USAARL-TECH-BB--2026-12

UNITED STATES ARMY AEROMEDICAL RESEARCH LABORATORY

U.S. Army Aeromedical Research Laboratory Fiscal Year 2025 Annotated Bibliography

Science Information Center

DISTRIBUTION STATEMENT A. Approved for public release: distribution is unlimited.

REPORT DOCUMENTATION PAGE	*Form Approved OMB No. 0704-0188*

1. REPORT DATE *(DD-MM-YYYY)*	**2. REPORT TYPE**	**3. DATES COVERED** *(From - To)*
04-02-2026	Bibliography	1 Oct 2024 - 30 Sept 2025

4. TITLE AND SUBTITLE U.S. Army Aeromedical Reserch Laboratory Fiscal Year 2025 Annotated Bibliography	**5a. CONTRACT NUMBER** **5b. GRANT NUMBER** **5c. PROGRAM ELEMENT NUMBER**
6. AUTHOR(S) Science Information Center	**5d. PROJECT NUMBER** **5e. TASK NUMBER** **5f. WORK UNIT NUMBER**
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Aeromedical Research Laboratory P.O. Box 620577 Fort Rucker, AL 36362	**8. PERFORMING ORGANIZATION REPORT NUMBER** USAARL-TECH--BB-2026-12
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Medical Research and Development Command Military Operational Medicine Research Program 504 Scott Street Fort Detrick, MD 21702-5012	**10. SPONSOR/MONITOR'S ACRONYM(S)** MRDC MOMRP **11. SPONSOR/MONITOR'S REPORT NUMBER(S)**

12. DISTRIBUTION/AVAILABILITY STATEMENT

DISTRIBUTION STATEMENT A. Approved for public release: distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

Open literature publications, technical reports, technical memorandums, oral presentations, and poster presentations by the U.S. Army Aeromedical Research Laboratory (USAARL) are included in this annotated bibliography, this edition dated October 2025.

15. SUBJECT TERMS

USAARL, annotated bibliography, FY25, aeromedical research

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			Loraine St. Onge, PhD
UNCLAS	UNCLAS	UNCLAS	SAR	41	**19b. TELEPHONE NUMBER** *(Include area code)* 334-255-6906

This page is intentionally blank.

Foreword

Open literature publications, technical reports, technical memorandums, oral presentations, and poster presentations by the United States Army Aeromedical Research Laboratory (USAARL) in Fiscal Year (FY) 2025 are included in this annotated bibliography.

All of USAARL's public release and limited distribution technical reports are available for download from the Defense Technical Information Center.

https://discover.dtic.mil/

Requests for copies of open literature publications and technical memorandums must be made in writing directly to:

usarmy-usaarl-sic@health.mil

This annotated bibliography does not include abstracts submitted to conferences, symposia, and meetings.

Visit https://usaarl.health.mil

Follow us on Facebook at Facebook.com/USAARL
Connect with us on Linkedin at Linkedin.com/company/usaarl
Check out USAARL's content on DVIDS at https://www.dvidshub.net/unit/USAARL

This page is intentionally blank.

Summary of Technical Products

In FY25, USAARL published 13 open literature manuscripts, 41 technical reports, and 9 technical memorandums, totaling 63 publications. USAARL delivered 59 oral presentations and 23 poster presentations.

Note that Fort Novosel was re-named Fort Rucker on July 15, 2025. The Department of Defense was re-named the Department of War on September 11, 2025. Since these changes took place during FY25, all four possible designations were referenced in technical products.

This page is intentionally blank.

Table of Contents

This page is intentionally blank.

Open Literature Publications

D'Alessandro, M., Mackie, R., Berger, T., Ott, C., Sullivan, C., Barnett, J., & Curry, I. (2025). Cognitive engagement profiling of pilots in high-speed, high-threat scenarios. *Aerospace Medicine and Human Performance, 96*(9), 819–828. https://doi.org/10.3357/AMHP.6664.2025

Introduction: This study investigated pilot cognitive engagement patterns across diverse flight conditions using electroencephalography (EEG)-based measurements in a high-fidelity rotary-wing simulation environment.

Methods: A total of 8 experienced U.S. Army test pilots completed 24 flights across 3 distinct route designs using the National Aeronautics and Space Administration Ames Vertical Motion Simulator, with airspeeds ranging from 120 to 240 kn. Analysis focused on EEG Beta/(Alpha + Theta) ratios as indicators of changing cognitive engagement over time.

Results: Analyses revealed distinct cognitive engagement patterns across routes: highly variable individual responses in routes with changing navigation demands, more consistent cognitive engagement in systematic route designs, and intermediate variability in mixed-demand routes. Airspeed effects on cognitive engagement became particularly pronounced above 200 kn, though these effects varied significantly by route and individual pilot. Temporal analysis demonstrated evolving patterns of cognitive adaptation, with routes eliciting different progression patterns over extended flight periods. Regression analysis showed that EEG Beta/(Alpha+Theta) values increased significantly during all three routes, with mean increases ranging from 0.0051–0.0146.

Discussion: These findings provide quantifiable metrics for optimizing route design, developing personalized training approaches, and implementing real-time monitoring systems for enhanced aviation safety and performance.

D’Alessandro, M., Mackie, R., Berger, T., Ott, C., Sullivan, C., & Curry, I. (2024). Real-time neurophysiological and subjective indices of cognitive engagement in high-speed flight. *Aerospace Medicine and Human Performance, 95*(12), 885–896. https://doi.org/10.3357/AMHP.6489.2024

Introduction: Managing cognitive demand is critical for aviation safety. Yet, accurately assessing pilot workload during complex flight maneuvers remains challenging. This study evaluated an integrated methodology combining real-time cognitive engagement indicators to provide a comprehensive assessment and assess the reliability of physiological and subjective measures for monitoring operator state.

Methods: Six experienced U.S. Army rotary-wing pilots completed simulated high-workload flight scenarios like low-altitude, reconnaissance, and air threat avoidance maneuvers. Continuous wireless EEG, heart rate data, and subjective workload ratings were recorded during the flights.

Results: EEG engagement indices and heart rate variability metrics demonstrated reliable within-subject consistency across trials for individual pilots, with mean intraclass correlation coefficient values ranging from 0.59–0.69. Both measures exhibited synchronized fluctuations across pilots at key events, increasing during high workload segments and decreasing in lower demand periods. Subjective ratings also showed good within-subject reliability, with mean intraclass correlation coefficient values ranging from 0.74–0.85. These findings underscore the reliability of our measurements, instilling confidence in the validity of our research.

Discussion: The findings of this study provide strong support for the feasibility of using a multi-measure approach that integrates EEG, heart rate variability, and subjective ratings. This approach can continuously monitor real-time cognitive workload fluctuations during simulated rotary-wing operations. While objective measures showed within-subject consistency, substantial between-subject variability highlights the importance of individualized neurocognitive profiling. The integration of neurophysiological, autonomic, subjective, and environmental data holds great promise for the future of pilot workload assessment despite the challenges posed by individual differences.

Evangelista, C., Harris, J., Trinh, T., Kohler, P., Mackie, R., Turovets, S., Aden, J., & Capo-Aponte, J. (2025). Comparing visual outcomes of keratoreflective lenticule extraction, photorefractive keratectomy (PRK), and laser in situ keratomileusis (LASIK) procedures in the military population. *Journal of Cataract and Refractive Surgery, 51*(2), 98–105. https://doi.org/10.1097/j.jcrs.0000000000001565

Purpose: To assess the 6-month visual and refractive outcomes of keratorefractive lenticule extraction (KLEx) as compared with LASIK and PRK in a military population at a Joint Warfighter Refractive Surgery Center (JWRSC).

Setting: JWRSC, Lackland Air Force Base, San Antonio, Texas

Design: Retrospective study

Methods: Patients who underwent KLEx, PRK, or LASIK between 2019 and 2022 were included. Anonymized data collected included demographics, preoperative and postoperative uncorrected and corrected visual acuity, and manifest refraction.

Results: Of the 4466 treated eyes, 737 (16.5%) underwent the KLEx, 2801 (62.7%) underwent PRK, and 928 (20.8%) underwent LASIK treatment. Regarding efficacy, there was no statistically significant difference at postoperative month (POM) 6 between the percentage of eyes reaching an uncorrected distance visual acuity of 20/20 or better between the three procedures. At POM1 ($P < .001$) and POM3 ($P < .001$), there were a greater number of eyes in the KLEx group that achieved the same or 1 line better of distance visual acuity than the PRK group. The efficacy indices of KLEx, PRK, and LASIK at POM6 were 1.09, 1.10, and 0.97, respectively. The safety indices for KLEx, PRK, and LASIK at POM6 were 0.96, 1.01, and 0.81, respectively.

Conclusions: After the initial recovery period, KLEx demonstrates comparable outcomes in efficacy, safety, and accuracy as compared with LASIK and PRK.

Feltman, K., & Kelley, A. (2025). Enhancing cognition in healthy soldiers with transcranial direct current stimulation (tDCS): Potential for non-targeted effects [Abstract]. *Brain Stimulation, 18*(4),1333. https://www.brainstimjrnl.com/article/S1935-861X(25)00116-0/fulltext

The ability to maintain and/or enhance aspects of cognition that can aid in military performance is of interest to the U.S. Army. However, in doing so, it is possible to also achieve non-targeted effects that may have negative consequences for performance. A study was completed that included 27 healthy, well-rested, active-duty soldiers. Active and sham tDCS was applied for 30 minutes at 2 milliampere (mA) targeting the left dorsolateral prefrontal cortex (three conditions: active-anodal, active-cathodal, and sham). A variety of cognitive tasks relevant to military task performance were completed. Additional cognitive tasks were performed to assess potential negative performance tradeoffs. Performance improvements were found for sustained attention (active-anodal) for males in reaction time ($p = 0.024$, $\eta_p^2 = 0.16$) and for sensitivity index in females ($p = 0.013$, $\eta_p^2 = 0.18$). In addition, faster reaction times ($p = 0.034$, $\eta_p^2 = 0.15$) and increased accuracy ($p = 0.029$, $\eta_p^2 = 0.16$) associated with executive function (active-anodal and -cathodal) were found, and worsened working memory performance (active-cathodal; $p = 0.008$, $\eta_p^2 = 0.18$). Finally, it was found that participants had increased risk-taking with active-anodal ($p = 0.001$, $\eta_p^2 = 0.33$). When considering military tasks, increases in risk-taking could have the potential for negative effects if it results in placing the individual in a dangerous situation. In addition to cognitive tasks, a marksmanship task was performed. For this task, throughput (hits/second) was evaluated. It was found that participants performed better in both active conditions compared to the sham condition, $F(2, 32) = 0.037$, $\eta_p^2 = 0.19$. Thus, the use of tDCS in healthy military populations may show some promise for maintaining or enhancing performance; however, potential negative effects associated with its use needs to be more thoroughly evaluated. Additionally, there are still no guidelines regarding the frequency of using tDCS or any associated long-term effects that may occur.

Kelley, A., & Feltman, K. (2025). A comparison of two studies: Enhancing military functional performance with the use of transcranial direct current stimulation and pharmaceuticals [Abstract]. *Brain Stimulation, 18*(4),1333. https://www.brainstimjrnl.com/article/S1935-861X(25)00117-2/fulltext

Military members are required to maintain attention and alertness while operating within complex environments. They must be able to make quick, accurate decisions, often when experiencing significant stressors. One critical task that members of the military may need to perform is to accurately and quickly shoot at targets. Here, tDCS and pharmaceuticals were evaluated in separate studies to determine whether they enhanced performance on a simulated marksmanship task. The tDCS study evaluated 2 mA of active-anodal, active-cathodal, and sham stimulation applied for 30 minutes to the left dorsolateral prefrontal cortex (across separate days). The pharmaceutical study evaluated mixed amphetamine salts (MAS), Modafinil, and a placebo (across separate days). Both studies included healthy, well-rested, active-duty soldiers. In both studies, participants' performance on a simulated marksmanship task was evaluated, with throughput (accurate shots/second) as the outcome. Regarding tDCS, both active-stimulation conditions yielded better performance compared to sham stimulation, $F(2,32) = 3.67$, $p = 0.037$, $\eta_p^2 = 0.19$. For the pharmaceutical study, there was a significant effect of condition, $F(2, 44) = 8.92$, $p = 0.001$, $\eta_p^2 = 0.28$, with better performance when MAS was administered compared to placebo, but no effect of Modafinil compared to placebo. Large effect sizes were noted in both studies, although individual differences were controlled for in the analyses and likely impact the utility of both methodologies. Although both methods produced similar positive outcomes, each method poses different considerations for use in practice. For example, the different potential side effects between each method needs to be weighed before recommending either for enhancing functional performance. Additionally, whether the findings here are considered practically significant also needs to be weighed prior to making recommendations for implementation. Moreover, additional research in more realistic scenarios (e.g., training events) may yield a better understanding of the practicality of these methods.

