UNDER SECRETARY OF DEFENSE
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WASHINGTON, D.C. 20301-4000

PERSONNEL AND
READINESS

The Honorable Mike D. Rogers
Chairman
Committee on Armed Services
U.S. House of Representatives
Washington, DC 20515

JUL 24 2023

Dear Mr. Chairman:

The Department's response to House Report 117–118, pages 106-107, accompanying H.R. 4350, the National Defense Authorization Act (NDAA) for Fiscal Year (FY) 2022, "Use of Fitness Wearables to Measure and Promote Readiness," and House Report 117–397, page 115, accompanying H.R. 7900, the NDAA for FY 2023, "Use of Fitness Wearables to Measure and Promote Readiness," is enclosed.

The Department aims to continue leading as a change agent committed to innovating, collaborating, and adopting cutting edge wearable health and fitness technology to measure and promote Service member readiness and care. There is both great potential and noted risks for a Department of Defense (DoD)-wide program to use wearables for tracking health and fitness to provide warfighters with key readiness metrics and scores. The Defense Health Agency (DHA) will invest roughly $337M over six wearable related programs from FYs 2021-2027. DHA is coordinating with key military training commands to leverage aggregated health and fitness data and further advance wearable technology systems development.

While great potential to aggregate data exists, consolidated data in a DoD-managed server could also result in a valuable target for adversary exploitation. The Department intentionally strives to design data privacy measures into wearable systems and to preserve privacy of health data protected under Health Insurance Portability and Accountability Act (HIPAA) and personal identifiable information (PII) requirements.

Steps required to safeguard data and maintain privacy protections include, but are not limited to, performing the operations security (OPSEC) cycle, evaluating wearable fitness device usage and location requirements, Service-specific guidance and policies, and wearable device accessories (headphones, Bluetooth, etc.). Any capability of a fitness wearable to capture external data poses a significant risk to classified, and non-public, data. DoD must carefully review fitness wearables under consideration and only allow such wearables that do not have such capabilities.

Additional OPSEC consideration must be paid to fitness wearables' geolocation capabilities, especially when those wearables will be worn while deployed into operational areas. DoD also incorporates cybersecurity mitigation approaches in wearable system design when possible, however, in commercial wearable systems this may be limited. Securing warfighter

wearables data in Government managed cloud-based data repositories is a common design solution DHA has implemented to reduce risk of data exposure.

Thank you for your continued strong support for the health and well-being of our Service members.

Sincerely,

[redacted]

Gilbert R. Cisneros, Jr.

Enclosure:
As stated

cc:
The Honorable Adam Smith
Ranking Member

//signed//

Report to the Committee on Armed Services of the House of Representatives

Use of Fitness Wearables to Measure and Promote Readiness

July 2023

The estimated cost of this report or study for the Department of Defense is approximately $488,000 in Fiscal Years 2018 - 2019. This includes $289,000 in expenses and $199,000 in DoD labor.

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EXECUTIVE SUMMARY

This report is in response to House Report 117–118, pages 106-107, accompanying H.R. 4350, the National Defense Authorization Act (NDAA) for Fiscal Year (FY) 2022, and House Report 117–397, page 115, accompanying H.R. 7900, the NDAA for FY 2023, on the use of fitness wearables to measure and promote readiness. House Reports 117–118 and 117–397 requested that the Secretary of Defense provide a report to the Committee on Armed Services of the House of Representatives on the potential for wearable technology to improve readiness. In order to collate information on current, planned, and recommended programs from the numerous Components which have ongoing activities within the fitness wearables area of interest, the Department of Defense (DoD) submitted interim reports on May 9, 2022 and September 15, 2022.

The House Reports requested the following in the report:

1. An assessment of the potential for a DoD-wide program to use wearable health and fitness trackers to provide the warfighter with key readiness metrics and scores, including activity levels, stress, sleep, heart rate variability, and oxygen saturation.
2. How aggregated data could be used to improve physical readiness programs.
3. What steps would be required to safeguard data and maintain privacy protections.
4. What steps would be required to safeguard classified data in locations where wearables are being used.

The DoD has led multiple analytical efforts to include pilot programs to collect and use data from health and fitness trackers to measure individual and troop readiness. The Department aims to continue harnessing data gathered from health and fitness wearables to demonstrate improved individual performance and resilience, personnel wellness across the unit, and ultimately, to inform and support decisions affecting training, readiness, and mission planning.

BACKGROUND

STRATEGIC ALIGNMENT

The DoD continues to strategically prioritize and align investments to meet the priorities and goals of the National Defense Strategy (NDS). As outlined in the 2022 NDS, the Department's priorities include building a resilient Joint Force and defense ecosystem by building enduring advantages for the future Joint Force through reforms and accelerated force development to deliver technology to Service members.[1]

The NDAA for FY 2022 requires the Secretary of Defense to assess, address, or develop capabilities spanning critical Military Health System (MHS) priorities, including: clinical care, population health, medical research, and bio surveillance.[2] Section 724 of the NDAA for FY 2022 (Public Law 117–118) requires the Department to develop a digital health strategy that incorporates new and emerging technologies and methods, including wearables devices and other innovative methods that leverage new or emerging technologies in the provision of clinical care within the MHS.[2] Section 722 of the NDAA for FY 2022 (Public Law 117–81) requires the

Department to enable collection and stratification of data from multiple sources to measure population goals to improve and integrate wellness services across the MHS.[2] Section 724 of the NDAA for FY 2021 (Public Law 117–81) requires the Department to assess whether medical research entities are manned at a level necessary to support the missions of the Combatant Commands (including with respect to missions related to pandemic influenza or homeland defense).[2] Section 734 of the NDAA for FY 2018,[3] section 253 of the NDAA for FY 2019,[4] and section 742 of the NDAA for FY 2020[5] requires the DoD to determine the feasibility, via studies, of longitudinally recording individual exposures to blast overpressure and impulse noise in the permissive training environment. Additionally, section 717 of the NDAA for FY 2020[5] requires that blast overpressure exposure be recorded in health records when associated with a concussive event.

