVCEN, Warminster, PA 18974-5000.

INTRODUCTION: Characteristics of fighter aircraft were studied to determine whether or not the aviators experienced G-LOC while undergoing Gz-tolerance enhancement training on the Naval Air Development Center centrifuge. METHODS: Five hundred twenty-five aviators, including members of the Air National Guard and the Navy, were exposed to a series of centrifuge training profiles, comprising a gradual on-set Gz run (Gz = 3.0) and 5 different rapid on-set runs (ROR). Information on subject's weight, height, training time, flying hours (total), etc. was compiled along with performance data relating to the centrifuge runs. To uncover significant relationships between G-LOC and characteristics of the aviators, correlation and t-test analyses were performed. Logistic regression was then carried out relating G-LOC simultaneously with the variables which showed significance at the .05 level. RESULTS: Logistic regression analysis showed number of tactical flying hours to be the best predictor of presence or absence of G-LOC, with no other variable adding significantly after it was considered. Most of the 5 individual variables significantly related to G-LOC were moderately or highly intercorrelated.

CONCLUSIONS: Greater experience in tactical flying, which tends to rise with age in fighter aircrew, was shown to improve the likelihood of avoiding G-LOC during centrifuge training.

CASE REPORT: SERIOUS ARRHYTHMIA ASSOCIATED WITH HIGH Gz LOAD.


INTRODUCTION: Since 1961, more than 5,500 pilots have been trained by Japanese Self Defense Force human centrifuge and ECG monitoring during G-load was done on all trainees. A large number of high-G related arrhythmia has been found. PVCs were the most frequent dysrhythmia. Ventricular tachycardias (2.3%), including 13 triplets (1.1%); 6 supraventricular tachycardias (0.6%); and 4 of aomalous bradycardia (0.2%). CONCLUSIONS: Ventricular tachycardias were frequently observed. Session-terminating dysrythmias included: 101 ventricular tachycardias (1.9%); 27 supraventricular tachycardias (0.5%), including 11 triplets (0.2%); 13 supraventricular premature beats (1.3%); 2 of supraventricular tachycardias (0.1%); and 4 of anomalous bradycardia (0.3%). Conclusions: Centrifuge training can provoke serious dysrhythmias in ostensibly healthy individuals, and ECG monitoring of aircrew undergoing such training is recommended for their safety. Because some of these dysrythmias are disqualifying for aircrew duties, the need for a more lenient aeromedical disposition policy must be considered.

-119-
DESSERT STORM: AN AERONOMICAL TECHNICIANS PERSPECTIVE.

L.D. Tripp Jr.*, Msgt, USAFR, 356th Tactical Airlift Squadron, Hickam AFB, HI 96855.

INTRODUCTION. Aeromedical Evacuation Flight Surgeons (AEFS) in War: The Use of Aeromedical Evacuation Flight Surgeons (AEFS) in Desert Storm at King Khalid Military City, Saudi Arabia L. A. Richardson* and R. A. W. M. Hanlon, Royal Auxiliary Air Force, RAF.*

DEPLOYMENT. The deployment of the 356th Squadron Medical Element (SME) to the Persian Gulf provided the unit with a medical team from a staff that already had a pre-established relationship with the aircraft members which was vital throughout the Desert Storm deployment.

METHODS. On 25 Nov 1990, the 356th TAS deployed to a classified site (site 1). On arrival in the area, the SME combined resources with a prepositioned SME and established a Flight Medicine Clinic. This was also true for a redeployment on 29 April 1991 to site 2 where 4 SME's were combined into a single clinic. RESULTS: All of the patients were relatively healthy and the patient count at site 1 totalled 249 in a two month period. At site 2, a total of 746 patients were seen in a two month period. Again, URI's and urological conditions were the most predominant problems totaling 32% of the patient visits. CONCLUSIONS. The medical conditions, experiences, and lessons learned in this 4.5 month deployment may be of value to the Aeromedical community in planning for future desert deployments.

A NEW CONCEPT FOR A MOBILE, REPELLENT RESPONSING AND VERSATILE AERONOMICAL UNIT. T. E. Martin, 460th Aeromedical Evacuation Squadron, Royal Air Force, RAF Balderton, LN6 0NH, UK.