McMahon, J., Berthelson, P., Eaton, M., Lorente, A., Leite, T., McEntire, B. J., & Salzar, R. (2024). Use of a porcine cadaver as a human surrogate for behind armor blunt trauma. *American Society of Mechanical Engineers (ASME) Journal of Engineering and Science in Medical Diagnostics and Therapy, 8*(4), 041103. https://doi.org/10.1115/1.4066934

Current body armor design evaluation is based on legacy backface deformation criteria for protection despite limited medical basis. This uniform protection approach, which does not account for anatomical and physiological variability within the torso, may result in heavy armors that limit warfighter mobility. To optimize armor design, anatomical and physiological regional injury tolerances must be assessed through live animal experimentation. Prior to this, the animal and human must first be compared to determine the animal model's viability as a surrogate for thoracoabdominal behind armor blunt trauma (BABT) response. Here, 74 BABT impacts were conducted using ten midsized male post-mortem human subjects (PMHS) and ten 40-kilogram (kg) porcine cadavers in matched testing conditions over the lungs, liver, and sternum. Injury risk functions were generated from experimental data and compared across surrogates at each body region.

The PMHS and 40-kg porcine cadaver correlated well for chest wall injuries in the lung region, and similarities were noted in high-severity impacts to the liver. Further, assessment of the backface intrusion injury risk function showed regional tolerance differences between anatomical regions, highlighting the need for separate region-specific design criteria. These results indicate that the 40-kg porcine cadaver was an appropriate torso surrogate for certain PMHS regions, such as the ribcage overlaying the lungs and the liver, in BABT conditions. As this study used cadaveric tissue, future studies should investigate the physiological components of BABT-induced injury in a live animal model, focusing on quantifying regional injury tolerances toward armor design optimization.

Noetzel, J., Henry, P., Mackie, R., Cave, K., Stefanson, J. R., Hale, J. K., Andres, K., & Jones, H. (2025). Simulated hearing loss on speech recognition, flight performance, and workload in aviators. *Aerospace Medicine and Human Performance, 96*(4), 269–278. https://doi.org/10.3357/AMHP.6570.2025

Introduction: Hearing loss can compromise U.S. Army aviators' performance, safety, and situational awareness, resulting in increasing mental workload and listening effort. This study evaluated simulated hearing loss on performance and cognitive workload among Army aviators.

Methods: A mixed-effects linear regression study design was used. A total of 21 aviators underwent clinical audiological testing and simulated flight performance assessments. Simulated hearing loss and workload were manipulated to investigate their effects on speech recognition, flight performance, and subjective workload. Flight simulator routes included normal hearing and simulated hearing loss conditions for both high and low workloads. Task load questionnaires were administered for subjective workload assessments and compared across conditions.

Results: Speech recognition scores decreased with increasing levels of hearing loss. In-flight speech intelligibility declined in high workload conditions, with a 26% decrease for mild hearing loss and a 40% decrease for severe hearing loss. High workload conditions degraded flight performance and response times to a secondary task which was exacerbated by simulated hearing loss. Workload scores validated increased workload with simulated hearing loss. No significant findings were observed on the hearing assessment.

Discussion: Findings suggest hearing loss negatively impacts speech recognition and flight performance, especially under high workloads. These results support the importance of addressing hearing loss in aviators. Further research is needed to determine if the clinically adapted Modified Rhyme Test can reflect the impact of hearing loss on aviator performance.

Ranes, B., Wilkins, J., Kenser, E., & Caid-Loos, M. (2024). Trust in automation measures for aeromedical settings. *Aerospace Medicine and Human Performance, 95(11), 851–861.* https://doi.org/10.3357/AMHP.6465.2024

Introduction: As military environments integrate more complex technological systems, operators increasingly require more assistance from automation. When used properly, automation can significantly enhance performance; however, proper use is predicated on the operator's trust in the automation (TIA). TIA, like trust among people, is influenced by biological, psychosocial, and behavioral aspects. While options for measuring TIA have rapidly expanded in the past decade, there has been little consideration for how well these measures perform in operational environments.

Methods: A 10-year literature review was conducted to identify TIA measures and rate their appropriateness for operational aeromedical environments. Articles from Google Scholar, EBSCO, and the Defense Technical Information Center databases were included, focusing on user-reported, physiological, and behavioral measures. Study quality was rated by aeromedical research scientists, while aeromedical appropriateness was evaluated by rated military pilots. Measures were categorized as high recommendation, cautious recommendation, or not recommended based on these evaluations.

Results: Of the measures reviewed, 28 were recommended for operational use, 23 received cautious recommendations, and 6 were not recommended. The recommended measures demonstrated high research quality and suitability for aeromedical environments. The cautious recommendations highlighted measures with specific limitations that need to be considered in operational settings, while the measures not recommended lacked sufficient evidence for reliable use in these contexts.

Discussion: Several high-quality TIA measures appear suitable for operational aeromedical settings. While these recommendations offer a starting point for testing TIA in aeromedical settings, further research is required to test how well these measures perform in an operational environment.

Simmons, E., Lee, A., & Kelley, A. (2025). The most common disqualifying medical conditions in Army aviators, 2016-2020. *Aerospace Medicine and Human Performance, 9*(6), 490–495. https://doi.org/ 10.3357/AMHP.6613.2025

Introduction: Military aviators have long undergone enhanced medical screening to minimize accidents and deaths. U.S. Army aviators undergo a rigorous initial screening process followed by annual medical evaluations governed by published standards of medical fitness which are updated periodically. An aeromedical summary is submitted for disqualifying conditions, resulting in either a waiver of the standard or suspension of flight status. This study aimed to identify the most common disqualifying medical conditions in U.S. Army aviators in recent years and analyze trends over time.

Methods: A retrospective observational study was performed using five years of data from the U.S. Army's Aeromedical Epidemiological Data Repository. Incidence rates for the 10 most common disqualifying conditions, and the waiver approval rate for those conditions, were calculated. Annual incidence was calculated for hypertension aeromedical summary submissions.

Results: Lumbar and cervical spinal disorders (101.55 and 39.26 per 10,000 aviator-years, 81.6% and 79.1% waived, respectively), obstructive sleep apnea (62.00 per 10,000 aviator-years, 93.4% waived), hearing loss (27.96 per 10,000 aviator-years, 98.0% waived), and hypertension (26.13 per 10,000 aviator-years, 97.3% waived) were the most common conditions submitted. Psychological diagnoses were also common, with post-traumatic stress disorder (PTSD), anxiety and phobias, adjustment disorder, and mood disorders having a cumulative incidence of 44.20 per 10,000 aviator-years and a waiver rate of 45.4%. Submissions for hypertension substantially decreased starting in 2019.

Discussion: Spine disorders are among the leading disqualifying conditions in U.S. Army aviators and metabolic conditions were submitted less often than previously reported, likely due to changes in aeromedical policy with respect to hypertension.

Vogl, J., McCurry, C. D., Bommer, S., & Atchley, J. A. (2024). The United States Army Aeromedical Research Laboratory Multi-Attribute Task Battery. *Frontiers in Neuroergonomics, 5*. https://doi.org/10.3389/fnrgo.2024.1435588

The USAARL Multi-Attribute Task Battery (MATB) represents a significant advancement in research platforms for human performance assessment and automation studies. The USAARL MATB builds upon the legacy of the traditional MATB, which has been refined over 30 years of use to include four primary aviation-like tasks. However, the USAARL MATB takes this foundation and enhances it to meet the demands of contemporary research, particularly in the areas of performance modeling, cognitive workload assessment, adaptive automation, and trust in automation. The USAARL MATB retains the four classic subtask types from its predecessors while introducing innovations such as subtask variations, dynamic demand transitions, and performance-driven adaptive automation handoffs. This paper introduces the USAARL MATB to the research community, highlighting its development history, key features, and potential applications.

Vogl, J., O'Brien, K., & St. Onge, P. (2025). One size does not fit all: A support vector machine exploration of multiclass cognitive state classifications using physiological measures. *Frontiers in Neuroergonomics, 6*.

Introduction: This study aims to develop and evaluate support vector machine (SVM) learning models for predicting cognitive workload (CWL) based on physiological data. The objectives include creating robust binary classifiers, expanding these to multiclass models for nuanced CWL prediction, and exploring the benefits of individualized models for enhanced accuracy. Cognitive workload assessment is critical for operator performance and safety in high-demand domains like aviation. Traditional CWL assessment methods rely on subjective reports or isolated metrics, which lack real-time applicability. Machine learning offers a promising solution for integrating physiological data to monitor and predict CWL dynamically. SVMs provide transparent and auditable decision-making pipelines, making them particularly suitable for safety-critical environments.

Methods: Physiological data, including electrocardiogram and pupillometry metrics, were collected from three participants performing tasks with varying demand levels in a low-fidelity aviation simulator. Binary and multiclass SVMs were trained to classify task demand and subjective CWL ratings, with models tailored to individual and combined subject datasets. Feature selection approaches evaluated the impact of streamlined input variables on model performance.

Results: Binary SVMs achieved accuracies of 70.5% and 80.4% for task demand and subjective workload predictions, respectively, using all features. Multiclass models demonstrated comparable discrimination, providing finer resolution across CWL levels. Individualized models outperformed combined-subject models, showing a 13% average improvement in accuracy. SVMs effectively predict CWL from physiological data, with individualized multiclass models offering superior granularity and accuracy.

Discussion: These findings emphasize the potential of tailored machine learning approaches for real-time workload monitoring in fields that can justify the added time and expense required for personalization. The results support the development of adaptive automation systems in aviation and other high-stakes domains, enabling dynamic interventions to mitigate cognitive overload and enhance operator performance and safety.

Yoganandan, N., Somasundaram, K., Harinathan, B., Devaraj, K., Shah, A., Koser, J., Stemper, B., Chancey, V. C., & McEntire, B. J. (2024). Behind armor blunt trauma lung and liver strains from indenter loading via finite element modeling. *ASME Journal of Engineering and Science in Medical Diagnostics and Therapy, 8*(3), 31009. https://doi.org/10.1115/1.4066830

To determine BABT injury criteria, experiments have been conducted by launching blunt projectiles at live swine at velocities up to 65 meters per second (m/s) using one type of indenter design. To ensure the generalizability of the developed injury criteria, additional tests with different indenter designs are needed. The objectives of this study were to evaluate the kinematics and injury parameters from two indenter designs using human body finite element modeling. The simulation matrix consisted of chord and cylindrical shape indenter designs with two different masses of 150 and 230 grams. They were used to impact the liver and lung regions at velocities of 30 and 60 m/s using a human body model. Rib and lung strains from lung impacts and rib strain and liver strain energy densities from liver impacts were used to evaluate the design variables of mass and shape.

Both designs played a role in skeletal and organ injury parameters. Analysis revealed an increased susceptibility for skeletal and organ traumas with the high mass indenter during high velocity impacts. The cylindrical indenter may be protective for organ injuries due to the larger area of loading on the ribcage compared to the chord indenter. Results from the chord indenter may serve as a conservative estimate of injury criteria.

