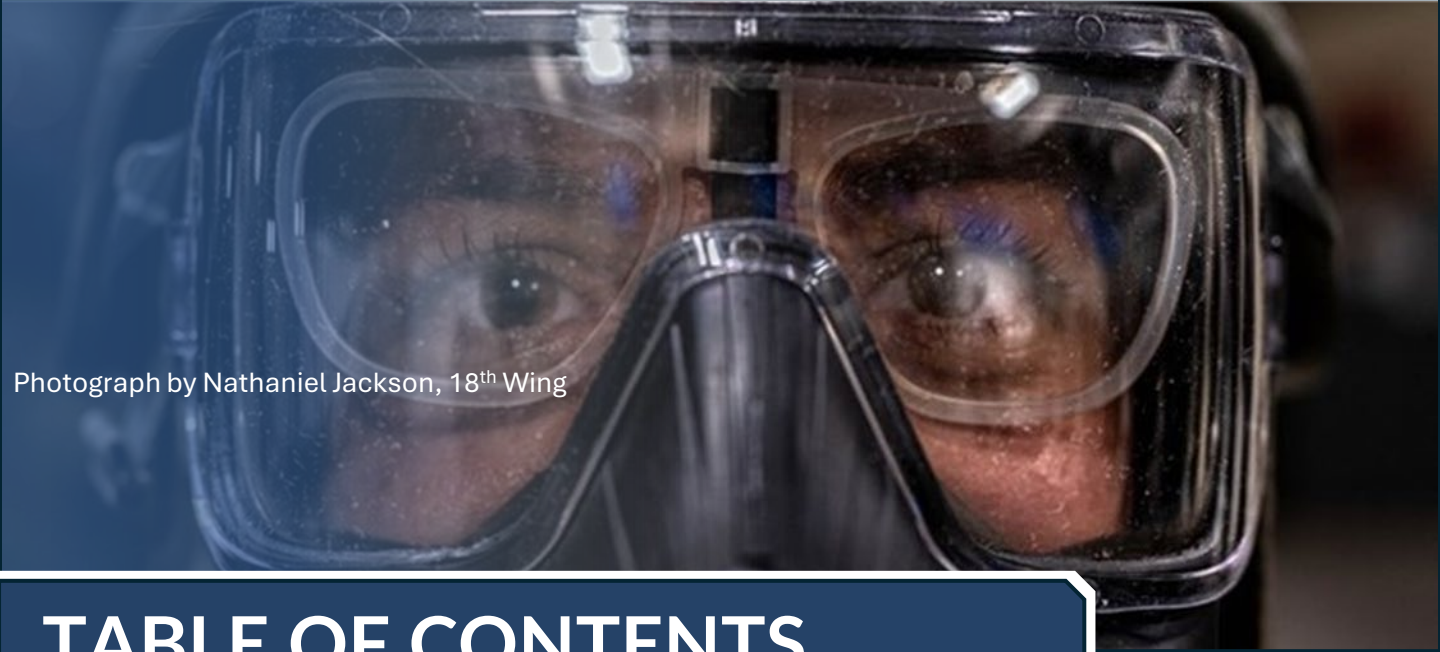




Comprehensive Exposure Monitoring Strategy

2026



Photograph by Nathaniel Jackson, 18th Wing

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FOREWARD

Our most valuable and decisive asset is our people. From the logistics nodes and shipyards of our industrial base to the farthest tactical edge, the health and well-being of every Service member, civilian, and contractor are paramount to our ability to defend the nation. For generations, the Department has worked diligently to protect our personnel from hazards faced in the line of duty. Today, however, the changing character of war and the modernization of our forces introduce an increasingly complex landscape of potential exposures—ranging from legacy chemical and industrial hazards to blast overpressure and emerging environmental threats. Our commitment to mitigating these risks must be stronger, more holistic, and more scientifically advanced than ever before.

The Comprehensive Exposure Monitoring (CEM) Strategy represents a landmark effort to unify and elevate our approach to force health protection. It addresses the critical need to identify and track exposures before they manifest as adverse health outcomes. Moving us beyond fragmented or reactive systems, this Strategy establishes a proactive, data-driven, and enterprise-wide framework. It serves as our roadmap to develop and field the next generation of environmental and occupational monitoring technologies, refine our risk assessment methodologies, and leverage advanced analytics to predict and prevent harm.