The 2020 DoD Data Strategy[6] aims to transform the Department into a data-centric enterprise and focuses on the warfighter from the perspective of data usage on the battlefield (i.e., Joint All Domain Operations), improving DoD management (i.e., Senior Leader decision support), and driving informed business decisions at all echelons (i.e., Business Analytics). The strategy specifies that sensors and platforms across all domains must be designed, procured, and exercised with open data standards as a key requirement.[6] Further, it indicates that "survival on the modern battlefield will depend upon leveraging and making connections among data from diverse sources, using analytic tools for superior situational awareness, and coordinating information for disaggregated-precision effects."[6] Finally, it emphasizes that achieving digital modernization, defined by automation to AI to 5G-enabled edge devices, requires connected sensors and platforms.[6]

The Department's current and future planned efforts to leverage health and fitness wearables to improve readiness is guided by the overarching vision, guiding principles, essential capabilities, goals, and objectives outlined in the NDS, NDAA for FY 2021, and 2020 DoD Data Strategy. Through strategic alignment of operational concepts and capabilities, we aim to ensure an enhanced lethal, resilient, agile, and ready Joint Force.

FITNESS WEARABLES OVERVIEW

Wearables are sensors that are worn on or close to the surface of the skin, typically in combination with software applications in the wearable device itself, on smartphones, and tablets.[7] Wearables worn by an individual may collect external data (location data, environmental data, etc.) or physiological data (heart rate, respiratory rate, skin temperature, electrocardiogram, etc.).[7] Wearables may have a wide variety of uses, including fitness/mobility tracking, human performance, contact tracing, clinical decision support, and screening/diagnosis.[7] According to the 2016 DoD Chief Information Officer's Cybersecurity Memorandum[8], wearable fitness devices are defined as devices that are commercially available in the United States and Military Exchange stores globally and marketed as fitness devices for the primary purpose of tracking fitness-related activities (e.g., step counting, heart rate, sleep tracking, etc.). By leveraging both individual and aggregated data, leaders can make better decisions on how to optimally train and fight, while proactively preventing excess exposure to harmful conditions.

Wearable devices, like smartwatches, are ubiquitous in the commercial space due to their convenience, diverse functionality, and rich actionable data that support user-specific insights to enhance situational awareness and inform performance, health, and wellness outcomes. Advances in edge computing (i.e., computation and data storage closer to the devices), cloud computing, and Machine Learning capabilities have resulted in multiple online coaching platforms. The ability for health and fitness trackers to quantitatively measure readiness through readiness metrics and scores, activity level, stress, sleep, heart rate variability, and oxygen saturation uniquely distinguishes the potential impact of wearable technology. Warning signs such as fatigue, pain, injuries, lack of sleep, and lack of focus can be indicative of an individual or unit in need of proper recovery and risk mitigation strategies to optimize their health and return their system back to a "ready" status. Recent studies indicate that over 40 percent of active military personnel experience insufficient sleep, which may contribute to inflammation, stress, obesity, diabetes, cardiovascular disease, neurodegenerative diseases, dependence on sleep aids, poor quality of life, and risk of accidents.[9]

The Department's unique mission drives the application and use cases based on the Service member's (end user) specific needs and requirements, especially with regards to security-related concerns not generally applicable to private-sector, non-DoD users. While utilization of wearables ranges broadly, the Department primarily applies wearables for uses ranging from: training and operations (real or near-real-time for units and/or commanders), enterprise-wide readiness analytics, incident responses (Chemical, Biological, Radiological, Nuclear, and high yield Explosives), research and development (i.e., clinical trials), and clinical care/patient health and wellness. Multiple factors may influence the wearable technology and sensors themselves such as: deployed or in-garrison settings, operations security (OPSEC) concerns, mission needs (i.e., human performance, medical readiness, non-medical, chemical/biological/radiological/nuclear, etc.), form factor (i.e., miniaturized), and timeliness (i.e., real-time or near-real-time). Service member-worn technology could reshape the DoD's ability to monitor and predict situational/environmental awareness, as well as Service member health, wellness, and performance The insights generated could be utilized to monitor the immediate battlespace surrounding the Service member as well as the physical, cognitive, and behavioral aspects of individual warfighter performance, thus providing leadership crucial data to assess and enable force readiness, risk assessment, and mission analysis. Although wearables provide information, the information is only as good as the people trained to utilize it and change/influence behavior. Transforming data into insight for both warfighters and leaders remains a critical component to realizing the true potential wearable technology offers.

Rapid advancements in wearable technologies offers the Department promising solutions to pressing needs; however, an on-going question is whether the underlying accuracy and integrity of data generated through these historically consumer-facing products is adequate to support warfighter and force readiness decisions. Currently, there is limited data regarding the efficacy of sensor technology in wearable devices. Additionally, there is a limited number of recognized wearable data standards, physiological or otherwise that provide actionable device characterization and/or validation guidance. Those that do exist are consumer-focused, governed by laboratory-based testing and evaluation only, and thus do not necessarily map to evolving real-world monitoring or combat use. Furthermore, while these devices offer valuable insight, they also present a range of privacy, OPSEC, and cybersecurity vulnerabilities. For example,

when Service members uploaded data from wearable fitness devices to Strava, heat maps of an individual's exercise routes and Global Positioning System coordinates of military bases were published and available for download.[10] To address these particular risks, the Deputy Secretary of Defense signed the memorandum, "Use of Geolocation-Capable Devices, Applications, and Services," on August 3, 2018, prohibiting DoD personnel from using geolocation features and functionality on both non-Government and Government-issued devices, applications, and services—while in locations designated as operational areas.[11]

SCOPE OF REPORT

House Reports 117–118 and 117–397 requested that the Secretary of Defense submit a report to the Committee on Armed Services of the House of Representatives on the potential for wearable technology to measure and improve readiness. As such, the scope of this report is confined to assessing potential for a DoD-wide program to use wearable health and fitness trackers to provide the warfighter with key readiness metrics and scores (including activity levels, stress, sleep, heart rate variability and oxygen saturation), data aggregation for improved physical readiness programs, steps required to safeguard data and maintain privacy protections, and safeguard classified data in locations where wearables are being used.