Yue, X., Andres, K., Duffy, M., Rodriguez, R., Aura, C., & Feltman, K. (2025). Measuring pilot physiology during in-flight training and implications for real-time monitoring. *Aerospace Medicine and Human Performance, 96*(5), 447–452. https://doi.org/10.3357/AMHP.6596.2025

Introduction: Real-time monitoring of pilots through physiological responses may provide a means of identifying onset of degraded states. This could potentially be used to introduce methods of preventing negative impacts to performance. However, few studies to-date have examined whether quantitative physiological data can successfully be recorded in actual flight, with even fewer during extreme maneuvering.

Methods: An observational study was completed where physiological data was collected from three Army aviators while they completed an upset prevention and recovery training. The training was through a private company not affiliated with the Department of Defense. Subjects completed multiple flights within a small, acrobatic fixed-wing aircraft. Physiological data (EEG and electrocardiography) were recorded continuously in flight.

Results: The physiological data were evaluated for signal loss and signal quality. The electrocardiography signals were determined as excellent quality based on the metrics proposed previously, with minimal signal loss. Similarly, the EEG recordings had near zero loss of data, except for one of the participant's flights. The EEG quality was determined to be acceptable.

Discussion: This study demonstrates an important step in real-time monitoring. It was demonstrated that qualitative physiological data can successfully be recorded in flight during extreme maneuvering. Further research is needed to determine the utility of such data in relation to pilot state and performance. Demonstration that this type of data can be successfully collected in flight while pilots undergo extreme maneuvers provides promise for using these types of measures across a variety of flight scenarios where a pilot's cognitive states may become degraded.

Technical Reports

USAARL-JAOA-PV--2025-01. **The United States Army Aeromedical Research Laboratory Virtual Reality Vection System (Reprint).** October 2024.
AD1310924

By Temme, L., Nagy, R., & Persson, I.

> The present report describes and documents the USAARL Virtual Reality Vection System (VRVS), a versatile, inexpensive tool to investigate, demonstrate, and characterize vection as a representative example of or type of spatial disorientation (SD). In aviation, SD refers to a pilot's failure to correctly sense the position, motion, and/or attitude of the aircraft with respect to the fixed coordinate system the earth's surface and its gravitational vertical provide. That is, SD refers to the potentially catastrophic situation in which a pilot does not know where the aircraft is heading relative to the surface of the earth. One example of SD is vection, which is the illusion of self-motion in an individual who is not moving. Since vection is a form of SD that can be reliably generated under controlled laboratory conditions, it is a convenient SD example for demonstrations as well as a powerful tool to study and characterize SD and its effects in general. The VRVS as described includes its components, software, hardware, and user interfaces. Tests and evaluations, conducted while creating the VRVS and reported here, demonstrate that the system does reliably provoke vection and thus SD. The VRVS includes two complementary methods for quantifying the presence and magnitude of vection. Moreover, the VRVS enables the simultaneous measurement of vection and symptoms of cybersickness, such as nausea.

USAARL-TECH-FR--2025-02. **Critical review of civilian and military crashworthy aircraft seat performance requirements.** October 2024.
AD1310941

By McEntire, B. J., Willett, J. F., Rhodes, D., & Chancey, V. C.

> DISTRIBUTION STATEMENT C. Distribution authorized to U.S. Government agencies and their contractors; Administrative or Operational Use; 30 SEPT 23. Other requests for this document shall be referred to U.S. Army Aeromedical Research Laboratory (FCMR-UAC/Commander), Bldg 6901 Farrel Road, Fort Novosel, AL 36362.

USAARL-TECH-AR--2025-03. **Examining the effects of head-supported mass on cervical spine biomechanics and injury risk in Special Forces operators.** October 2024. AD1310944

By Brozoski, F., & Madison, A.

> Cervical spine injuries and neck pain are particularly problematic. These injuries and complaints of pain have been linked to head-supported mass (HSM) including helmet, communications, and night vision technology. The Congressionally Directed Medical Research Program (CDMRP) Peer Reviewed Medical Research Program (PRMRP) funded collaborative effort "Examining the Effects of Head-Supported Mass on Cervical Spine Biomechanics and Injury Risk in Special Forces Operators" is one of several dismounted soldier HSM-focused projects at the U.S. Army Aeromedical Research Laboratory. This study, conducted in collaboration with Atrium Health and Duke University, aims to examine the effects of HSM on cervical spine epidemiology, strength/flexibility, and health in Special Forces dismounted populations. This report summarizes the progress made to the aims from August 2022 – July 2023.

USAARL-TECH-AR--2025-04. **Examining the effects of head-supported mass on cervical spine biomechanics and injury risk in Special Forces operators.** October 2024. AD1310946

By Brozoski, F., & Madison, A.

> Cervical spine injuries and neck pain are particularly problematic. These injuries and complaints of pain have been linked to HSM including helmet, communications, and night vision technology. The CDMRP PRMRP funded collaborative effort "Examining the Effects of Head-Supported Mass on Cervical Spine Biomechanics and Injury Risk in Special Forces Operators" is one of several dismounted soldier HSM-focused projects at the U.S. Army Aeromedical Research Laboratory. This study, conducted in collaboration with Atrium Health and Duke University, aims to examine the effects of HSM on cervical spine epidemiology, strength/flexibility, and health in Special Forces dismounted populations. This report summarizes the progress made to the aims from August 2023 – July 2024.

USAARL-TECH-FR--2025-05. **Methodology for development of realistic patient scenarios for research applications.** October 2024.
AD1313903

By Kroening, L., Snyder, S., Lloyd, A., Molles, J., Toelle, R., Kinsler, R., & Ravelli, A.

The U.S. Army Aeromedical Research Laboratory's Enroute Care Group (ECG) research team has performed several research studies that require participants to provide care to simulated patients during data collection. These simulated patients must mimic human anthropometry, display recognizable injuries and symptoms, provide real-time vital signs monitoring, and respond to treatments as expected. To meet these requirements, ECG has iteratively developed a methodology for creating these patient scenarios. Several organizations, such as training centers, also use simulated patients, but there is no standard method of generating patient scenarios. They are frequently generated by experienced medical personnel who rely on their expertise to create patient conditions, vital signs, and such. While this expert input is invaluable, the methodology described in this paper is created with expert input and is based on real patients, including their injuries, prior treatments, and initial vital signs, and so are the representations of what critical care flight paramedics have seen in actual medical evacuation (MEDEVAC) scenarios, enhancing realism and immersion. The specific application of the methodology shown in this paper was for the upcoming "Effect of Tier 2 Responder Assistance on Flight Paramedic Task Saturation During Medical Evacuation" study that ECG will be performing in FY 2025. This methodology is used for research purposes but can also be adapted for use at training facilities that use simulated patients to train medical personnel. Patient requirements are determined during early development of the research protocol, such as casualty evacuation category (i.e., urgent surgical, urgent, priority, or routine) and number of patients needed in each category. This decision is made with the input of a subject matter expert (SME) such as a critical care flight paramedic or flight surgeon, to determine realistic patient configurations in the medical evacuation platform being used. A data request form is submitted to the Joint Trauma System (JTS) Department of Defense Trauma Registry with detailed patient parameters. After receiving de-identified patient records from the JTS registry, the SME down-selects the records, extracts the essential clinical information, then uses it as the basic structure for the simulated patients. The team then designs the scenarios (e.g., decompensation events, alarm causes and timing, responses to interventions) using available technology that meet the study objectives, and program them into the patient simulator software. The simulated patients are dressed with mock injuries to match the injury patterns from the JTS record summary, and tactical combat casualty care (TCCC) cards (also known as Defense Department Form 1380) are created for each patient. Participants review the TCCC cards just prior to the start of data collection and begin treatment based on the TCCC information, injuries presented, and the live vital signs displayed on patient monitors. Treatments given during data collection are input into the simulator program by research team members remotely monitoring the scene so that patients respond to the treatments in real-time. Medical

SMEs on the research team oversee data collection to communicate non-replicable patient conditions to participants, such as skin pallor and type of bleeding, and to advise patient simulator operators on realistic patient responses to treatments. This methodology is an adaptable model for creating realistic simulated patient care scenarios based on the specific patient types and equipment available to the study population in the course of their real-world duties. This report provides a concrete example of the creation of high-fidelity patient scenarios for the purposes of patient-care-centric research.

USAARL-TECH-TR--2025-06. **A replication study of psychophysiological indicators of aviator flight performance for operator state monitoring.** October 2024.
AD1310949

By Mackie, R., Yue, X., Melton, J., Basso, J., & Feltman, K.

The current study replicated the methods used in a previous 2021 study where workload was individualized to the aviator. In the present study, 12 participants completed two visits. The first visit included four flights that allowed the research team to determine individualized workload manipulations for the second visit. In the second visit, participants completed first a baseline flight that consisted of a low, manageable workload, while the second flight consisted of a high workload flight tailored to the individual aviator. Several physiological measures, subjective measures, and performance measures were collected. Despite the larger sample size in the current study compared to the 2021 study, no significant differences in flight performance measures were found between the baseline and high workload flight on the second visit. Several differences in physiological and subjective measures were found. The findings of this study suggest that operator state monitoring efforts will need to take into account individual differences in physiological responses to increased task demands.

USAARL-TECH-TR--2025-07. **Arctic testing and evaluation of medical equipment set and blood fluid warmer performance for en route care.** October 2024.
AD1310953

By Lawson, C., Black, R., Cupples, M., & Snyder, S.

Arctic operations are typically defined as those that occur in subzero degrees Celsius (°C) operating environments. The operational, environmental, and logistical challenges faced by U.S. Army rotary-wing MEDEVAC units supporting remote patient evacuation efforts in these settings are formidable. The current Joint En Route Care Equipment Test Standard guidance for climatic – low temperature testing of electronic medical equipment set (MES) items used in en route care is inadequate for MEDEVAC operations in the Arctic. Overall, critical care flight paramedics in Alaska are performing MEDEVAC missions with a low temperature operating goal of -40 °C (-40 degrees Fahrenheit [°F]). The Enroute Care Group test & evaluation team completed a test plan to address climatic-low temperature testing gaps for several electronic patient movement items (PMI) in the U.S. Army's air ambulance MES. All test articles were evaluated using battery life to a low temperature testing threshold of -40 °C (-40 °F). Electronic PMI tested included the Hamilton Medical T1 Ventilator, ZOLL Medical Propaq MD, and the Belmont Medical Technologies Buddy Lite AC. Additionally, several commercial-off-the-shelf blood fluid warmers were tested in this project, to include the Buddy Lite XP AC, EMIT Corporation HX100 and LG, and °MEQU °M Warmer System.

USAARL-TECH-BB--2025-08. **U.S. Army Aeromedical Research Laboratory FY24 annotated bibliography.** October 2024.
AD1313904

By USAARL Science Information Center

Open literature publications, technical reports, technical memorandums, oral presentations, and poster presentations by USAARL are included in this annotated bibliography, this edition dated October 2024.

USAARL-TECH-TR--2025-09. **Optimizing adaptive automation in aviation: A literature review on dynamic automation system interaction.** November 2024.
AD1313907

By Vogl, J., D'Alessandro, M., Wilkins, J., Ranes, B., Persson, I., McCurry, C., & Bommer, S.

This literature review examines the evolution of adaptive automation in aviation, comparing foundational research with modern advancements (2013-2023) to identify best practices for future automated systems. Automation has been pivotal in reducing pilot workload and enhancing safety; however, it also introduces challenges such as over-reliance, disengagement, and diminished situational awareness. With the growing complexity of modern military aircraft systems and increasingly dynamic operational environments, adaptive automation offers a promising solution by dynamically adjusting to the pilot's workload and environmental conditions. Key areas explored include automation activation processes—static, adaptable, and adaptive—and their respective impacts on safety and operator performance. Literature review findings emphasize the importance of maintaining situational awareness, particularly during automation handoffs. Transparency in automation interfaces is crucial, ensuring pilots remain informed about system decisions and actions both in real-time and in near-future projections. This is especially important in high-stakes environments, where failure to properly manage automation transitions can lead to catastrophic outcomes. The review concludes with recommendations for future adaptive automation systems in aviation, focusing on dynamic task allocation, human-centered interface design, and enhanced transparency to optimize safety and performance. By addressing the risks of automation misuse and disuse, adaptive systems can support human operators while leveraging the strengths of automation to manage increasingly complex aviation scenarios. These guidelines offer a foundation for future research and system development in adaptive automation.