Crucially, this Strategy solidifies our commitment to the Individual Longitudinal Exposure Record (ILER). We must ensure that every member of the Total Force has a comprehensive, accurate, and easily accessible lifetime record of their exposures. This data is vital, not only for immediate operational risk management, but also for ensuring our personnel receive specialized medical care and veterans' benefits long after their service concludes.

Implementing the CEM Strategy requires a cultural shift across the Department. It demands that we integrate health and safety considerations into the earliest stages of operational planning and system acquisition. It is about ensuring that we provide our personnel with the safest possible working conditions while deployed or in garrison.

The strategic objectives outlined in this document provide a clear path forward, but success will require the sustained, collaborative effort of the entire defense enterprise. I am confident that, together, we will meet this challenge, uphold our sacred obligation to our people, and build a healthier, more resilient, and more lethal joint force for the future.

EXECUTIVE SUMMARY

The Comprehensive Exposure Monitoring (CEM) Strategy, hereinafter referred to as the Strategy, establishes the Department of War (DoW) Vision, Strategic Objectives, and Guiding Principles to strengthen CEM in support of national security and national defense objectives. Aligned with priorities of continued prosperity, competitive advantage, and military dominance from the 2026 *National Defense Strategy* and 2025 *National Security Strategy*, this Strategy will enable senior leaders to make timely, critical decisions that mitigate health risks and sustain mission assurance. Further, recognizing that exposures encountered through military activities may have lasting impacts on health and readiness, this Strategy establishes a framework that enhances DoW's ability to preserve its personnel by protecting their health and optimizing readiness throughout the entire military lifecycle.

Guided by the Strategy's Vision statement for CEM, the Department will modernize its CEM capabilities under a common framework to improve how the Department anticipates, recognizes, evaluates, documents, and communicates diverse exposure data, information, and indications at all echelons. This approach will enhance the Department's ability to characterize exposures and potential health hazards, employ appropriate exposure controls to reduce risk, and mitigate hazards across the range of military activities.

The graphic below (Figure 1) depicts the Strategy's key elements: Strategic Objectives and Guiding Principles united by a vision for CEM. Together these elements articulate how the Department will achieve technologically advanced CEM capabilities that protect the Total Force, strengthen readiness, and enable mission success in evolving threat environments.