INTRODUCTION. Of the many lessons learned in the deployment of aeromedical assets by the RAF during Operation Granby/Desert Storm, perhaps the most vital was the recognition of the need for total flexibility with respect to resourcing and evacuation methods. METHODS. The RAF established a mobile aeromedical deployment asset from a single cross-section of medical needs. One in particular, at Al Jubail, expanded to become a major resuscitation facility. RESULTS: A RAF helicopter could rapidly transport an ill field aircrew detachment to one having the capability of a full Aeronomedical Evacuation Facility (AEF), with a substantial suite of medical and surgical equipment. Although, over 700 patients were treated and transported through the AEF at Al Jubail alone, fortuitously, less than 50 were battle casualties. Most were over 700 patients were treated and transported through the AEF at Al Jubail alone, fortuitously, less than 50 were battle casualties. Most were...
MOBILIZATION OF FIBRONECTIN AND PROLACTIN BUT NOT BASELINE CORTICOLONE BY TRAINING STRESS. H.M. Neely*, W.G. Lott, and J. Satter. Naval Aerospace Medical Research Laboratory, Pensacola, FL 32508.

INTRODUCTION. Consistent, predictable biochemical markers of cumulative physical stress have not been identified. Increased cortisol levels have traditionally served as markers of physical stress and typically reflect as acute, rather than chronic stress response. Under similar stressful circumstances, prolactin has been shown to increase in males. In contrast, though prolactin has been shown to beneficially affect physical training, but fibronectin levels are decreased during the early phases of training. No previous reports simultaneously address the predictability and interrelationship among cortisol, prolactin, and fibronecctin as stress markers in males. METHODS. Male aviators, naval flight officers, and enlisted aircrew from six training and fleet squadrons were surveyed to identify the frequency of self-medication. The Brief was developed to assess the frequency of self-medication and the conditions prompting such use. The survey is confidential in that individual anonymity is maintained during the collection process. The survey instrument elicits data on personal use of both over-the-counter and previously prescribed medications taken without medical consultation. Solicited data include: time since aircrew designation, incidence and frequency of self-medication, basis for self-medication (cold, headaches, etc.) and identification of medications used. Additionally, Naval Safety lots (NSC) and Armed Forces Institute of Pathology (AFIP) data on micnaph and medication use will be reviewed for a comparison analysis. COMMENTS. The brief will review the results of the aircrew survey and correlate those results with the information obtained from the NSC and AFIP. The incidence of self-medication from the survey will be compared to the micnaph data. The implications of these results for aircrew, safety personnel, flight surgeons, and policy makers will be discussed.


INTRODUCTION. The Navy prohibits the practice of self-medication in its aircrews. Self-medication is defined as the act of taking medication without the consent of a family surgeon. Nevertheless, reports continue to reveal the unauthorized use of medications in aircrews. If self-medication is rare, it is rarely listed as a causal factor in these mishaps, the anecdotal frequency of its appearance in these reports suggests the possibility of an unrecognized role. Further, the fact that highly disciplined military personnel can engage in self-medication with some frequency speaks to the need to identify the factors pertaining to this abuse. METHODS. Naval aviators, naval flight officers, and enlisted aircrew from six training and fleet squadrons are surveyed to identify the frequency of self-medication and the conditions prompting such use. The survey is confidential in that individual anonymity is maintained during the collection process. The survey instrument elicits data on personal use of both over-the-counter and previously prescribed medications taken without medical consultation. Solicited data include: time since aircrew designation, incidence and frequency of self-medication, basis for self-medication (cold, headaches, etc.) and identification of medications used. Additionally, Naval Safety Center (NSC) and Armed Forces Institute of Pathology (AFIP) data on micnaph and medication use will be reviewed for a comparison analysis. COMMENTS. The brief will review the results of the aircrew survey and correlate those results with the information obtained from the NSC and AFIP. The incidence of self-medication from the survey will be compared to the micnaph data. The implications of these results for aircrew, safety personnel, flight surgeons, and policy makers will be discussed.