USAARL-TECH-TR--2025-10. **Holistic situational awareness and decision-making operator state monitoring final report.** November 2024.
AD1314714

By Godfroy-Cooper, M., Miller, J., Alicia, T., Yue, X., Bachelder, E., Turovets, S., Mackie, R., Feltman, K., Mielcarek, N., Szoboszlay, Z., Takahashi, M., Whalley, M., Goerzen, C., Lusardi, J., Fujizawa, B., & Shivers, M.

The operator state monitoring (OSM) study is one component of the Holistic Situational Awareness and Decision Making (HSA-DM) program. The HSA-DM program is focused on identifying CWL drivers and developing cognitive workload management capabilities. The OSM effort was utilized to explore the validity and reliability of metrics selected for the monitoring of pilot CWL and to provide recommendations for operationalization in future Army aircraft. The U.S. Army Combat Capabilities Development Command (DEVCOM) Aviation & Missile Center (AvMC) recruited 24 volunteer participants with relevant experience to complete challenging MEDEVAC scenario vignettes in reconfigurable rotary-wing flight simulators. Over the course of two evaluations utilizing advanced cueing and autonomy design solutions, the pilots' workload was assessed using a variety of techniques. The findings indicate strengths and limitations of each assessment in an operational setting and recommend a hybrid approach of complementary assessment techniques to provide a holistic view of workload and the subsequent impact on warfighter performance. This report describes the operationalization of CWL for this MEDEVAC environment, explores the validity and reliability of the metrics selected for the monitoring of pilot CWL, and provides recommendations for operationalization and further study.

USAARL-TECH-TR--2025-11. **The physical basis of spatial disorientation in flight: A scoping review.** December 2024.
AD1318260

By Sharma, K., Petrassi, F., D'Alessandro, M., Temme, L., Billock, V. A., & Campbell, B.

SD directly interferes with an aviator's ability to maintain proper flight metrics and often results in devastating consequences. To avoid SD, the aviator must be aware of the obstacles and challenges they may encounter in flight that could cause SD. A deeper understanding of the physical and physiological phenomenon resulting in SD may increase the aviator's ability to respond appropriately when the illusion(s) impact cognition, reasoning/decision-making, and general awareness. The vestibular system plays a vital role in the balance and regulation of spatial awareness. We have applied a multidisciplinary approach, including physics, physiology, and state of perception, to bridge many fundamental concepts of how the vestibular system physiologically functions (creating perceptions and responses) and how external forces and variables affect those functions. From a physical standpoint, we explain how the kinematics of aircraft motion can create perceptual illusions that contribute to SD. We provide relevant flight review examples from the aerospace environment. We integrated the physics of those phenomena with perceptual and physiological effects to give a synoptic framework for understanding SD.

USAARL-TECH-TR--2025-12. **An evaluation of tDCS intensities for aviator performance enhancement: Comparison of 1 mA, 1.5 mA, and 2 mA.** December 2024.
AD1318262

By Feltman, K., Mackie, R., Basso, J., & Yue, X.

tDCS is a non-invasive brain stimulation method that has been shown to impact performance. In using tDCS, a researcher must select a number of parameters that can each impact the effects tDCS has on behavioral outcomes. One such parameter is the stimulation intensity. Previous research within our laboratory has demonstrated the utility of tDCS in improving aviator performance using an intensity of 2 mA. However, recent research suggests that lower intensities such as 1 or 1.5 mA may have greater effects on performance. Additionally, a number of individual differences can impact the effectiveness of tDCS. To determine which intensity to use in an upcoming study, a pilot study was conducted where six Army aviators experienced each of the following three intensity values (on separate days): 1 mA, 1.5 mA, and 2 mA. Stimulation was applied during a simulated flight scenario and a number of individual difference measures were collected. Results showed that 1.5 mA demonstrated consistent trends of improving performance. Additionally, individual difference measures such as intelligence and behavioral inhibition were found to have an effect on the outcomes.

USAARL-TECH-TR--2025-13. **Relationships between individual differences, physiological measures, cognitive workload, and task performance: Implications for operator state monitoring.** December 2024.
AD1325398

By Kelley, A., Yue, X., Aura, C., Feltman, K., Mackie, R., & Brooks, J.

The potential to monitor operator states and predict future performance deficits in real-time using physiological metrics continues to expand. Technological advancements continue to drive OSM forward in terms of wearable sensors, data synchronization, and feasibility of use in applied settings. Likewise, advancements in understanding the relationships between physiological measurements, performance, and cognitive states are key to the development of a predictive model with acceptable levels of accuracy and classification. Individual differences, both within- and between-operators, introduce error into the model and need to be accounted for during computation in order to boost model performance. The main objective of this study was to identify and control for both stable (e.g., demographics) and dynamic (e.g., baseline physiology) sources of variance. Results indicated support for EEG-derived measures of cognitive workload, demographic information (education level), and differences in perceived workload as predictors of performance deficits. The resultant sample size limited the analyses and thus further research is warranted.

USAARL-TECH-SR--2025-14. **Field evaluation of head impact sensors in naval special warfare training environments using accelerometer-based environmental sensors.** January 2025.
AD1318263

By Daniel, R., Morehouse, R., & Rooks, T.

DISTRIBUTION STATEMENT C. Distribution authorized to U.S. Government agencies and their contractors; CTI; OCT 24. Other requests for this document must be referred to U.S. Army Aeromedical Research Laboratory (FCMR-UAC/Commander), Bldg 6901 Farrel Road, Fort Novosel, AL 36362.

USAARL-TECH-MT--2025-15. **U.S. Army syphilis testing.** January 2025.
AD1325443

By Snyder, S.

This study determined the prevalence of syphilis among military populations and compared the Centers for Disease Control’s two screening algorithms, traditional (i.e., nontreponemal) and reverse (i.e., treponemal), for syphilis serological testing to make informed policy recommendations regarding screening practices. A retrospective descriptive study of the prevalence of syphilis in the Department of Defense (DoD), specifically the Army aviator and Navy diver communities, was completed using the Defense Medical Epidemiological Database. Overall, the prevalence of syphilis in the DoD was higher from 2016 to 2018 when compared to the national population. No statistically significant correlation was found between a reported diagnosis of syphilis and occupational status, specifically the military occupational specialties of Army aviator and Navy diver. These communities had a notably lower reported prevalence of syphilis when compared to the larger DoD. The Army branch of service and Army aviation community were also found to have a reduced risk of reported disease (i.e., protective factors), especially compared to the Navy branch of service from odds ratios calculated in the study. The traditional algorithm is the most appropriate screening method in the DoD and specific military occupations, such as Army aviator and Navy diver.

USAARL-TECH-SR--2025-16. **Evaluation of commercial-off-the-shelf assistive devices on litter carriage during field-based experimentation – Army Expeditionary Warrior Experiment and Project Convergence Capstone 4.** February 2025.
AD1325404

By Ballard, M. T., Fjerstad, M., Conti, S. M., Robinette, A., Stewart, A., Barazanji, K., Madison, A. M., & Chancey, V. C.

> DISTRIBUTION STATEMENT C. Distribution authorized to U.S. Government agencies and their contractors; Export Controlled; 30 SEPT 24. Other requests for this document must be referred to U.S. Army Aeromedical Research Laboratory (FCMR-UAC/Commander), Bldg 6901 Farrel Road, Fort Novosel, AL 36362.

USAARL-TECH-TR--2025-17. **Investigating the benefits and operational gaps of 3D spatial audio technology in aircraft.** February 2025.
AD1325407

By Noetzel, J., & Brunner, L.

> Three-dimensional spatial audio technology, commonly known as 3D audio, has emerged as a promising tool to enhance communication, situational awareness, and optimize pilot performance in military aircraft. This technology creates a realistic sound environment by allowing listeners to perceive sound as if it is coming from different directions and distances. The implementation of a 3D audio system (3DAS) in military aircraft can improve communication in multi-channel environments, mitigate challenges associated with hearing in noisy settings, and reduce cognitive workload for pilots. Previous research has shown that a 3DAS leads to increased understanding of verbal messages, quicker target acquisition, and aids in threat and collision avoidance.
>
> To gather feedback on the benefits and limitations of 3D spatial audio technology, a 28-question survey was administered to A-10 aircraft pilots who have operational experience using a 3DAS. The survey collected demographic information and asked about the benefits of 3D audio, training experiences, operational gaps, and key mission areas where 3D audio was beneficial. The survey had 16 respondents. Overall, there was general acceptance and benefits were noted by users. Radio separation emerged as a notable benefit in both multiple choice and open text responses. Pilots annotated customizable radio placement and volume adjustments for different channels, as well as the need for noise reduction. Training experiences were varied, including classroom instruction, hands-on training, simulator training, and briefings. Proper fitting of the ear cups in the helmet was emphasized for optimal performance as well. The primary operational gap of the 3D audio system identified is its susceptibility to failure, which can lead to potential performance degradation. Issues included the system entering fallback mode, loss of

noise canceling features, and audio loss from certain sources, making it a single point of failure that affects overall effectiveness and focus.

Overall, the survey provided valuable insights into the utilization, benefits, training experiences, and operational gaps of 3D audio technology in military aircraft operations. Majority of respondents found the technology to be beneficial, although there were some limitations and individual preferences regarding customization and adjustability. Further research should explore the integration of 3D audio and active noise reduction technologies to optimize their effectiveness. Additionally, investigations are needed to assess the efficacy of 3D audio in pilots with hearing loss and explore customization options for individual hearing needs, using real-world experiences and feedback to guide future research and development.

USAARL-JAET-PV--2025-18. **Comparing visual outcomes of keratorefractive lenticule extraction, PRK, and LASIK procedures in the military population (Reprint).** March 2025. AD1325426

By Evangelista, C., Harris, J., Trinh, T., Kohler, P., Mackie, R., Turovets, S., Aden, J., & Capo-Aponte, J.

Purpose: To assess the 6-month visual and refractive outcomes of KLEx as compared with LASIK and PRK in a military population at a Joint Warfighter Refractive Surgery Center.

Setting: JWRSC, Lackland Air Force Base, San Antonio, Texas

Design: Retrospective study

Methods: Patients who underwent KLEx, PRK, or LASIK between 2019 and 2022 were included. Anonymized data collected included demographics, preoperative and postoperative uncorrected and corrected visual acuity, and manifest refraction. Results: Of the 4466 treated eyes, 737 (16.5%) underwent the KLEx, 2801 (62.7%) underwent PRK, and 928 (20.8%) underwent LASIK treatment. Regarding efficacy, there was no statistically significant difference at POM 6 between the percentage of eyes reaching an uncorrected distance visual acuity of 20/20 or better between the three procedures. At POM1 ($P < .001$) and POM3 ($P < .001$), there were a greater number of eyes in the KLEx group that achieved the same or one line better of distance visual acuity than the PRK group. The efficacy indices of KLEx, PRK, and LASIK at POM6 were 1.09, 1.10, and 0.97, respectively. The safety indices for KLEx, PRK, and LASIK at POM6 were 0.96, 1.01, and 0.81, respectively.

Conclusions: After the initial recovery period, KLEx demonstrates comparable outcomes in efficacy, safety, and accuracy as compared with LASIK and PRK.

USAARL-CNPA-BC--2025-19. **Optimizing adaptive automation in aviation: A literature review on dynamic system interaction (Reprint).** April 2025.
AD1329024

By Atchley, J. A., Vogl, J., Ranes, B., Mackie, R., McCurry, C., & Bommer, S.

A current goal of operator state monitoring research is developing models that predict an operator's CWL in real-time to support adaptive automation. It is common in the literature for researchers to create different demand levels for studies involving workload as a manipulation; however, the implementation of automation invalidates these demand levels. The USAARL MATB (a desktop aviation simulator) was utilized because of its inclusion of controllable demand levels and automation functionality. The approach to calculating computational Multiple Resource Theory interference scores and Improved Performance Research Integration Tool (IMPRINT) scores provided by Wickens (2002) and Mitchell (2000), respectively, were applied to the USAARL MATB to calculate theoretical workload values for each possible task combination and automation status. Findings indicate that the scores generated by both approaches were related to performance, subjective workload, and heart rate, supporting the idea that these scores are reflective of CWL and could be a viable replacement for demand levels in research manipulating workload.