DISCUSSION

Efforts Underway

KEY DOD HEALTH AND FITNESS WEARABLES CAPABILITIES

Multiple ongoing efforts between and across the Department are aimed at leveraging health and fitness wearables to measure and improve readiness. The depth and breadth of health and fitness wearable devices across the Department spans the acquisition lifecycle from basic science to advanced development. Multiple programs and portfolios across key DoD agencies, military Departments, and organizations are researching, developing, and procuring wearable health and fitness devices, such as the Defense Health Agency (DHA), Military Services, Combatant Commands, and Defense Threat Reduction Agency (DTRA).

DHA

DHA is a Joint Combat Support Agency that enables the Army, Navy, and Air Force medical services to provide a medically ready force and ready medical force to Combatant Commands in both peacetime and wartime. DHA supports the NDS and Military Departments by leading the MHS as an integrated, highly reliable system of medical training, readiness, and health.[12]

DHA and United States Army Medical Research Development Command have funded key Joint efforts for medical wearable applications to enhance medical readiness and force health protection. DHA has close partnerships with key stakeholders across military, industry, and

academia to assess, evaluate and implement wearable technologies specifically aimed at augmenting Service member medical readiness and training. Commercially developed and Government-sponsored wearable technologies are assessed for deployment scalability spanning monitoring individual Service members to small squad-level units to larger military units (i.e., company, battalion squadron, etc.). Wearable systems are also continuously assessed for data accuracy, quality, and interpretability.

DHA, as a Combat Support Agency, leverages robust partnerships and collaborations with the Military Departments to execute medical readiness-related programs on their behalf.

DHA Science and Technology (S&T)

DHA S&T efforts for wearable technology are guided by the documented gaps in the Military Operational Medicine Initial Capabilities Document (MOM ICD, 2017)[13] that identifies the primary gap being an insufficient ability to protect, sustain, and optimize the physical and psychological health, readiness, and performance of Service members operating in all environments. DHA S&T efforts, through the DoD laboratories and extramural partners, communicate and coordinate to ensure military alignment in cutting edge research that utilizes wearable sensors to address the MOM ICD gap. This supports the ability to develop capabilities that recognize, collect, monitor, track, store, data mine, and assess, in real-time and longitudinally, the Service member's environmental, physical, physiological, cognitive, and psychological condition and health. Specific areas of research focus include: understanding effects on human performance associated with environmental stressors and threats/hazards (e.g., blunt/blast exposure); utilizing wearable sensors to assess human performance and monitoring; and identifying and monitoring the impacts of sleep deprivation among Service members on readiness and performance. DHA S&T laboratories and extramural investments generate tailored algorithms that address these identified gaps that are utilized by leadership and the individual to support and enhance help the behavioral and physical well-being and performance of the Joint Force.

S&T research also operates in the garrison and training environment to generate knowledge products which inform the usability of laboratory innovations and commercial products into a functioning capability. Current research being conducted by DHA S&T includes identification of barriers for utilization of the sensors by the Service member including: optimized compliance with wearable sensors, end user preferences for form/fit/function, and ease of use of the technology. DHA S&T efforts also engage with individual end users and leadership, to include medical and behavioral health personnel to better understand implications of the wearable sensor data. The initial usage of wearable data by Joint leadership contributed to adjustments of battle rhythms in training and deployed environments, resulting in additional rest time for the Service members to promote readiness and increase performance. Individual Service member education on the utility of this data has demonstrated the potential to guide self-regulation and behavioral changes to increase readiness.

The overarching research on both algorithm development and integration of end user needs allows a flexible framework that results in the process of developing, objectively assessing, and validating emerging capabilities for use in garrison, training, and deployed environments. Upon

successful verification of the capability, DHA S&T efforts typically transition to the DHA Advanced Development Acquisition Program portfolio's Health Readiness and Performance System (HRAPS), a system for integration and sustainment.

DHA Advanced Development Acquisition Program Portfolio

DHA's Advanced Development acquisition portfolio, HRAPS, is a system-of-systems program consisting of Government off-the-shelf (GOTS) and modified commercial off-the-shelf (COTS) open-architected, human wearable physiological, cognitive and psychological sensors, algorithms, and suggested leader actions. In training, HRAPS provides Service members, medical staff, and their trainees with physiological status' in real-time to mitigate injuries caused by high-risk training events. In operations, HRAPS provides Commanders with actionable information (i.e., key readiness metrics and scores) in real-time to mitigate non-battle injuries of their Service members, to maintain overmatch and maximize human potential. HRAPS Increment 1 will provide the capability to reduce heat injuries in warfighters. Future increments will provide capabilities to: reduce musculoskeletal injuries, reduce occurrences of hypoxic hypoxia, reduce occurrences of Acute Mountain Sickness, reduce occurrences of dehydration, determine alertness, cognitive status, determine mental and physical fatigue state, detect gunshot and blast events, detect infection before symptoms are present, and improve and optimize individual and small-unit performance.