BEAT-TO-BEAT MONITORING OF INOTROPY BY STATIC CHARGE BALLISTOCARDIOGRAPHY. A. Lindqvist and J. Allibanks. Cardiorespiratory Research Unit and Department of Physiology, University of Turku, FINLAND.

INTRODUCTION. Beat-to-beat chronotropic control of the heart can be analyzed by a heart rate signal acquired from ECG. Aim of the study was to evaluate inotropic control of the heart by static charge sensitive bed ballistocardiography (SCB, Biomatex Biorec Ltd, Finland) ballistocardiogram (BGC) after physical exercise and during pharmacological stimulation. METHODS. SCB-BGC was recorded supine before and 1, 3, and 5 minutes after maximal exercise test (N=6), an iv bolus of isoproterenol (Isuprel, 0.2 mg, N=3) and an iv bolus of atropine (Atropin, 1.5 mg, N=3). Systolic amplitudes of SCB-BGC were measured and interpreted triggered from R-wave of simultaneous ECG were measured over 10 30-second intervals. RESULTS. Exercise and isoproterenol increased systolic SCB-BGC amplitude and decreased R-BGC intervals. The positive inotropic effect was highly significant in the early systole (P<0.001). Atropine with no or slight negative inotropic effect increased remarkably heart rate but changed insignificantly SCB-BGC amplitude and the R-BGC intervals. CONCLUSION. The results indicate that changes of inotropy influence amplitude and electro mechanical intervals of systolic SCB-BGC which may be used as a noninvasive method for beat-to-beat monitoring of cardiac performance.


INTRODUCTION. Cell differentiation in microgravity may require intercellular recognition and adhesion. We tested the hypothesis that simulated microgravity does not inhibit the adhesive bond formation. METHODS. Human colorectal carcinoma cells (5 x 10^5 MIP-101 or KM-12c cells/ml) were cultured in the NASA Rotating Wall Vessel (RWV). Cells in the RWV are under low shear stress with randomization of the gravity vector. Cells were harvested at 6-7 days, labeled with SMC, and assayed for binding to carinoembryonic antigen (CEA), collagen, laminin, or fibronectin in microtiter plates. Cells (5 x 10^4/well) were incubated for 90 min at 37°C, nonadherent cells washed off, and remaining adherent cells were grown in standard tissue culture flasks. Differences between means assessed by ANOVA with Bodd print P < 0.01 versus None control.

RESULTS: Substrate To Which Cells Bind (MEAN + SEM)

<table>
<thead>
<tr>
<th>Adhere</th>
<th>RWV</th>
<th>MIP-101</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>65.1</td>
<td>14.1</td>
</tr>
<tr>
<td>CEA</td>
<td>62.3</td>
<td>12.1</td>
</tr>
<tr>
<td>Collagen IV</td>
<td>58.7</td>
<td>20.7</td>
</tr>
<tr>
<td>Fibronectin</td>
<td>93.1</td>
<td>14.1</td>
</tr>
<tr>
<td>Laminin</td>
<td>67.1</td>
<td>19.4</td>
</tr>
</tbody>
</table>

The RWV cultures give similar results to the Controls for binding to basement membrane proteins and to CEA, an epithelial intercellular recognition molecule. Thus, microgravity is not likely to alter cell association and adhesion.


INTRODUCTION. Studies of the physiological effects of environmental conditions such as pollutant exposure, thermal stress, noise, acceleration, and space flight often desire continuous estimates of physiological function during daily activity. METHODS. Eight healthy subjects aged 35 to 49 years (7 male, 1 female) were instrumented with electrocardiogram (ECG) and impedance cardiogram (ICG) electrodes and an ambulatory ECG & ICG analyzer for automatic signal acquisition and processing at 5 or 10 minute intervals. At each interval, a one-minute oscillogram of the ECG, ICG, and base impedence (Z0) was computed, and the waveforms analyzed for heart rate (HRATE), Z0 frequency amplitude (Z0fA), time to peak Z0fA (TPEAK), average Z0fA slope (ACC) and Z0, and the resultant measurements stored. Stroke volume (SV) and cardiac output (CO) were estimated off-line using the Kubicki formula. Vasoconstriction was estimated off-line using individualized multivariate regression models relating minute ventilation (VM) by spirocone to the independent variables (HRATE, ACC, Z0, and VM). RESULTS: Laboratory calibrations of multivariate-predicted versus spirocone- estimated values were excellent (R=0.95 and r=0.99). Ambulatory monitoring ranged from 590 to 1930 minutes, with an average duration of 767±503 minutes. Variability in subject activities, sleep patterns, and monitoring epochs precluded group statistical analyses, however, individual Vmax, SV, and CO trends could be assessed at 5 or 10 minute intervals. CONCLUSIONS. Reliable, 24 hour estimates of ventilation and cardiac output during daily activity are possible using automated ambulatory analysis of the electrocardiogram and impedance cardiogram.