USAARL-TECH-SR--2025-20. **Unmanned aerial systems injury risks in military applications.** April 2025.
AD1329027

By Gleason, A. J., Brozoski, F. T., Rooks, T., Johnson, B., Rhodes, D., McEntire, B. J., & Chancey, V. C.

The U.S. Army Aeromedical Research Laboratory received a request from the unmanned aerial systems (UAS) branch of the U.S. Army Aviation Center of Excellence for information on impact characteristics, energy transfer mechanics, and human injury risks associated with UAS use in military applications. This report summarizes findings reported in a briefing given by the Injury Biomechanics and Protection Group at the 2025 Army Aviation Unmanned Aircraft Systems/Launched Effects Summit along with additional discussion on currently available UAS safety standards and injury criteria. Currently available civilian UAS safety standards are discussed along with their origins and associated limitations. There have been recent efforts to update the injury risk limits in current standards to reflect the specific mechanics of UAS to human impacts, but results from those efforts are still limited in their applicability. Large scale efforts in other areas (i.e., automotive, sports, military) have developed a wealth of injury criteria that may be useful in the UAS space, but work is needed to determine applicability to military UAS exposures. This effort has revealed the need for a military-specific UAS safety standard. Collection of military-specific epidemiological data on UAS injuries, and creation of a test methodology to determine the risk UAS pose to personnel in training and operational environments are the next steps toward creating that standard.

USAARL-TECH-AR--2025-21. **U.S. Army Aeromedical Research Laboratory fiscal year 2024 annual historic report.** April 2025.
AD1336910

By Science Information Center

DISTRIBUTION STATEMENT C. Distribution authorized to U.S. Government agencies and their contractors; CTI; FEB 25. Other requests for this document must be referred to U.S. Army Aeromedical Research Laboratory (FCMR-UAC/Commander), Bldg 6901 Farrel Road, Fort Novosel, AL 36362.

USAARL-TECH-FR--2025-22**. Comparison of mass property measurement techniques for head-supported devices between the USAARL legacy mass properties instrument and the new U.S. Army mass property headforms and fixture.** April 2025.
AD1329034

By Logsdon, K. P., Rhodes, D., Flath, N., McEntire, B. J., McGovern, S., Willet, J. F., Johnson, B., Brozoski, F., & Chancey, V. C.

DISTRIBUTION STATEMENT D. Distribution authorized to Department of Defense and U.S. DoD contractors only; Critical Technology; 22 SEPT 23. Other requests for this document shall be referred to U.S. Army Aeromedical Research Laboratory (FCMR-UAC/Commander), Bldg 6901 Farrel Road, Fort Novosel, AL 36362.

USAARL-TECH-TR--2025-23. **Effects of commercial-off-the-shelf assistive devices on long-range field-based litter carriage.** April 2025.
AD1329038

By Ballard, M. T., Robinette, A. M., Stewart, A. S., Fjerstad, M., Conti, S. M., McGovern, S., Madison, A. M., & Chancey, V. C.

DISTRIBUTION STATEMENT D. Distribution authorized to Department of Defense and U.S. DoD contractors only; Export Controlled; 18 SEP 24. Other requests for this document must be referred to U.S. Army Aeromedical Research Laboratory (FCMR-UAC/Commander), Bldg 6901 Farrel Road, Fort Novosel, AL 36362.

USAARL-JAOA-PV--2025-24. **Simulated hearing loss on speech recognition, flight performance, and workload in aviators (Reprint).** April 2025.
AD1333067

By Noetzel, J., Henry, P., Mackie, R., Cave, K., Stefanson, J. R., Hale, J. K., Andres, K., & Jones, H.

Introduction: Hearing loss can compromise U.S. Army aviators' performance, safety, and situational awareness, resulting in increased mental workload and listening effort. This study evaluated simulated hearing loss on performance and cognitive workload among Army aviators.

Methods: A mixed-effects linear regression study design was used. A total of 21 aviators underwent clinical audiological testing and simulated flight performance assessments. Simulated hearing loss and workload were manipulated to investigate their effects on speech recognition, flight performance, and subjective workload. Flight simulator routes included normal hearing and simulated hearing loss conditions for both high and low workloads. Task load questionnaires were administered for subjective workload assessments and compared across conditions.

Results: Speech recognition scores decreased with increasing levels of hearing loss. In-flight speech intelligibility declined in high workload conditions, with a 26% decrease for mild hearing loss and a 40% decrease for severe hearing loss. High workload conditions degraded flight performance and response times to a secondary task which was exacerbated by simulated hearing loss. Workload scores validated increased workload with simulated hearing loss. No significant findings were observed on the hearing assessment.

Discussion: Findings suggest hearing loss negatively impacts speech recognition and flight performance, especially under high workloads. These results support the importance of addressing hearing loss in aviators. Further research is needed to determine if the clinically adapted Modified Rhyme Test can reflect the impact of hearing loss on aviator performance.

USAARL-TECH-TR--2025-25. **Evaluation of novel adaptive optics for aviators.** May 2025.
AD1333074

By Turovets, S., & Trinh, T.

Adjustable focus eyewear, also known as variable focus or self-adjusting glasses, is an innovative type of eyewear that allows users to modify the focal length of the lenses to see clearly at various distances. This technology is particularly beneficial for individuals with presbyopia, an age-related condition where the eye struggles to focus on close objects, but it also serves as a versatile solution for other vision needs. As of 2025, adjustable focus eyewear has been available on the market for several years and continues to advance with new developments. The goal of the proposed activity is to explore the existing technological landscape of adaptive eyewear for presbyopic aviators, the currently existing market of the adaptive eyewear, and conduct engineering tests of a few adaptive glasses available with regard to their performance and declared eyewear specifications independently at the USAARL optical laboratory. The findings of the study indicate strengths and limitations of each assessed prototype of eyewear in an operational setting and result in recommendations on the utility of adaptive eyewear for presbyopic aviators in the future.

USAARL-TECH-FR--2025-26. **The effects of whole-body vibration on critical care tasks and possible mitigation strategies for en route care: Subject matter expert review.** May 2025.
AD1333079

By French Krahn, H. A., Stewart, A. S., Barazanji, K. W., Wagner, C. E., Crowley, J. S., Chancey, V. C., & Rooks, T. F.

Military medical personnel are required to perform life-saving, invasive, medical interventions requiring visual perception and fine motor control while under vibration from ground and air evacuations. As evacuation durations and distances grow, there is a need to develop the capability to perform advanced critical care tasks while en route. The primary objective of this work was to identify: (1) critical care tasks performed en route affected by vibration and (2) learned mitigation strategies to cope with the effects of vibration. The study employed a semi-structured interview surveying SMEs in the community. SMEs also completed a task analysis of the standard medical operating guidelines focusing on those susceptible to vibration. SMEs ($N = 21$) commonly reported cricothyroidotomy, gaining intravenous access and use of sharps, rapid sequence intubation, and use of monitoring equipment as the most challenging tasks. The most common mitigation strategy was to leverage stabilization techniques, such as finding anchor points, propping the patient on a padded surface, or bracing against the aircraft.

USAARL-TECH-TR--2025-27. **Toward data synchronization and real-time processing methodologies for operator state monitoring at USAARL.** May 2025.
AD1333081

By Vogl, J., Atchley, A., Persson, I., Mackie, R., & Feltman, K.

The development of an operator state monitoring system for Future Vertical Lift aviators has been an ongoing program of research at the U.S. Army Aeromedical Research Laboratory. However, development of such a system requires the development of robust algorithms that can take data from physiological measures and use them to predict states indicative of performance degradations. The development of algorithms requires large quantities of data. The researchers at the laboratory intended to combine datasets from previous studies to achieve a larger pool of data for this purpose. However, it was determined that doing so is not feasible given several limitations of the archived datasets. This report details those limitations and provides a solution that will mitigate this from occurring with future datasets. The solution outlined includes the integration of Lab Streaming Layer software into the laboratory's simulator and physiological measurement devices.

USAARL-TECH-MA--2025-28. **Small arms noise dose escalation research project: Experimental blank discharge apparatus operation manual.** May 2025.
AD1335738

By Jones, H., Sept, W., Zollinger, W., Bertsch, B., Ohnstad, T., & Flamme, G.

The current technical report describes the construction of the blank discharge apparatus (BDA) designed for conducting research to identify the maximum tolerable dose (MTD) for impulse noises produced by small arms. Exposure to impulsive noise from small arms is a significant risk factor for auditory injury. Injuries to the auditory mechanism can lead to hearing loss and tinnitus, which can interfere with operational communications, situational awareness, and ultimately, mission success. Temporary threshold shifts compromise service member readiness, lethality, and survivability. The design and procurement of weapons and hearing protection, health hazard evaluations, and training and operational doctrine should include the goals of reducing the risk of auditory injuries and avoiding temporary reductions in hearing sensitivity. The small arms noise dose escalation research (SANDER) project will prospectively determine the candidate damage risk criteria (DRC) that returns the maximum safe allowable number of rounds in quasi-free field and reverberant environments without exceeding the MTD. The SANDER project will use the BDA device to identify the DRC that comes closest to predicting the empirical MTD without exceeding it. The results of this project will inform acquisition, training, and doctrine regarding the impact of small arms impulsive noise on auditory and other blast injuries.

USAARL-TECH-TR--2025-29. **Comparison of visual outcomes between wavefront optimized LASIK and small incision lenticule extraction (SMILE).** June 2025.
AD1335741

By Trinh, T., Capo-Aponte, J., & Turovets, S.

SMILE is a minimally invasive, flapless laser refractive surgical procedure with less propensity for dry eye and better preservation of corneal biomechanics compared to LASIK. However, its benefits in terms of superior visual outcomes remain inconclusive due to study design variability. The preliminary results show that both procedures significantly decrease refractive error, resulting in a mean uncorrected distance visual acuity better than 20/20 by POW2. LASIK eyes had slightly less residual manifest cylinder than SMILE eyes. There was no significant difference between LASIK and SMILE eyes in terms of reported or measured dry eye parameters in this study. Overall, we found no statistically significant differences between LASIK and SMILE across all measured visual and refractive parameters.

USAARL-TECH-FR--2025-30. **Head-supported mass and cervical spine health: A baseline assessment of non-Special Operation Forces Army soldiers.** June 2025.
AD1336495

By Fjerstad, M., Robinette, A., Prusia, M., Stewart, A., Brozoski, F. T., Madison, A., & Chancey, V. C.

There is a limit to how much HSM a soldier can wear during operational exposures before the risk of cervical spine injury and performance degradation outweighs the intended protection and capability. For rotary-wing aviators, these limits have been defined for 25 years and are being reassessed with the introduction of more complex helmet systems and changing mission requirements. Dismounted soldiers, however, do not yet have similar HSM guidelines. Additionally, while the effect of HSM on acute cervical spine injury has been studied, the research is lacking in longitudinal studies assessing HSM effects on chronic cervical spine injury. There is a need for further research to examine HSM effects combined with specific occupational factors that contribute to chronic cervical spine injury. This research is part of a larger research effort, "Examining the Effects of Head-Supported Mass on Cervical Spine Biomechanics and Injury Risk in Special Forces Operators," which is being led by Atrium Health, in collaboration with Duke University and USAARL. USAARL was tasked with collecting data describing cervical spine injury, range of motion, and strength in a healthy, non-Special Operations Forces (SOF) Army population with limited exposure to HSM and vibration environments. USAARL enrolled and evaluated 60 subjects, assessing and recording their cervical spine range of motion (CROM) and cervical spine strength. Averaged CROM data and the neck strength data are presented as a baseline metric to compare with data from experienced HSM wearers. The data from this report will contribute to a greater understanding of HSM effects on chronic cervical spine injury risk for SOF soldiers.

