Momentum Wins Wars, Casualties Stop Momentum

Advancing Special Operations Combat Medic Training and Performance in Exceptionally Austere Environments using Augmented Reality Tele-Mentoring, Advanced Biometric Monitoring and AI-Powered Analysis

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BACKGROUND

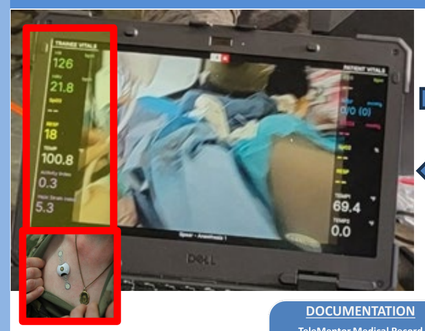
The future of large-scale combat operations (LSCO) are characterized by prolonged and intense casualty care, pushing medics to their limits. Medics will need to provide complex medical care beyond their traditional scope of practice with limited resources and support. It is essential to provide medics with advanced training and real-time access to specialty provider expertise through tele-mentoring. This capability enables medics to receive critical guidance, support during high-stress, high-acuity patient encounters, during training and real-world operational settings.

INTRODUCTION

Experimental training was conducted with Special Operations medics in the Arctic, focusing on augmented reality (AR) tele-mentored surgery, anesthesia, and prolonged casualty care on a moving passenger train in the North American High North. LifeLens devices were placed for continuous biometric and sleep monitoring to inform the impact of stress, extreme weather, and training on performance. AR glasses enabled 2-way communication with medical providers at Brooks Army Medical Center (BAMC) and the Joint Trauma System, providing real-time tele-mentoring, support, and patient data recording. The AR platform shared video, audio, biometric data, and simulated patient vitals. Data was collected and tagged according to a semantic ontology, uploaded into our data platform, and PII was encrypted using AES256 non-deterministic encryption. Subject biometric data was fed into a pipeline consisting of machine learning analysis, conventional data analytics and into an AI powered after action report, enabling near real time feedback of stress and cognitive load.

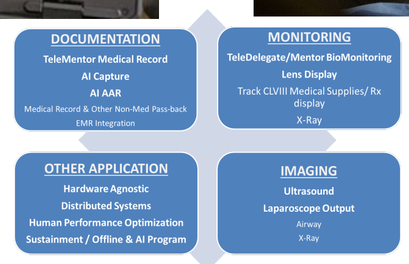
AR HARDWARE

TELE-MENTORING



Tele-mentor View: User vitals on left, patient vitals on right.

Medic performing a procedure with tele-mentoring.



RESULTS

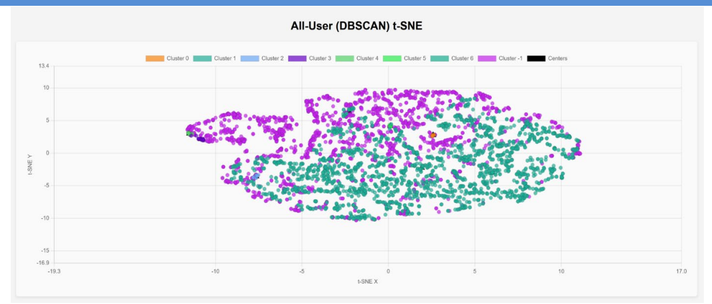


Fig 1. User 1 Biometric Cluster: Medic Anesthesia

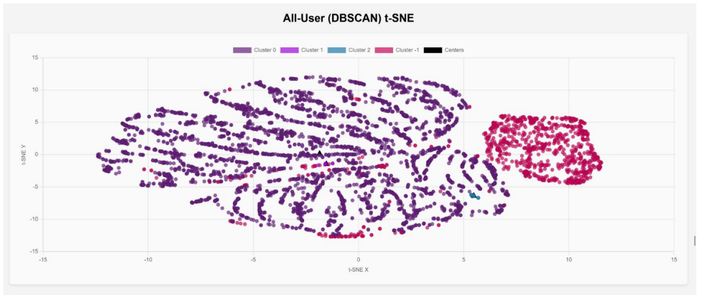


Fig 2. User 2 Biometric Cluster: Medic Surgeon

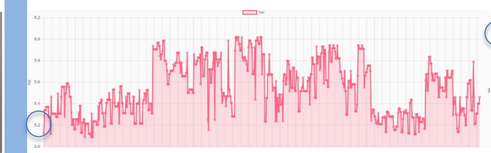


Fig 3. Heat Strain Index Medic Anesthesia

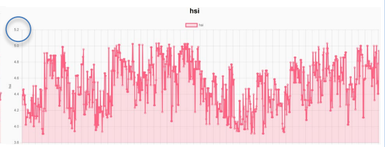


Fig 4. Heat Strain Index Medic Surgeon

RESULTS

After Action Report (AAR)

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AFTER ACTION REPORT (AAR)
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1. OVERVIEW
• Session Date and Time Range:
  - First Reading: 2025-02-21 00:27:39.366000
  - Last Reading:  2025-02-21 00:59:47.385000

• Recommendations:
  - Schedule additional short rest or cool-down periods if repeated sessions mirror
these sustained HR spikes with high Heat Strain.
  - Consider stress-mitigation strategies (hydration, micro-breaks, breathing
exercises) when HRV remains low (<15) for consecutive intervals.
  - Continue monitoring to determine if persistent activity above baseline correlates
with performance decrements or health risks.
  - Compare future sessions for trends in time-lagged correlation (especially HR vs.
Heat Strain), to proactively manage risk of overheating or undue cardiac stress.

8. CONCLUSIONS & RECOMMENDATIONS
• Conclusions:
  - Session exhibits multiple short bursts of elevated heart rate (≥140 BPM) paired
with moderate-to-high Heat Strain (~5.8–5.9). HRV dips in these periods, suggesting
increased cognitive load and physiological stress.
  - Respiration remained moderately elevated (24–30 breaths/min), consistent with
heightened physical or mental demand.
  - Core temperature stayed relatively steady (~100.82–100.89 °F), indicating that
thermoregulation remained fairly controlled, though above global averages.
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CONCLUSION

LSCO operations demands medics provide complex medical care in austere environments, often beyond their traditional scope of practice. This innovative training leveraged AR tele-mentoring, and advanced biometric monitoring to prepare medics for these challenges. Real-time access to specialty provider expertise and feedback enhanced medic performance, and will improve patient outcomes and save lives in very critical situations. This capability will revolutionize how medics train, are supported, and optimize contested logistics in far forward positions to enhance force regeneration.

Future research plans include conducting live surgeries with licensed surgeons as the tele-mentor and mentee, and to create a catalog of live surgeries for use off-line. Additionally, integrating pre-post training cognitive behavioral assessments, eye tracking, event and decision point mapping, and integrated biofeedback training to evaluate stress, cognitive load, and performance.

DISCLAIMER

The opinions and assertions expressed herein are those of the author(s) and do not reflect the official policy or position of the Uniformed Services University of the Health Sciences, the Army Reserve Medical Command, the U.S Army Reserve, Special Operations Command, Northern Command, the Alaska Army National Guard, the Department of Defense or the Department of Veterans Affairs.

OTSG AHRPO 11 FEB 2025, determined that the evaluation of the AR system did not meet the regulatory definition of human subject research IAW 21 CFR 219.102. Biometric Capture was covered under the NHRC IRB, NHRC.2019.0007 (NHRC IRB Version 1.6, dated 8 FEB 2024) with approval from the Alaska NG TAG.