STRATEGIES FOR SYNTHETIC BLOOD DEVELOPMENT: CHARACTERIZATION OF AN ULTRA-FINE PLURIPOTENT SOLID PHASE DELIVERY VEHICLE FOR SELF-ASSEMBLING BIOLOGICALS. N. Kozarovsky*, R. Spooner and A. Gellman. Biomaterials Bioactivity Characterization Laboratory, Department of Pathology and Laboratory Medicine, UCLA Medical Center, Los Angeles, CA 90024-1732.

Solid phase synthetic chemistry based on molecular self assembly is an exciting new area of biomaterials research. The scientific principle underlying our use of solid carriers for biologicals is that with appropriate surface modification, biologicals may be adsorbed without denaturation. For synthetic blood, hemoglobin is the preferred biological.. In experiments to date, model work has been done using the major envelope protein (gp350) of the Epstein-Barr Virus (EBV). Self assembled in low ion strength aqueous dispersions, these "oral decoys" display remarkable physical and immunological similarity to native EBV. At physiological pH the mean electrophoretic mobility and average dispersion diameter (Dav) of these synthetic carriers mimics that of its infectious counterparts. Monoclonal anti-EBV membrane antigen was shown to bind with high frequency to decoy particles through immunogold staining and by particle immunoagglutination. In studies with NZW rabbits primed with gp350, decoy particles elicited data on both in vitro and in vivo anti-gp350 responses approximately 3 and 6 weeks, respectively, after vaccination. These results were confirmed with a gp350-based adjuvant and gp350-specific responses characterized by ELISA and Western blotting. In contrast to other EBV vaccines. The apparent absence of significant molecular denaturation by the adsorption process suggests that this concept may be extended to synthetic blood, work is now in progress.
A NEW MODEL FOR ESTIMATING TOTAL BODY WATER FROM BIOELECTRICAL RESISTANCE 

INTRODUCTION
Estimation of total body water (TBW) from bioclinical resistance (R) is commonly done by stepwise regression models with height squared over R, \( \frac{H^2}{R} \), and weight over R, \( \frac{W}{R} \). However, the correlation between the disappearance of arterial pulsation and the occurrence of ocular symptoms, such as grey out and black out, has been reported. For the black out monitor, pulse waveforms were analyzed with a calibrated computerized radial pulse wave analyzer (CVD-I). The equivalent sensation contours were derived mathematically. RESULTS: The mean arterial pressure was raised 41.2-74.3% above the baseline, and the peripheral impedance (PI) increased by 99.5%. The results are shown below.

**RESULTS**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Low T</th>
<th>High T</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE (3,1)</td>
<td>58.1(8)</td>
<td>39.4(7)</td>
<td>56.9(3)</td>
</tr>
<tr>
<td>SE (2,1)</td>
<td>40.1(9)</td>
<td>38.9(6)</td>
<td>56.9(3)</td>
</tr>
<tr>
<td>SE (1,1)</td>
<td>40.1(9)</td>
<td>39.4(7)</td>
<td>56.9(3)</td>
</tr>
<tr>
<td>T</td>
<td>40.0(6)</td>
<td>27.8(5)</td>
<td>56.9(3)</td>
</tr>
</tbody>
</table>

**Correlations for all subjects**

All correlations were significant (p<0.05). The significant mean differences were between T and LB. The results are shown below.

**Conclusion**

The stepwise polynomial model may increase the accuracy of estimating total body water. The use of the Holter monitor is an effective assessment tool when used in the operational cockpit.