USAARL-TECH-TR--2025-31. **The Integrated Cueing Environment Threat and Hazard Cueing (ICE-TAHC).** June 2025.
AD1335754

By Miller, J.

> This report covers the fourth development iteration of the ICE collision avoidance system (CAS). The ICE CAS was developed by DEVCOM AvMC engineers and scientists for the Degraded Visual Environment-Mitigation (DVE-M) Program. The most recent iteration was developed in support of an operator state monitoring simulator study (Godfroy-Cooper et al., 2024; Godfroy-Cooper et al., 2022) performed for the Holistic Situational Awareness and Decision Making Program. The ICE CAS includes trimodal (visual, spatial-auditory, tactile) obstacle hazard cueing that provides 360° situational awareness about the ownship using a simulated bumper radar scanning three elevations. The simulated radar is based on the physical Echodyne radars that were flown in 2020 as part of the DVE-M flight trials (Miller et al., 2021). It scans 360° in azimuth in 4° increments at elevations -12°, 0°, and +12°. The simulated radar differs from the physical radar in that it is perfectly gimballed and scans the environment with a laser polygon hit test in place of the broad beam of a radar. In flight, the terrain and obstacle geometry database can be used in place of, or with, physical bumper radars. When used, geometry hit tests are ranked identically to radar hits. In addition to bumper radar hits, the ICE CAS indexes ownship location into an obstacle database to determine, and provide cueing for, the nearest power line segment. What follows is an abbreviated description of the cueing that focuses on the incremental changes from version 3 (2020 flight trials; Miller et al., 2021) to version 4 (the current effort). The development and evaluation of the first iteration is discussed in Miller et al. (2018) and Godfroy-Cooper et al. (2018) and the second iteration in Miller et al. (2019), Godfroy-Cooper et al. (2019), Feltman, Hartnett, et al. (2020), and Feltman, McAtee, et al. (2020). As part of the current design iteration, new visual-spatial-auditory aircraft survivability equipment (ASE) threat cueing was added to the ICE obstacle display to present obstacle hazards and ASE threats with a unified and consistent interface. The paired cueing set is referred to as the ICE-TAHC. The ASE systems supported are the radar warning receiver, the missile warning system, and the laser warning receiver.

USAARL-TECH-TR--2025-32. **Multisensory cueing.** June 2025.
AD1335761

By Miller, J., McDermott, D., Gerstner, J., D'Alessandro, M., & Rupert, A.

> The multisensory cueing (MSC) Title X project was initiated in response to an increase in U.S. Army Class A mishaps attributed to SD. These SD mishaps have historically been the leading cause of military aviation accidents and fatalities, with research indicating they account for approximately 30% of all Class A mishaps. The project aimed to

highlight MSC capabilities in both simulator and in-flight environments, initially focusing on integration into the USAARL NUH-60 Black Hawk full-motion simulator before developing an aircraft version for demonstration purposes. In this report, three complementary sensory systems to enhance situational awareness are highlighted: the ICE-TAHC, 3D audio, and the Tactile Situational Awareness System (TSAS). The ICE-TAHC system uses a trimodal approach incorporating visual, spatial-auditory, and tactile inputs to detect obstacle hazards. For threat detection, it switches to a bimodal approach focusing on visual and spatial-auditory cues. The 3D audio system creates spatially rendered sound cues that significantly improve pilots' speech recognition, reduce response times, and decrease perceived workload in complex environments. Furthermore, the TSAS consists of a torso-worn belt with vibrotactile arrays, supplemented by tactors in the seat cushion and shoulder restraints, providing intuitive awareness of orientation and threats. Research has consistently shown that both tactile and 3D audio cueing technologies enhance pilot performance by improving situational awareness and reducing cognitive workload. The ultimate goal of the MSC program is to provide intuitive awareness technologies that enhance both lethality and survivability in Army aviation missions. With continued development, including plans to implement Terma 3D audio in both simulator and helicopter environments, these multisensory systems represent the advancement in human-machine interface design for aviation.

USAARL-TECH-TR--2025-33. **Medical causes of temporary and permanent suspension of flight duty in female Army rotary-wing aviators.** June 2025.
AD1335765

By Wolf, S., & Kelley, A.

Understanding disease prevalence specific to women in aviation service is the key to a comprehensive understanding of the occupational risk. Data were retrieved on 1386 female U.S. Army rated aviators from the Aeromedical Epidemiological Data Repository from the years 2015 to 2023. The dataset yielded a total of 6658 cases of waiver or suspension request. The top ten most frequently occurring diagnoses combining International Classification of Diseases (ICD) ninth and tenth revision codes and ICD chapter headings were calculated. The top three diagnoses associated with a waiver request were lumbar spine pathology (12.4%), cervical spine pathology (6.7%), and headache disorders (6.3%). The top three diagnoses associated with permanent suspension request were lumbar spine pathology (12.5%), depressive disorders (10.8%), and cervical spine pathology (7.8%). The top three ICD chapter headings associated with both waiver and permanent suspension requests were diseases of the musculoskeletal system and connective tissue, mental, behavioral, and neurodevelopmental disorders, and diseases of the nervous system. Overall, the findings were consistent with a similar analysis of female aircrew data from 2005-2015. The results of this study show that no major changes are evident in the conditions impacting female Army aviators with respect to aeromedical disposition in the last eight years compared to the previous decade.

USAARL-TECH-TR--2025-34. **Acoustic testing of the Active Noise Reduction Communication Enhancement and Protective System (ANRCEP) and active noise reduction Head Gear Unit-56/Personal (HGU-56/P) flight helmet.** June 2025.
AD1335769

By Stefanson, JR, & Reeves, E.

DISTRIBUTION STATEMENT C. Distribution authorized to U.S. Government agencies and their contractors; CTI; JUN 25. Other requests for this document must be referred to U.S. Army Aeromedical Research Laboratory (FCMR-UAC/Commander), Bldg 6901 Farrel Road, Fort Novosel, AL 36362.

USAARL-TECH-TR--2025-35. **A comparison of cervical transcutaneous vagal nerve stimulation and transcranial direct current stimulation for maintaining aviator performance.** June 2025.
AD1335770

By Feltman, K., Duffy, M., Mackie, R., Wolf, S., Yue, X., & Turovets, S.

Two types of non-invasive brain stimulation methods were compared to evaluate their impact on aviator performance. These were tDCS and cervical transcutaneous vagal nerve stimulation (tVNS). The study was done in two phases. The first phase evaluated methods of sham tVNS to be used in the comparison phase. In the comparison phase of the study, five participants completed the entire study. The effectiveness of the devices were evaluated using an aviation task, the Psychomotor Vigilance Task (PVT), and a number of side effects measures. The results of the study found evidence for potential performance improvements on the PVT and a reduction in feelings of fatigue with the lower intensity setting of the tVNS device. The lower intensity setting was intended to be the sham method for tVNS. Further research is required to systematically evaluate the impacts of different tVNS intensity settings on performance outcomes in healthy adults.

USAARL-TECH-FR--2025-36. **Environmental sensors in training (ESiT): Head impact program.** July 2025.
AD1340260

By Rooks, T., Kelley, A. M., Brown, B., & Chancey, V. C.

The Traumatic Brain Injury Center of Excellence (TBICoE) tracks the number of diagnosed traumatic brain injuries (TBIs) across the DoD with data available starting in the year 2000 through Quarter 2 of 2024. The TBICoE reports that a total of 509,477 TBIs of all severities have been diagnosed in that time. The need for early and accurate diagnosis of mild TBI (mTBI) has been well recognized and has implications for return-to-duty timelines. Additionally, the need for guidance on when military personnel should seek or be directed to seek evaluation and treatment (if needed) has been a consideration of DoD policy for concussion management (DoD Instruction [DoDI] 6490.11; Headquarters, Department of the Army Executive Order [HQDA EXORD] 165-13). Wearable sensors have been proposed and used as a tool to identify potentially concussive events (PCEs) aiding in the early identification of injury. The Military Operational Medicine Research Program funded the ESiT program to address the challenges of introducing wearable sensors (i.e., environmental sensors) capable of monitoring head impact or blast exposures in military environments. A major goal of the ESiT research program was to evaluate the ability of commercially available devices to identify PCEs resulting from head impact or blast exposures. The present report summarizes the work completed by the USAARL-led head impact exposure arm of the ESiT research program.

USAARL-TECH-FR--2025-37. **Health hazards in military tandem tethered bundled operations.** July 2025.
AD1339276

By Rooks, T. F., French Krahn, H., McGovern, S., Johnson, B., Brozoski, F., & Chancey, V. C.

DISTRIBUTION STATEMENT C. Distribution authorized to U.S. Government agencies and their contractors; Administrative or Operational Use; 24 MAR 25. Other requests for this document shall be referred to the U.S. Army Aeromedical Research Laboratory (FCMR-UAC/Commander), Bldg 6901 Farrel Road, Fort Rucker, AL 36362.

USAARL-CNPA-BC--2025-38. **Critical review of civilian and military crashworthy aircraft seat performance requirements (Reprint).** August 2025.
AD1340277

By Rhodes, D., McEntire, B. J., Willet, J., & Chancey, V. C.

U.S. Army rotary-wing seating system specifications, MIL-S-58095A (AV) (pilot and co-pilot) and MIL-S-85510 (AS) (crew and passenger) provide rigorous safety metrics with the goal of proper occupant protection. Although MIL-S-58095A (AV) has been canceled and MIL-S-85510 (AS) rendered inactive, they are still referenced by the active MIL-STD-1290A. Civilian standards provide an appealing alternative due to less rigorous testing conditions and off-the-shelf, mass-produced materiel for seating systems. Future Vertical Lift (FVL) designers are considering adopting civilian rotary-wing crew seat performance requirements due to a lack of adequate and active specifications requirements. Static and dynamic requirements of the seating system of the U.S. Army's pilot, crew, and troop seat and system requirements/guidance specified in MIL-S-85510, MIL-S-58095A, and JSSG-2010-7 were compared to those of the civilian requirements in SAE AS8049D and SAE AS8049/1 Revision. B. Researchers found that the testing conditions and performance metrics defined by the civilian rotary-wing seating standards are less rigorous than the legacy military seating specifications and, as such, will not replicate the exposures experienced in military operational environments and will likely result in increased occupant injury and mortality rates in severe but otherwise survivable military rotary-wing mishaps. As the rotary-wing seating system is the occupant's last line of defense against crash-induced injury, it is imperative that the military rotary-wing aircraft seating and occupant restraint systems be designed for and tested against stringent, military-relevant, performance and test standards.

USAARL-CNPR-PC--2025-39. **Proceedings of the 2025 Human Center of Gravity Symposium.** August 2025.
AD1340278

By Noetzel, J., Brunner, L., & Jones, H.

DISTRIBUTION STATEMENT D. Distribution authorized to Department of Defense and U.S. DoD contractors only; CTI; JUN 25. Other requests for this document must be referred to U.S. Army Aeromedical Research Laboratory (FCMR-UAC/Commander), Bldg 6901 Farrel Road, Fort Rucker, AL 36362.

USAARL-TECH-TR--2025-40. **Pilot performance in multi-talker environments: Effects of 3D audio and active noise reduction.** August 2025.
AD1340435

By Noetzel, J., Henry, P., Mackie, R., Stefanson, JR, Hale, J. K., Andres, K., McDermott, D., Brunner, L., & Jones, H.

This study investigates the impact of 3D spatial audio and active noise reduction (ANR) on aviators' cognitive workload and flight performance when monitoring multiple radio channels. Laboratory experiments demonstrated that 3D audio significantly enhanced speech recognition, particularly under high auditory workload, and reduced perceived workload, as confirmed by pupil dilation measurements. While increased auditory workload negatively impacted speech recognition, simulator-based experiments revealed no statistically significant differences in speech recognition across listening conditions. However, pilots showed a strong preference for 3D audio, indicating its potential for improving aviator performance and reducing cognitive burden. The study recommends prioritizing the integration of 3D audio into aircraft and suggests further research into optimizing ANR technologies for aviator headsets.

This space is intentionally blank.