The HRAPS Increment 1 configuration, the Ascent Platform by LifeLens Technologies, is a patch-based physiological status monitor consisting of a disposable, hypoallergenic patch, a reusable encrypted electronics module ("hub"), a charger case (either single use or centralized use), and a small, environmentally hardened gateway to facilitate secure off-body communications. While it can currently measure activity level and heart rate variability very accurately, future iterations will also be able to provide measures for stress, sleep, and oxygen saturation. HRAPS Increment 1 is being integrated with Program Executive Office (PEO) Soldier's Nett Warrior system to provide small unit leaders with key readiness metrics related to heat stress for all squad members wearing the Ascent Platform.

The Military Services and Combatant Commands

Marine Corps Rapid Capabilities Office (MCRCO) Biosensors

The MCRCO Biosensor project investigated the future of human performance augmentation technologies and their ability to support the individual Marine and unit. The use of biosensor technologies included wearable technologies, jump plate hardware technologies, and athletic analytical software aimed to support improved mission readiness through the understanding of how sleep factors, heart rate, basic jump and body analysis, and daily activity levels can affect individual physical readiness and injury prevention

U.S. Special Operations Command (USSOCOM)

In conjunction with the Air Force Research Laboratory (AFRL), USSOCOM Special Operations Forces Acquisition, Technology, and Logistics, Science & Technology Directorate and the

USSOCOM Preservation of The Force and Family (POTFF) program conducted a 5- year development effort to produce a Government cloud-based (GovCloud) version of a COTS Human Performance Data Management System (HPDMS) to baseline and monitor USSOCOM Operators' physical and cognitive performance, brain health, environmental exposures, etc. in order to optimize Service member performance and/or effect a rapid return to duty, thereby increasing the quality of life of its operators.

Development of the USSOCOM HPDMS facilitates direct aggregation and near-automated data capture of third-party technologies via Application Programming Interface (API) or data import, such as wearables, USSOCOM POTFF program data/technology, Android Tactical Assault Kit (ATAK), and blast exposure monitoring devices, in addition to integrating clinical data with the electronic health record.

Key USSOCOM Efforts:

- **AFRL Signature Tracking for Optimized Nutrition, Training, and Enhanced Recovery (STRONGER) – Developing, Validating, and Fielding Next-Gen Training and Recovery Technologies for USSOCOM:** Unbiased scientific assessment of emerging prototype and commercial performance technologies, to include continuous operational test and evaluation and validation of COTS physiological sensors (wearables Gold Standard Testing). The GovCloud version of HPDMS will enable an agile, flexible data aggregation, analysis, visualization, and actioning system is highly customizable to meet USSOCOM needs at multiple levels (i.e., end users, unit leadership, unit providers).

- **U.S. Army Combat Capabilities Development Command Soldier Center – Optimizing The Human Weapon System (OHWS) Pilot at Special Forces Underwater Operations School:** Equipping Combat Diver Qualification Course instructors and students with wearables, remote data capture, and data aggregation/processing/analysis/visualization in a GovCloud HPDMS. Near-term implementation of tools to monitor student health status (sleep, physical activity, and other physiological measures) until a long-term solution for a Diver Performance Monitoring System to stay ahead of medical emergencies during swimming and diving evolutions is developed/fielded.

- **DHA Advanced Development – Next-Gen Prediction and Causality Analytics for USSCOM HPDMS:** This project, funded by DHA CARES Act funds, is being executed by AFRL. It focuses on the development and fielding of next-gen analytics and integration capabilities for the USSOCOM HPDMS that includes: respiratory illness prediction (including coronavirus disease 2019) from fitness wearables, injury risk prediction from annual physical assessments, automated referrals recommendation for psychological and spiritual support following deployment, integration with electronic medical records (e.g., MHS GENESIS), physical/mental recovery recommendations based on training load monitoring, and manpower utilization for precision resource allocation. USSOCOM also received funding from the Close Combat Lethality Task Force in FY 2019 to collaborate with AFRL for development of Advanced Data

Analytics in the USSOCOM HPDMS for wearables data, USOCOM POTFF program data, etc., tailored to SOF's need.

- **Blast Exposure Monitoring (BEMO) System:** An automated, lightweight, wearable device that will accurately identify, measure, and record USSOCOM personnel exposure to blast overpressure in both training and combat environments. The data gathered will be transmitted to the USSOCOM HPDMS to aid leadership in the monitoring and determination of individual readiness. Further, this data will transmit from the HPDMS to multiple DoD information systems in support of the longitudinal surveillance of warfighter brain health. Currently, USSOCOM has awarded two Other Transaction Agreements for prototyping of BEMO devices.

Department of the Air Force

The Department of the Air Force is pursuing the research and development of wearables to advance the Department's goals for mission-specific performance, affordability, safety, and well-being of Airmen and Guardians. This work is conducted in close collaboration with the other Services and agencies based on the specific mission areas addressed.

Key Department of the Air Force Efforts:

United States Air Force – Air Force Research Laboratory 711 Human Performance Wing (AFRL 711 HPW)

- **FOCUS:** Applied research and development of a pre-mission and real-time fatigue management system including sensors, analytic models, and personalized interventions (on mobile device and on computer) to include non-invasive real-time cognitive state assessment with closed-loop neuromodulation interventions to restore and enhance operator performance.

- **Advanced development of the Airman Data Analysis & Performance Tracking System (ADAPTS):** ADAPTS delivers a (GovCloud) HPDMS that includes mobile fitness applications, wearable sensors, prediction analytics, and visualization software to monitor readiness status of special operations personnel. Dashboards provide fitness and cognitive feedback to enhance human monitoring, assessment, and training capabilities to reduce workload and improve communication and decision-making capabilities for the Airman. ADAPTS forms the tech basis for AFRL's work on behalf of USSOCOM, U.S. Space Force, and OHWS.

