WearOptimo

DEFENSE CAPABILITY

Continuous Hydration Risk Monitoring for Heat-Exposed Defense Personnel

Operational Problem

Military forces do not choose where they fight. They must train, deploy, and sustain combat power in hot, humid, load-bearing environments; and the U.S. Department of Defense now explicitly recognizes that climate change is increasing operational demands and health risks to service personnel. Heat stress and mis-hydration therefore represent more than a medical issue; they are a deployability issue. These challenges degrade cognition, physical output, and decision quality early, often escalating into heat exhaustion, heat stroke, evacuation, and prolonged duty restrictions. Commanders do not need large numbers of casualties for this to become a readiness problem. Loss of even a small number of personnel can degrade the operational viability, deployability and fighting strength of the whole unit.[1, 2, 3, 4, 5]

"Becoming a casualty of heat stress can reduce both individual and unit-fighting strength."

– Defense Health Agency, 2025 [3]

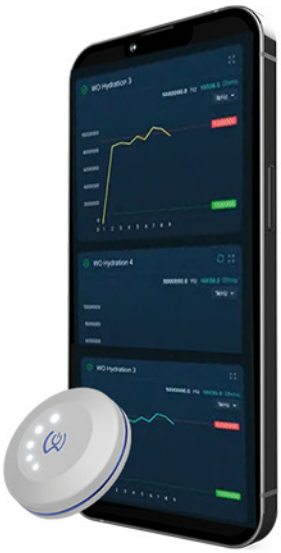
Quantified Impact

Impact area	Evidence-based implication
Mis-hydration is a key modifiable determinant of heat casualties	US Army, Medical Technical Bulletin 507 states that dehydration raises core temperature by ~0.36°F per 1% body-weight loss and contributes directly to exertional heat-illness risk. Army guidance also defines exertional heat illness as a spectrum from dehydration to heat stroke and also identifies hyponatremia from excessive water intake as a significant hazard. [4,8]
Operational burden is already force-wide	Heat illness was among the top five most reported medical events among U.S. active duty service members in 2024. In addition, Defense Health Agency surveillance recorded 12,430 heat illness cases across the active component at 300+ installations and geographic areas worldwide from 2020–2024. 2024 alone included 2,380 heat exhaustion and 471 heat stroke cases. [3]
Training pipelines are hit hardest	In 2024, the heat-exhaustion rate among recruit trainees was 14.9× higher than other enlisted personnel and 31.5× higher than officers, meaning preventable heat events disproportionately remove people from the very pipeline that generates deployable combat power. [2]
Force availability loss is real, not theoretical	Army public-health guidance states that, on average, 2–3 soldiers die annually from exertional heat illness and more than 1,000 soldiers each year require medical attention and/or lost duty time. [4]
Heat can remove combat power at unit scale	NATO guidance reports that during the 2004 Battle of Najaf, Iraq, 10% of engaged forces of engaged forces were incapacitated by heat stress and evacuated, and notes that heat illness can also deplete forward medical support. [9] Expeditionary operations can lose a company-equivalent within days: U.S. Army Military Review, citing British operational experience, states that in austere summer expeditionary operations ~50 heat casualties per 1,000 troops deployed can be expected in the first 10–14 days, enough to cause the temporary loss of more than a company from a brigade-sized response. [10]
Recovery and cost	Military return-to-duty guidance shows moderate/high-risk cases start with 7–14 days of limited activity and are no sooner than 4 weeks to full return, with some cases limited for up to 3 months. Separate military analyses estimate nearly USD $1B in severe heat-injury costs from 2008–2018, including lost duty time, treatment, and medical evacuation. [5,6]

Capability Gap

- Current controls rely heavily on work/rest tables, self-report, and episodic spot checks rather than continuous physiological insight.
- Existing approaches do not provide individual, real-time hydration-risk visibility under body armor, fatigues, or other restrictive equipment.
- Leaders have limited information on the operational viability of their personnel, particularly in hot conditions, before or during a mission, or during training.
- Medics often lack timely team-level visibility to intervene before performance degrades, training stops, or casualties occur.
- Today's typical wearables sit on the skin, and are limited by the skin's barrier, leaving them unable to access key biosignals. This includes light and sweat capture-based devices. Other wearables that do reach important biosignals, can only reliably measure a few signals, and require large (~5 mm) needles – such as those used by Continuous Glucose Monitors (CGMs). Such large needles are often painful and are not suitable for broad uptake.