USAARL-TECH-TR--2025-41. **Evaluation of patient-specific medical device alarms during multi-patient medical evacuation scenarios.** September 2025.
AD1341106

By Enzor, M., Kroening, L., Kinsler, R., Lloyd, A., Molles, J., Mackie, R., Jones, H., Fralish, V., Hale, J. K., Toelle, R., Ravelli, A., Snyder, S., Price, B., & Owens, C.

The objective of this work was to evaluate 3D audio alarms that may contribute to enhanced medical awareness of patients for care providers in the military medical evacuation environment. The specific effect examined was the alarm response time. Qualitative end-user feedback was also collected to evaluate the efficacy of the alarm configurations. Each subject participated in four 60-minute patient care scenarios, two scenarios with monaural alarms broadcasted over a simulated intercommunication set (ICS) and two scenarios with 3D audio alarms broadcast over the simulated ICS. Each alarm type was used with two- and three-patient configurations. Although statistical significance was not achieved, trends in the reaction time data indicate that the implementation of 3D audio alarms may be beneficial in high workload environments. Average reaction times were reduced between 1–4 seconds in the configurations with the 3D audio alarms compared to the monaural alarms. Subject feedback indicated that 3D audio was well received and had a positive impact on reducing reaction time and directing attention to the necessary patient.

Technical Memorandums

2025-01. **V-22 lessons learned applied to Future Long Range Assault Aircraft (FLRAA) acquisition.** November 2024.

Delivered to: U.S. Army Aeromedical Research Laboratory

Technical point of contact (POC): Michael Wilson

2025-02. **Airworthiness test results for the ZOLL AED 3 aviation defibrillator.** March 2025.

Delivered to: ZOLL Medical Corporation

Technical POC: Robert Eshelman

2025-03. **Army aviator assessment of standard and photochromic helmet visor performance.** April 2025.

Delivered to: Program Manager, Air Warrior

Technical POC: Toan Trinh

2025-04. **Recommended definitions of ocularity of display systems.** April 2025.

Delivered to: U.S. Army Combat Capabilities Development Command Aviation and Missile Command

Technical POC: Christopher Aura

2025-05. **Test results for the PJ Sked and Matbock Origins, LLC Cobra Sled.** April 2025.

Delivered to: United States Special Operations Command, Program Manager, Protection & Integration

Technical POC: David Jones

2025-06. **Test results for the Triton II 490 H and Triton 497 H harnesses.** April 2025.

Delivered to: Product Director MEDEVAC

Technical POC: Vince Fralish

2025-07. **Decompression sickness in unpressurized high-altitude Future Vertical Lift aircraft.** May 2025.

Delivered to: Future Vertical Lift Cross Functional Team

Technical POC: Ian Curry

2025-08. **Test Results for the United States Special Operations Command, MEQU M Warmer System with Power Pack+.** June 2025.

Delivered to: U.S. Special Operations Command, Program Manager, Protection & Integration, Tactical Combat Casualty Care Program

Technical POC: Robert Eshelman

2025-09. **Test Results for the Myrna Advanced Differential Diagnostics System manufactured by Inflammatix, Incorporated.** September 2025.

Delivered to: Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear (CBRN) Defense Joint Program Manager for CBRN Medical Diagnostics

Technical POC: Vince Fralish

Oral Presentations

Atchley, J. A., Vogl, J., Ranes, B., Mackie, R., McCurry, C., & Bommer, S. (2025, 1-3 April). *Optimizing adaptive automation in aviation: A literature review on dynamic automation system interaction* [Oral presentation]. Human Center of Gravity, Fort Novosel, AL.

Barazanji, K., Dhabi, Y., Rahmatalla, S., Deshaw, J., Kinsler, R., Rhodes, D., & Madison, A. (2025, 4-7 August). *Head-neck motion of supine humans during pre-hospital transport: Implications of injury models* [Oral presentation]. Military Health System Research Symposium (MHSRS), Kissimmee, FL.

Barazanji, K., & Rahmatalla, S. (2025, 22 September). *Mechanical vibration - Combined effects of head- and body-worn equipment, posture, and whole-body vibration* [Oral presentation]. International Organization for Standardization Annual Meeting, Edinburgh, UK.

Bommer, S. (2025, 1-3 April). *Identifying adaptive automation opportunities using IMPRINT cognitive modeling* [Oral presentation]. Human Center of Gravity, Fort Novosel, AL.

Brunner, L., & Noetzel, J. (2025, 1-7 April). *Audiology in Army aviation* [Oral presentation]. 2025 Joint Defense Veterans Audiology Conference, Atlantic City, NJ.

Colon-Cruz, J. (2025, April 8). *PTSD and UAS operators* [Oral presentation]. Lyster Aeromedical Problems Course, Fort Novosel, AL.

Crowley, J. (2024, 3-5 October). *Aeromedical aspects of Future Vertical Lift aircraft* [Oral presentation]. International Congress of Aerospace Medicine, Lisbon, Portugal.

Crowley, J. (2024, 3-5 October). *Effects of cockpit technology on Army aircrew and the future of aviation medicine* [Oral presentation]. International Congress of Aerospace Medicine, Lisbon, Portugal.

Curry, I., D'Alessandro, M., Sullivan, C., Berger, T., & Ott, C. (2025, 1-6 June). *Subjective vs. objective measures of workload in an experimental FVL paradigm* [Oral presentation]. Aerospace Medical Association Annual Meeting (AsMA), Atlanta, GA.

Curry, I., & Duffy, M. (2025, April 5-10). *Human Factors Analysis and Classification System* (*HFACS) as a potential confounder in Army aviation mishap analysis* [Oral presentation]. Shoresh, Tel Aviv, Israel.

D'Alessandro, M. (2025, 1-6 June). *Circadian rhythms and intrinsically photosensitive retinal ganglion cells (ipRGCs)* [Oral presentation]. AsMA, Atlanta, GA.

Feltman, K., Kelley, A., Aura, C., & Yue, X. (2025, April 5-10). *Maintaining health and performance with inflight physiological monitoring: Research update* [Oral presentation]. Shoresh, Tel Aviv, Israel.

Feltman, K., Mackie, R., & Yue, X. (2025, 1-6 June). *Evaluation of neurophysiological responses of impending helicopter crash in simulation* [Oral presentation]. AsMA, Atlanta, GA.

French Kranh, H., Stewart, A., Barazanji, K., Wagner, C., Chancey, V. C., & Rooks, T. (2025, 9 June). *Whole-body vibration effects on en route care provider performance - Subject matter expert review of potential mitigation strategies* [Oral presentation]. 'Thursday' Combat Casualty Care Conference, Virtual.

Gleason, A., Brozoski, F., Rooks, T., Johnson, B., Rhodes, D., McEntire, B. J., & Chancey, V. C. (2025, 10-13 February). *Injury risks associated with small UAS (sUAS) in military applications* [Oral presentation]. Army UAS/Launched Effects Summit, Fort Novosel, AL.

Jones, H., & Gerstner, J. (2025, 1-3 April). *Flight to innovation: Navigating challenges in simulator research* [Oral presentation]. Human Center of Gravity, Fort Novosel, AL.

Jones, H., Noetzel, J., Henry, P., Mackie, R., Stefanson, JR, Hale, K., Andres, K., McDermott, D., & Brunner, L. (2025, 4-7 August). *Improved aviator speech recognition and workload reduction with spatial audio* [Oral presentation]. MHSRS, Kissimmee, FL.

Jones, H., & Piehler, T. (2025, 7-9 May). *Conducting the SANDER project: Validating blast exposure damage risk criteria* [Oral presentation]. 9th International Forum on Blast Injury Countermeasures, Tokyo, Japan.

Kelley, A. (2025, 1-3 April). *Operator state monitoring: USAARL update and challenges* [Oral presentation]. Human Center of Gravity, Fort Novosel, AL.

Kelley, A. (2025, April 5-10). *Pre-mission fatigue assessment tools* [Oral presentation]. Shoresh, Tel Aviv, Israel.

Kinsler, R. (2025, April 5-10). *Physiology-based environmental control during casualty transport* [Oral presentation]. Shoresh, Tel Aviv, Israel.

Kinsler, R. (2025, 16 June). *Combat evacuation mission module - Safe Transport and Evacuation Protocol System (STEPS)* [Oral presentation]. En Route Care Research Community Cross Talk, Virtual.

Kinsler, R., Mayer, A., Lloyd, A., Kroening, L., Mackie, R., Grunig, C., McQuaid, J., van der Horn, H., Pacheco, M., Michaliszyn, N., & Molles, J. (2025, 1-6 June). *Novel method for evaluation of the effects of rotary-wing transport on a large animal polytrauma model* [Oral presentation]. AsMA, Atlanta, GA.

Madison, A. (2024, November 12-14). *Small Business Technology Transfer (STTR) topic DHA23C-003: Assistive device technologies for use in military casualty litter transport scenarios* [Oral presentation]. 2024 DoD Exoskeleton Technical Interchange Meeting/Working Group, Washington, D.C.

Madison, A. M., Ballard, M., Novotny, B. L., McGovern, S., Robinette, A., Stewart, A. S., Williams, S. T., Brozoski, F. T., & Chancey, V. C. (2024, November 12-14). *Effects of assistive device use on carry distance and grip strength during simulated litter transport* [Oral presentation]. 2024 DoD Exoskeleton Technical Interchange Meeting/Working Group, Washington, D.C.

Mayer, A. (2025, 4-7 August). *An evaluation of aeromedical evacuation strategies following traumatic brain injury and severe blood loss* [Oral presentation]. MHSRS, Kissimmee, FL.

McCurry, C., & Rock, T. (2025, 1-3 April). *A MATB operator composite scoring methodology for cognitive workload assessment* [Oral presentation]. Human Center of Gravity, Fort Novosel, AL.

McCurry, C., Vogl, J., Atchley, A., Temme, L., & Bommer, S. (2025, 28-31 July). *A MATB operator scoring methodology for cognitive workload estimations* [Oral presentation]. Institute of Electrical and Electronics Engineers National Conference on Aerospace and Electronics, Fairborn, OH.

McMahon, J., Glass, G., Stotka, A., Berthelson, P., Bass, C., Yoganandan, N., McEntire, B. J., & Salzar, R. S. (2025, 22-26 September). *Preliminary lethality risk as a result of behind armor blunt trauma to the heart* [Oral presentation]. Personal Armour Systems Symposium, Bruges, Belgium.

McEntire, B. J., Yoganandan, N., Salzar, R., & Bass, C. (2025, April 23). *Behind armor blunt trauma consortium: Injuries, mechanisms, and biomedical injury criteria* [Oral presentation]. Med-BABT/Behind Helmet Blunt Trauma (BHBT) Stakeholder Meeting, Virtual.

Noetzel, J., Henry, P., & Jones, H. (2025, 4-7 August). *Analysis of audiometric trends in Army aviators: Implications for hearing standards and waiver policies* [Oral presentation]. MHSRS, Kissimmee, FL.

Ranes, B. (2024, 2-6 December). *Warfighter Performance Group capabilities at the U.S. Army Aeromedical Research Laboratory* [Oral presentation]. 2024 Helicopter Military Operations Technology Meeting (HELMOT) XX, Hampton, VA.

Ranes, B. (2025, 4-7 August). *The belief-behavior gap with TIA* [Oral presentation]. MHSRS, Kissimmee, FL.

Ranes, B., & Hoefer, M. (2025, 10-13 February). *Advancing Army UAS capabilities with enhanced operator performance* [Oral presentation]. Army UAS/Launched Effects Summit, Fort Novosel, AL.

Rhodes, D., McEntire, B. J., Willet, J., & Chancey, V. C. (2025, 1-6 June). *Civilian versus military rotorcraft crashworthy seat standards for crash protection* [Oral presentation]. AsMA, Atlanta, GA.

Rhodes, D., Schlick, M., Logsdon, K., Willett, J., McEntire, B. J., & Chancey, V. C. (2024, 22-24 October). *Monitoring pelvis punch through on the Federal Aviation Administration Hybrid III anthropomorphic test device standard pelvis during related vertical testing* [Oral presentation]. SAFE Symposium, Virginia Beach, VA.