- **Arctic Survival Evasion Resistance Escape Health Awareness Responder's Kit (SHARK):** SHARK is an advanced development project that has the capability to integrate physiological system leveraging COTS products and commercial Long-Term Evolution/WiFi network. It features health alerts from configurable vitals thresholds and vital sign baseline and trend graphs with constant awareness of trainee location. Arctic SHARK leverage and modify the SHARK, designed to prevent hyperthermia, to function in cold temperatures. Operator vital data will be integrated into a web-based common

operating picture viewable by cadre or the command staff to ensure safety and rapid responses to dangerous conditions.

- **Integrated Cockpit Sensing (ICS):** The advanced development and integration of multiple select sensors into one system provides real-time Unexplained Physiological Events data analysis in-flight. The ICS system provides an integrated, airworthy, and safe-to-fly solution that enables the saving of lives and aircraft, and improved mission capable rates across the enabled aircraft fleets.

Air Force Lifecycle Management Center (AFLCMC)

- **STOPS:** In December of 2020, the National Commission on Military Aviation Safety published a report to Congress on Military Aviation Losses FY 2013 – 2020 and found that even the most advanced fighter aircraft lack the sensors required to better understand the physiological limits of human performance. The goal of this effort is to address this lack of information by instrumenting aircrew and assessing the military utility of the COTS sensors.

- **Wearables for Combat-Ready Airmen:** Under this effort launching in FY 2024, AFLCMC is seeking sensing and data analysis capabilities that maximize every member's ability to be fit to fight and ready to support United States Air Force missions. Wearable sensors that help prevent or alleviate injuries, optimize rehabilitation routines, maximize performance are desired. Ideally, sensors will be paired with data analysis capabilities showing members their own physical readiness and providing commanders with real-time insight. The 711th Human Performance Wing and AFLCMC, Human Systems Division, Combat Ready Airman Branch, Wright-Patterson Air Force Base, Ohio will conduct a technology assessment that provides information on wearable human performance and human capability tracking systems with a goal of delivering capability applicable to Security Forces.

- **AFRL Materials and Manufacturing Directorate:** The Materials for Aerospace Cognitive Sensing (MACS) program is a new advanced development program. The main objective of the program is to advance materials that will enable cognitive sensing in austere and extreme environments. MACS will conceptualize, design, and develop wearable, airworthy, ambulatory solutions for tracking key eye metrics related to fatigue as well as biomarker cognitive stress detections. The design solutions should be lightweight, comfortable, capable of monitoring for long durations, and stream data wirelessly to a mobile device for real-time decision-making capabilities.

United States Space Force

Key United States Space Force Efforts:

- **Continuous Fitness Assessment (CFA):** CFA is part of the Space Force's Holistic Health Assessment. This capability will use Portable Wearable Fitness Devices and will only collect cardiorespiratory fitness (via VO2 max) and purposeful physical activity

with weekly goals. The intent is to promote continuous physical activity and prevent episodic preparation for episodic fitness tests. CFA will be paired with primary prevention, lifestyle medicine principles, and education and training to ensure Guardians have the tools to promote overall health and wellness, readiness, resilience, retention, and quality of life. This rapid development and acquisition effort is delivering a tested and validated wearable system for fitness assessments. Continuous Fitness Assessment provide a 21st century alternative solution to annual Physical Testing assessments that incorporates wearable technology and cognitive performance testing relevant to Space Force operations. Individual data, actionable and in real-time, utilizing commercial fitness wearables combined with Government data platforms and analytics will provide Guardians rapid and agile touchpoints for intervention to mitigate injury/risk, while also providing immediate positive feedback of performance optimization success."

DTRA-Joint Science & Technology Office (JSTO)

Key DTRA-JSTO Efforts:

- **Rapid Assessment of Threat Exposure (RATE):** DTRA began assessing wearable devices to determine whether COTS products like Fitbits, Garmin watches, Apple watches and the Oura ring might provide enough biometric data to predict that someone is getting sick before the onset of symptoms. Conducting a retrospective analysis using clinical data, it was found that one can predict the onset of hospital acquired infections using a machine learning tool to analyze the data and get approximately a 70 percent confidence rate. Pivoting to the SARS-COV-2 pandemic, an early warning algorithm using data from the Garmin 6 and Oura ring combination, which captures biometric data feeds, was shown to provide an accurate indication of the onset of illness before clinical symptoms occurred. The RATE Operational Demonstration included over 10,000 study participants wearing these devices. Capability specifications that were evaluated included the ability to wear the devices in DoD facilities, feature extraction, cost, ease of data syncing, and battery life. The RATE algorithm continues to be enhanced with the aim of providing a threat agnostic alerting capability to any biological agent exposure prior to symptom onset with guidance on time to symptom onset, duration, severity, and return to duty following CB exposures.

- **Detecting Indicators of Chemical Exposure (DICE):** JSTO-sponsored industry partners are developing individual sensors to detect exposure to chemical warfare agents: opioids, organophosphates, and mustard agents. This effort evaluates the technical feasibility of a combination of enzymatic electrochemical, electrical impedance, and other sensors to detect early exposure to these agents. Development of algorithms for physiological monitoring and adverse event sensing will be programmed onto the device and paired with data storage to provide remote monitoring capability via ATAK compliant wireless data transmission. The sensors will be combined into a single, minimally invasive sensing system combined with body-worn electronics.

- **In-Ear Wearable Device (EWD):** JSTO-sponsored Government partners are collaborating to build and test a customizable EWD to detect the onset of changes in a

warfighter's health state through Autonomic and Bio-Chemical signatures such as heart rate, blood oxygen level, and glucose. Development of algorithms for physiological monitoring and adverse event sensing will be programmed onto the EWD and paired with data storage to provide remote monitoring capability via ATAK compliant wireless data transmission.

Feasibility Analysis

Assessing the potential for a DoD-wide program to use wearable health and fitness trackers to provide the warfighter with key readiness metrics and scores.