WearOptimo Capability



WearOptimo is developing a continuous, minimally invasive hydration monitoring platform designed to turn an invisible physiological liability into a visible readiness signal. The technology provides a 'sticker-like' skin-patch sensor that accesses signals that today's wearables cannot reach, in a minimally invasive, pain-free format. The powerful technology platform (17 granted patents; 45 patent filings) works by microelectrodes reaching just a hair's width into the skin, directly detecting key body biosignals & biomarkers. Our novel AI and machine learning algorithms translate this data into real-time actionable health insights for the users.

The intent is to help individuals, leaders, and medics identify evolving hydration risk earlier, before mis-hydration progresses into degraded performance, heat casualties, or avoidable loss of deployable strength.

Capability Snapshot

- **Wear location:** adhesive sensor worn on the arm or shoulder and intended to be suitable for wear under clothing and kit.
- **Wear cycle:** disposable microneedle patch intended for up to 14 days of continuous wear; reusable sensor is rechargeable and targeted for ~12 months service life.
- **Data architecture:** offline-first capture with later sync to a paired smart device; cloud analytics when authorized and available.
- **Outputs:** individual hydration status on a paired device, plus optional supervisor dashboard for team alerts, trends, and reporting.
- **Development model:** staged prototype-to-field program for high-risk defense cohorts and use cases.

Why This Matters

- Targets hydration directly rather than relying only on environmental assessment, indirect proxies or periodic manual checks.
- Aims to provide continuous individual monitoring rather than intermittent spot assessments.
- Designed for austere use cases, including degraded communications and extended wear.
- Supports action at two levels: the individual warfighter and the leader/ medic responsible for force protection and readiness to train and fight.

Operational Value

The value proposition is straightforward: earlier detection, earlier intervention, fewer preventable heat casualties, less training disruption, better deployability, and stronger duty of care. For defense leaders, this is not just a health monitoring tool, it is a potential readiness, safety, and force-protection capability.

GOAL

Keep more personnel mission-capable, more of the time, in the environments where heat risk matters most.

Selected References

1 U.S. Department of Defense. Department of Defense 2024–2027 Climate Adaptation Plan. 2024.

2 Maule AL, Kotas KS, Scatliffe-Carrion K, Ambrose JF. Update: Heat Exhaustion and Heat Stroke Among Active Component Members of the U.S. Armed Forces, 2020–2024. Medical Surveillance Monthly Report. 2025;32(6).

3 V. Hauschild. Defense Health Agency. Military Efforts Preventing Severe Heat Illness Cases. 9 Jun 2025.

4 Army Public Health Center. Heat Illness Fact Sheet 12-005-0316.

5 O'Connor FG, Nye NS, DeGroot D, Deuster PA. Clinical Practice Guideline for the Prevention, Diagnosis, and Management of Exertional Heat Illness. CHAMP/WHEC. 2024.

6 Rowan SD et al. Exertional Heat Illness in the Military: Exploring Factors for Injury, Prevention, and Treatment. 2020.

7 Alele FO, Malau-Aduli BS, Malau-Aduli AEO, Crowe M. Epidemiology of Exertional Heat Illness in the Military: A Systematic Review of Observational Studies. Int J Environ Res Public Health. 2020;17:7037.

8 Dept. of the Army, TB MED 507, Heat Stress Control and Heat Casualty Management (12 Apr 2022)

9 Management of Heat and Cold Stress – Guidance to NATO Medical Personnel. NATO Science and Technology Organization. Dec 17, 2013 DOI: 10.14339/RTO-TR-HFM-187

10 Maj. Erik M. Patton, RG, PhD, U.S. Army. Preparing for Hot Conflicts Army Training and Operations in a Warming World. Military Review. January-February 2025. p132-144.

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