Rooks, T. F. (2024, 3 October). *Overview of wearables for head impact monitoring in the DoD and academia* [Oral presentation]. TBI Advisory Council, Virtual.

Rooks, T. F. (2024, 19 December). *Overview of wearables for head impact monitoring in the DoD and academia* [Oral presentation]. Defense Safety Oversight Council - Safety and Occupational Health, Virtual.

Rooks, T., & French Krahn, H. (2025, 1-6 June). *Parachute opening shock in military tandem tethered bundle operations* [Oral presentation]. AsMA, Atlanta, GA.

Rupert, A. (2025, 1-6 June). *SD Type III - Overwhelming or incapacitating?* [Oral presentation]. AsMA, Atlanta, GA.

Stefanson, JR, & Noetzel, J. (2024, 22-24 October). *Research efforts overview from the U.S. Army Aeromedical Research Laboratory* [Oral presentation]. SAFE Symposium, Virginia Beach, VA.

Stotka, A. V., McMahon, J., Berthelson, C., Bass, C., Yoganandan, N., McEntire, B. J., & Salzar, R. (2025, 22-26 September). *Progression of soft tissue contusions in behind armor blunt trauma* [Oral presentation]. Personal Armour Systems Symposium, Bruges, Belgium.

Temme, L. (2025, 1-6 June). *Introducing the ipRGCs* [Oral presentation]. AsMA, Atlanta, GA.

Temme, L., Turovets, S., & Trinh, T. (2025). *Will night vision goggles keep you up at night?* [Oral presentation]. MHSRS, Kissimmee, FL.

Trinh, T. (2025, 1-6 June). *Sensitivity and light adaptation characteristics of intrinsic-photosensitive retinal ganglion cells driven pupillary light responses in patients with mild traumatic brain injury* [Oral presentation]. AsMA, Atlanta, GA.

Trinh, T., & Crowley, J. (2025, April 5-10). *Corneal refractive surgery: Visual performance and innovations* [Oral presentation]. Shoresh, Tel Aviv, Israel.

Tucker, D., Luu, P., Shusterman, R., & Turovets, S. (2024, 10 December). *Electrocortical Neuromorphic Augmented Cognition Transmission (ENACT) for human digital twin communication* [Oral presentation]. North Atlantic Treaty Organization (NATO) Meeting on Human Digital Twins in the Military: Findings and Prospectives, Orlando, FL.

Turovets, S., Trinh, T., & Temme, L. (2025, 1-6 June). *The green and white phosphors night vision goggles spectral characteristics and their impact on circadian rhythms: Experiments and modeling* [Oral presentation]. AsMA, Atlanta, GA.

Vogl, J. (2025, 1-6 June). *Adaptive automation and task demand transitions: Analyzing the impact of transition direction on physiological and cognitive workload recovery* [Oral presentation]. AsMA, Atlanta, GA.

Vogl, J., McCurry, C., Bommer, S., & Atchley, A. (2025, 1-3 April). *On the development of the USAARL MATB* [Oral presentation]. Human Center of Gravity, Fort Novosel, AL.

Wilkins, J., Feltman, K., & Mackie, R. (2025, 1-6 June). *Evaluating EEG activity as a predictor of sleepiness scores in a high-workload flight environment* [Oral presentation]. AsMA, Atlanta, GA.

Wolf, S., & Kelley, A. (2025, 1-6 June). *Medical causes of temporary and permanent suspension of flight duty in female Army rotary-wing aviators* [Oral presentation]. AsMA, Atlanta, GA.

Yoganandan, N., Koser, J., Shah, A., Somberg, L., Wilson, D., Stemper, B., Salzar, R., Bass, C., Chancey, V. C., Johnson, B., & McEntire, B. J. (2025, 22-26 September). *Behind armor blunt trauma lung injury risk curves from different backface deformation profiles* [Oral presentation]. Personal Armour Systems Symposium, Bruges, Belgium.

Yoganandan, N., Salzar, R., Panzer, M., Bass, C., Piehler, T., & Brozoski, F. (2025, April 23). *Stakeholder briefing on medical behind helmet blunt trauma consortium: Biomechanical tolerance for brain injuries and skull fracture* [Oral presentation]. Med-BABT/BHBT Stakeholder Meeting, Virtual.

Yoganandan, N., Shah, A., Koser, J., Stemper, B., Somberg, L., Chancey, V. C., & McEntire, B. J. (2024, 17-21 November). *Behind armor blunt trauma liver injury viscous criteria from live swine tests* [Oral presentation]. International Mechanical Engineering Congress & Exposition, Portland, OR.

Yoganandan, N., Somasundaram, K., Devaraj, K., Harinathan, B., Shah, A., Koser, J., Stemper, B., Chancey, V. C., & McEntire, B. J. (2024, 17-21 November). *Lung and liver injuries in behind armor blunt trauma: A finite element modeling study with different indenter designs* [Oral presentation]. International Mechanical Engineering Congress & Exposition, Portland, OR.

Yue, X., & Feltman, K. (2024, 10-13 December). *An artificial intelligence (AI) framework for real-time flight performance forecasting and assessment* [Oral presentation]. NATO Science and Technology Organization Human Factors and Medicine Panel Modeling & Simulation Group, Orlando, FL.

Yue, X., & Feltman, K. (2025, 1-3 April). *Using physiological measures to evaluate crash dynamics* [Oral presentation]. Human Center of Gravity, Fort Novosel, AL.

Yue, X., & Feltman, K. (2025, 4-7 August). *Using physiological measures to evaluate crash dynamics* [Oral presentation]. MHSRS, Kissimmee, FL.

Poster Presentations

Aura, C., Feltman, K., Vogl, J., Yue, X., & Jones, H. (2025, 4-7 August). *Eye tracking as a correlate of workload, fatigue, and performance* [Poster presentation]. MHSRS, Kissimmee, FL.

Bass, C., Yoganandan, N., Salzar, R., Panzer, M., Sirhan, K., & Brozoski, F. (2025, 4-7 August). *A review of injury criteria for behind helmet blunt trauma* [Poster presentation]. MHSRS, Kissimmee, FL.

Brunner, L., & Noetzel, J. (2025, 4-7 August). *Perceived benefits of spatial audio in military aircraft: Insight from pilot survey responses* [Poster presentation]. MHSRS, Kissimmee, FL.

D'Alessandro, M., Mackie, R., Berger, T., Ott, C., Sullivan, C., Barnett, J., & Curry, I. (2025, 4-7 August). *Cognitive engagement profiling of pilots in high-speed, high-threat scenarios* [Poster presentation]. MHSRS, Kissimmee, FL.

Duemmler, M., McGovern, S., Rhodes, D., Vasquez, K., Beltran, C., Madison, A., McEntire, B. J., Chancey, V. C., & Brozoski, F. (2025, 4-7 August). *Using survival analysis to determine cervical spine injury risk due to head-supported mass during accelerative loading* [Poster presentation]. MHSRS, Kissimmee, FL.

Duffy, M., Feltman, K., & Kelley, A. (2025, 4-7 August). *Evaluating efficacy of sham devices for tVNS* [Poster presentation]. MHSRS, Kissimmee, FL.

Enzor, M., Kinsler, R., Kroening, L., Jones, H., Snyder, S., Stefanson, JR, Fralish, V., Toelle, R., Hale, J., Molles, J., Ravelli, A., Lloyd, A., Price, B., Owens, C., Baugher, K., & Brunner, L. (2025, 4-7 August). *Integrated three-dimensional audio system for conveying medical device alarms to critical care flight paramedics during medical evaluations* [Poster presentation]. MHSRS, Kissimmee, FL.

Enzor, M., Kinsler, R., & Ranes, B. (2025, 4-7 August). *Physiological effects of environmental factors during aeromedical evacuation on patient injuries and health outcomes* [Poster presentation]. MHSRS, Kissimmee, FL.

Feltman, K., Yue, X., Andres, K., & Basso, J. (2025, 4-7 August). *Considerations for wearable requirements for operational use: Lessons learned from Army aviation* [Poster presentation]. MHSRS, Kissimmee, FL.

French Krahn, H., Stewart, A., Barazanji, K., Wagner, C., Chancey, V. C., & Rooks, T. (2025, 4-7 August). *Whole body vibration effects on en route care provider performance - Subject matter expert review of potential mitigation strategies* [Poster presentation]. MHSRS, Kissimmee, FL.

Jones, D., & Lawson, C. (2025, 4-7 August). *Use of anti-rotation device technology for U.S. Army MEDEVAC rescue hoist missions* [Poster presentation]. MHSRS, Kissimmee, FL.

Kelley, A., Feltman, K., & Aura, C. (2025, 4-7 August). *Reliable interpretation of physiological data as it pertains to perceived cognitive workload in aviation* [Poster presentation]. MHSRS, Kissimmee, FL.

Morgan, K., Arumugam, E., Luu, P., Tucker, D., Kelley, A., & Turovets, S. (2025, 4-7 August). *Effects of boosting slow wave sleep stages during daytime flight naps on pilot operational readiness: Preliminary results* [Poster *presentation*]. MHSRS, Kissimmee, FL.

Rifkin, J., Martinez, E., Salzar, R., Bass, C., Panzer, M. B., & Brozoski, F. (2025, 4-7 August). *Computationally modeling brain deformation in BHBT scenarios* [Poster presentation]. MHSRS, Kissimmee, FL.

Rooks, T., Fetchko, T., Aderman, M. J., Malvasi, S. R., Hart, G. J., Cameron, K. L., & Chancey, V. C. (2025, 4-7 August). *Low severity head accelerations associated with concussion: A case series* [Poster presentation]. MHSRS, Kissimmee, FL.

Salzar, R., Stotka, A., McMahon, J., Glass, G., Bass, D., Yoganandan, N., & McEntire, B. J. (2025, 4-7 August). *Behind armor injury risk resulting from cardiac impacts* [Poster presentation]. MHSRS, Kissimmee, FL.

Snyder, S., Carlson, R., Lawson, C., Black, R., & Cupples, M. (2025, 4-7 August). *Testing and evaluation of MES and blood fluid warmer performance for en route care in arctic environments* [Poster presentation]. MHSRS, Kissimmee, FL.

Temme, L., Vogl, J., O'Brien, K., McCurry, C., & St. Onge, P. (2025, 4-7 August). *Toward a qualitative psychophysics of cognitive workload: A new methodology* [Poster presentation]. MHSRS, Kissimmee, FL.

Turovets, S., Mackie, R., Basso, J., & Feltman, K. (2025, 4-7 August). *Electrode to skin impedance conditioning with direct current in applied operational settings* [Poster presentation]. MHSRS, Kissimmee, FL.

Wilkins, J., Feltman, K., & Andres, K. (2025, 4-7 August). *Measuring electroencephalography under an aviator helmet: Implications for in-field wearables* [Poster presentation]. MHSRS, Kissimmee, FL.

Wolf, S., Feltman, K., & Basso, J. (2025, 4-7 August). *Evaluating side effects and tolerability of non-invasive brain stimulation using tDCS for performance maintenance* [Poster presentation]. MHSRS, Kissimmee, FL.

Vogl, J., O'Brien, K., & St. Onge, P. (2025, 4-7 August). *One size does not fit all: A support vector machine exploration of multiclass cognitive state classifications using physiological measures* [Poster presentation]. MHSRS, Kissimmee, FL.

Yoganandan, N., Panzer, M., Salzar, R., Bass, C., Chancey, V. C., & Brozoski, F. (2025, 4-7 August). *A novel paradigm to develop improved medical injury criteria for brain injuries and skull fractures for behind helmet blunt trauma* [Poster presentation]. MHSRS, Kissimmee, FL.

U.S. ARMY AEROMEDICAL RESEARCH LABORATORY

FORT RUCKER, ALABAMA

Optimizing

HUMAN PROTECTION AND PERFORMANCE

since 1962

All of USAARL's science and technical informational documents are available for download from the Defense Technical Information Center.

https://discover.dtic.mil/results/?q=USAARL

U.S. ARMY

FUTURES COMMAND

MRDC