There is both great potential and noted risks for a DoD-wide program to use wearables for tracking health and fitness to provide warfighters with key readiness metrics and scores. DHA will invest roughly $337M over six wearable related programs from FYs 2021-2027. Key DHA funded programs and efforts that utilize health and fitness wearables to enhance readiness and care, include: HRAPS, OHWS, ADAPTS, Measuring and Advancing Soldier Tactical Readiness and Effectiveness (MASTR-E), and the USSOCOM POTFF program.

HRAPS

While the initial focus of HRAPS is the dismounted warfighter in operations, the program could be expanded to be a DoD-wide program to use wearable health and fitness trackers to provide the warfighter with key readiness metrics. While the Ascent Platform is very versatile in capabilities, it may not be suitable for all monitoring situations, especially in a non-deployed garrison environment where commercial wearables can be used, and transmission mediums are not as restrictive. HRAPS would seek to expand the use of its small, environmentally hardened gateway to enable secure connectivity between commercial wearables and Government appropriate information systems regardless of environment. Connectivity and performance standards would need to be developed for those commercial wearables that would connect through the gateway. Data pathways would also need to be developed such that a seamless transition would occur if the warfighter entered a secure, operational environment. Integration with multiple service enterprise information systems would be required.

OHWS

The OHWS study is an operating model for embedded research, a true partnership with the units and schoolhouses integrating logistics, planning, mission command, supporting enablers, training and education, and reach back capability. The utilization of commercial wearable technologies and data science (i.e., GovCloud HPDMS) has offered an unprecedented opportunity to monitor and measure human physiological parameters not only in a nonintrusive manner, but in a near-continuous 24-hour cycle. OHWS and its Human Performance (HP) Ecosystem allows the Services to think, learn, and analyze essential HP capabilities, the requirements for automated analyses, and identification of critical relationships that holistically quantify and qualify the Human Weapon System across his or her lifecycle which is essential for successful optimization and readiness.

MASTR-E

The MASTR-E program is a 5-year S&T effort to measure, predict, and enhance Soldier and squad close combat performance. This is accomplished through the quantification of the human trait/state and how it relates to operational outcomes, enhanced training tools that identify performance deficiencies at the Soldier and Squad level, and through the understanding of how novel enhancement techniques and strategies affect performance outcomes to increase resilience and lethality under close combat stress. The utilization of commercial wearable technologies, advanced analytics, and information portrayal systems in addition to Soldier leader derived Measures of Performance and Squad Measures of Effectiveness has enabled the MASTR-E program to develop novel cognitive and physical performance models predictive of close combat performance (Shoot, Move, Communicate, and Navigate) under stress. Ongoing efforts include integrating developed performance models into the OHWS ADAPTS-based GovCloud HPDMS currently in operational use by USSOCOM, HRAPS, and the OSD Advana platform. MASTR-E will provide objective Human Performance information with recommendations in an actionable format so individuals and leaders can reduce risk and increase the likelihood of success and training/mission completion for themselves and their formations.

Building upon the success of programs such as HRAPS, OHWS, ADAPTS, MASTR-E, and USSOCOM POTFF, the Department can utilize such automation efforts to increase its understanding of emerging HP technologies and the identification of human-enhancement opportunities across the acquisition and performance lifecycle. This will lead to an increasingly effective warfighter and present progressively significant improvements in readiness and HP. Given DoD's intent to remain warfighter-focused, it is imperative that a DoD-wide program work with the agencies responsible for development, employment, and deployment to avoid the pitfalls of snapshot-in-time HP assessments. Adopting a multiagency/interdisciplinary approach that utilizes and leverages validated, data-driven decision-making approaches will facilitate marked improvements and results in warfighter health, fitness, and readiness.

Aggregating data to improve physical readiness programs.

To date, the great potential that wearable devices represent for the DoD has not been fully realized. To centralize data architectures, many programs are using the ADAPTS-based GovCloud HPDMS. DHA is coordinating with key military training commands to leverage aggregated health and fitness data and further advance wearable technology systems development. DHA has funded wearable system development to prevent physical and environmental injuries in military recruit and trainee populations. Aggregated wearable system data are being explored to understand how best to implement training regimes and curricula and monitor for initial states of injury. Extending these performance metrics to operational end-user communities is an active area of stakeholder engagement. DHA is investing in developing analytical models to transform wearable sensor measurements into actionable information for force readiness, such as using sleep duration to estimate overall fatigue levels for the purpose of improving shift work planners. While great potential to aggregate data exists, consolidated data in a DoD-managed server could also result in a valuable target for adversary exploitation.

Crew Readiness, Endurance, & Watchstanding (CREW)

CREW is a notable study focused on the feasibility and acceptability of Navy operational use of wearable devices, to include identifying technical and security barriers to sustainability and participant compliance. Over 1,000 Sailors and Marines assigned to Navy warships were enrolled in the FY 2021 effort. The focus on shipboard personnel was due to the known risks of infection associated with operating within close quarters and high-stress environments. The biometric data collected included sleep parameters and additional self-report information, such as illness symptoms and fatigue levels, were assessed to provide the context for wearable data interpretation. Over the course of the initial effort, CREW data was collected with a biometric data capture infrastructure that relied on commercial technology as intended by the device manufacturers, which was not optimized for military use or for the shipboard environment. Despite these limitations, very early in the effort, the sleep health and fatigue data were clearly prioritized by operational partners and stakeholders, and consequently the CREW programmatic and research focus evolved to prioritize investigating sleep health and fatigue management applications using the wearable biometric infrastructure. Given that there has not previously been a method to collect and integrate empirical data in shipboard operational settings, there is currently little understanding as to how candidate crew optimization strategies may be feasible or acceptable to the fleet. Therefore, by exploring associations between device and self-report data with health and performance outcomes, the data collected as part of this research program can also be used to better understand and drive the importance of sleep and fatigue management practices within the Navy.

Integrated Soldier Sensor System (ISSS)

ISSS will monitor external environmental conditions and Soldier performance and health while minimizing Soldier burden by leveraging existing and emerging compact, lightweight, and low-power sensor systems. ISSS will leverage ongoing investments by multiple Army and DoD agencies in emerging wearable sensors and associated algorithm capabilities will be incrementally developed. The following sensing capabilities and associated performance and health risk that lead to actionable information are targeted for Increment 1 based on needs of the training and operational communities: Core temperature estimation - Heat illness/injury risk, Fluid intake - Underhydration or overdrinking/hyponatremia risk, Low blood oxygen - Acute mountain sickness or respiratory compromise, Gait abnormality - Overloading, musculoskeletal overuse, Blast overpressure - Traumatic brain injury (mild – severe) risk, and Gunshot detection - Indication and localization of hostile fire. Deployed wearable sensors and associated algorithms will be evaluated for use in ISSS Increments minimize Soldier burden and accelerate integration of the capability. Performance and health risks that lead to actionable information generated by Increment 2-n capabilities include auditory injury risk, early detection of exposure to chemical and biological agents, early detection of infection, detection of performance degradation, indication of gunshot wound, and cold injury risk.[14]

Steps required to safeguard data and maintain privacy protections.

The Department intentionally strives to design data privacy measures into wearable systems and to preserve privacy of health data protected under Health Insurance Portability and Accountability Act (HIPAA) and personal identifiable information (PII) requirements. Wearable technology data for warfighter performance assessment purposes requires further policy consideration and coordination across the DoD. Steps required to safeguard data and maintain privacy protections include, but are not limited to, performing the OPSEC cycle, evaluating wearable fitness device usage and location requirements, Service-specific guidance and policies, and wearable device accessories (headphones, Bluetooth, etc.).[15] Most DoD studies, prototypes, and pilots closely consider and de-identify personally identifiable data posing potential HIPAA and PII privacy and security concerns. Open source reporting indicates that de-identification is exceptionally hard to properly implement, with many attempts at de-identification being reversed and re-associated with the person in question. Based upon DoD guidance, HIPAA, and PII requirements, the DoD carefully considers risks and adapting commercial wearable systems for DoD use can require that the wearable data be consolidated in a DoD-owned server, rather than the vendor's cloud-based solution. Even when consolidated in a DoD-managed server, the concentration of this data results in a valuable target for adversary exploitation.

In operational scenarios, tactical networks like the Army's Integrated Tactical Network (ITN) must be used to handle the bidirectional flow of information from the battlefield to upper echelons. Programs like PEO Soldier's Nett Warrior enables secure communication over the ITN. Wearables on the battlefield must integrate with Service specific tactical network interfaces and adhere to all security controls of the host system. Testing and approvals (i.e., Authority to Operate (ATO)) must be granted in advance of deploying wearable technologies on the battlefield. This would allow encrypted, de-identified health data to be moved on the network without endangering privacy concerns.

USSOCOM obtained an Impact Level 5 (IL5; PII, PHI and HIPAA Compliant) ATO certification from the Army Analytics Group (AAG) in June 2020 to host its CAC-enabled GovCloud HPDMS in the AAG Cloud in support of the USSOCOM POTFF Program. Additionally, USSOCOM successfully integrated the Health Artifact and Image Management Solution into its GovCloud HPDMS in May 2022 and initiated follow-on API development with DHA for MHS GENESIS integration.

Steps required to safeguard classified data and critical information in locations where wearables are being used.

As outlined in DoD Chief Information Officer Memorandum, "Introduction and Use of Wearable Fitness Devices and Headphones within DoD Accredited Spaces and Facilities," April 21, 2016, the Department has already considered the scope, responsibilities, and implementation requirements for wearable devices and headphones in certain areas where classified data is stored, processed, or transmitted.[8] The memorandum authorizes certain wearable fitness devices that do not have camera or microphone capabilities for introduction and use within DoD offices,

work spaces, and facilities accredited up-to TOP SECRET collateral.[8] The DoD intelligence organizations have issued corresponding guidance for Sensitive Compartmented Information Facilities, with additional restrictions. These policies generally focus on fitness wearables' inclusion of microphone, camera, user-accessible storage (such as for music), or wireless capabilities. Any capability of a fitness wearable to capture external data poses a significant risk to classified, and non-public, data. DoD must carefully review fitness wearables under consideration and only allow such wearables that do not have such capabilities. Additional OPSEC consideration must be paid to fitness wearables' geolocation capabilities, especially when those wearables will be worn while deployed into operational areas. DoD also incorporates cybersecurity mitigation approaches in wearable system design when possible, however, in commercial wearable systems this may be limited. Securing warfighter wearables data in Government managed cloud-based data repositories is a common design solution DHA has implemented to reduce risk of data exposure.

Integrated DoD-wide Efforts

Requirements Development

Given the complementary yet oftentimes overlapping nature of cross-Department missions, budgets, and partnerships, we will closely consider, align, and execute capabilities according to each DoD agency's unique missions and end user needs. Examination of horizontal and vertical capability areas and gaps across the Department will provide ample opportunity for cost savings, consolidation, resource sharing, and improved efficiencies. While such opportunities to collaborate on mutual scope of health and fitness requirements remain ongoing Department-wide, alignment of funding and subsequent DoD agency leading and execution of requirements in accordance with each respective DoD agency's unique mission set will ensure synchronous and continued success.

Service Combat Developer Engagement

Acknowledging each of the Military Department's unique strengths, mission areas, operationalization, manning and equipping requirements will be critical to our success. Engaging and collaborating alongside our Service Combat Developers through requirements development and management processes such as Joint Capabilities Integration and Development System (JCIDS) will be critical to ensuring wearables are procured and sustained according to common Service member and Department needs as well as Service/Military Department-specific end user needs.

To streamline the requirements process, consideration of Joint needs will enable expanded opportunities for funding and consolidated procurement and execution of capabilities. Multiple efforts have already started to address Joint and Service-specific gaps. For example, USSOCOM is currently drafting an Information Systems Capability Development Document (CDD) for its GovCloud HPDMS in support of its transition from the USSOCOM POTFF program to an acquisition Program of Record under PEO SOF Warrior. This will enable follow-on development of a Wearables CDD that connects health and HP data to its GovCloud HPDMS for analysis and feedback (i.e., aggregated data for sleep, training load, recovery feedback, and individual alerts and recommendations).

In addition to a Comprehensive Exposure Monitoring Capabilities Based Assessment, DHA is also developing a Joint CDD to identify and pursue gaps applicable, but not limited to, wearables and physiological status monitoring to enhance readiness and care. Planned Joint CDD efforts aim to engage the Military Departments and Service Combat Developers in the JCIDS requirements development process in order to document and prioritize Joint needs.

Data Aggregation, Data Privacy, and Policy

While the DoD has been committed to securing area and individual-level de-identified warfighter data, many components of data storage, transfer, and download remain unanswered. Open source reporting indicates that de-identification is exceptionally hard to properly implement, with many attempts at de-identification being reversed and re-associated with the person in question.[16] Potential policies, DoD-wide and Service-specific related to data from wearables also need to be considered and developed accordingly. As the Principal Staff Assistant for security, including OPSEC, the Under Secretary of Defense for Intelligence and Security will play a key role in defining appropriate policies and requirements.

Investments and Partnerships

Considering the broad commercial market and applicability that wearable technology can offer begs the need for specified, mission-based end user engagements to properly procure and sustain GOTS and COTS health and fitness wearable technologies. Acknowledging the wide array of COTS capabilities in the market, the Department can achieve progress and innovation at the speed of relevance by expanding and leveraging industry and academic collaborations.

Our existing partnerships and engagements across the medical mission for DHA and Services S&T and Advanced Development portfolios has and will continue to enable the Department to rapidly bring innovative GOTS and COTS fitness and health wearable technologies in the hands of Service members. Pursuit of the DoD's Adaptive Acquisition Framework[17] as appropriate will enable the Department additional flexibility and opportunity to iterate upon custom software development methodologies and tools, cybersecurity and program protection, and Intellectual Property considerations.

DoD Wearables Integrated Acquisition Portfolio Review (IAPR)

As outlined in Deputy Secretary of Defense Memorandum, "Governance Structure for Deputy Secretary Management Process," March 11, 2021, the Department is transitioning to "integrated, portfolio, and systems based processes to enable visibility of risks, dependencies, and opportunities at an enterprise level to optimize strategic insight, synchronization, coordination, and decision-making."[18] An IAPR was conducted in March 2022 wherein the Office of the Assistant Secretary of Defense for Nuclear, Chemical, and Biological Defense Programs authorized the Chemical and Biological Defense Program to utilize Defense-wide funding to pursue a Physiological Monitoring Devices (Wearables) pilot program.[19] The aim of this IAPR includes: 1) assessing the utility of wearable technologies to enable early warning and detection of biological threats, whether naturally occurring, accidental, or deliberate, to protect the force and optimize capabilities, capacity, resilience, and readiness; 2) providing a venue to collaborate between stakeholder organizations with interest in wearable technology investments;

3) informing requirements development; 4) addressing hardware solutions appropriate for military use; and 5) addressing policy, data storage, and cyber concerns and limitations.

The collaboration and coordination across applicable DoD-wide stakeholders through the IAPR forum will enable discussion of common understanding and determination of wearable device, algorithm, architecture, and policy components. This IAPR will strive to acknowledge existing capabilities and investments across the DoD, especially with concern to existing robust health and fitness wearable capabilities and efforts nested with the DoD medical (DHA and Services) mission space. Furthermore, this IAPR will address gaps and constraints associated with wearable technology, such as: integration of requirements, consideration and recommendation of policies, and cyber security challenges and solutions.

CONCLUSION

The DoD remains committed to building resilient and secure enduring advantages for the future Joint Force and defense ecosystem. To accomplish this, the DoD will build enduring advantages for the future Joint Force through reforms and accelerated force development to deliver technologies, such as health and fitness wearable technologies, to Service members. The demonstration of individual-level insight, convenience, and utility that wearable technologies have offered across Federal, commercial, and civilian sectors indicates the promising potential for the Department to continue precisely and proactively measuring and promoting Service member readiness. Wearable technology offers the unique potential for individual Service members and Commanders real-and near-real time measurements of key readiness metrics and scores, including activity level, stress, sleep, heart rate variability, and oxygen saturation. However, when improperly implemented, wearable devices also present risks by offering adversaries that same insight, unauthorized disclosure of classified information, and information regarding sensitive operations and operating locations. The multitude of existing efforts and sizable investments across the Department demonstrates our belief and commitment to the impact that wearable technology offers for measuring and promoting readiness. While the potential for the Department to continue leveraging insight from wearable data will continue to expedite due to the pace of commercialization, innovation, and research across the wearable technology sector, acknowledging inherent risks that wearable technologies also present will remain critical to the Department's broader successful adoption and implementation of wearable technology.

Recognizing and addressing inherent risks – both general and unique to the DoD, such as safeguarding data (both classified and non-classified), maintaining privacy protections, and developing and refining associated policies – remains critical. The DoD is committed to integrating multiple ongoing efforts that leverage data from fitness wearable technologies. Risks will be mitigated by developing specific end-user driven wearables requirements, continuing investments and partnerships, and engaging through the DoD Wearables IAPR forum.

The Department aims to continue leading as a change agent committed to innovating, collaborating, and adopting cutting edge wearable health and fitness technology to measure and promote Service member readiness and care.

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