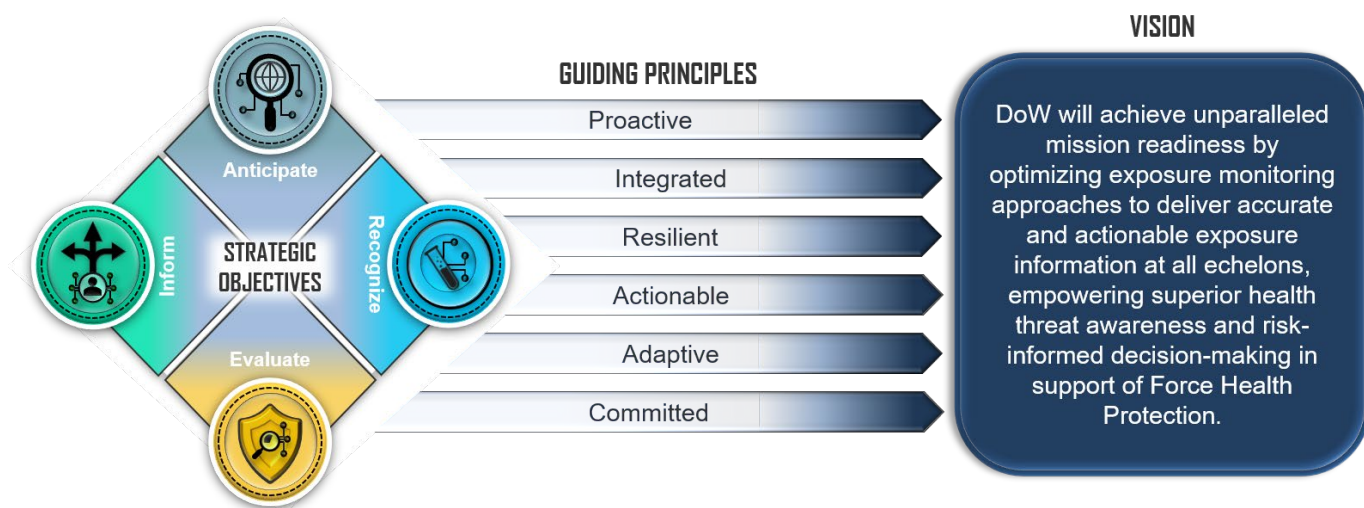
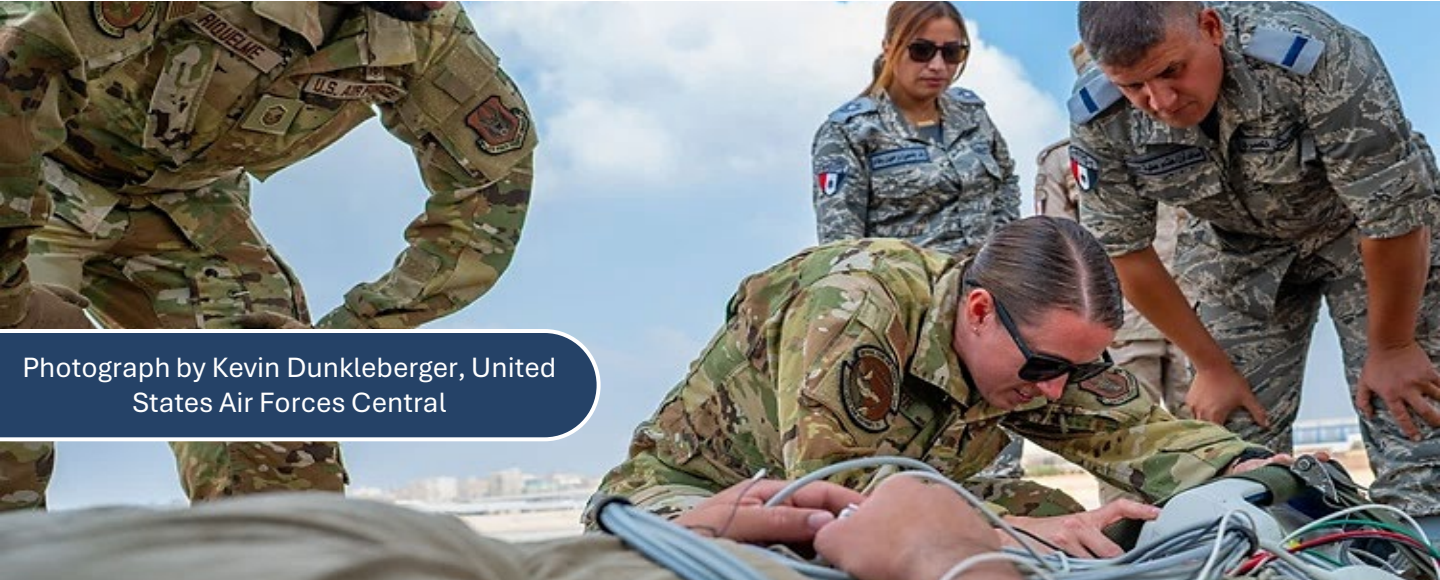


Figure 1. CEM Strategy Key Elements



Photograph by Kevin Dunkleberger, United States Air Forces Central

INTRODUCTION

The Department of War (DoW) conducts CEM by anticipating, recognizing, and evaluating exposures to inform risk management. CEM is conducted across all environments (e.g., deployed, installation or base, garrison, shipboard) and military activities for populations aligned under the Department's Total Force. CEM plays a vital role in safeguarding DoW personnel's health and readiness by informing stakeholders, leaders, and decision-makers about potential health effects caused by hazardous exposures.

CEM improves and enables leader awareness of known risks and potential exposures and their effect on Total Force health and readiness through active and passive exposure monitoring capabilities. This Strategy identifies what activities CEM comprises, who is in the CEM Enterprise, and how CEM enables decision-making and risk management. CEM activities are varied and include collecting, identifying, measuring, and documenting health hazards across DoW personnel's careers and across a broad array of environmental, occupational, and operational exposures, including chemical, biological, and physical exposures. CEM activities also include informing risk assessments and disseminating collected exposure data, and preliminary analysis and information to stakeholders across the Department. Continued investment in CEM capabilities will facilitate improved force health protection (FHP) and empower leaders with reliable and robust information to ensure a secure and strong future for the Total Force.

CEM: *The collection and analysis of data to characterize and assess exposures to potential health hazards, including chemical, biological, and physical (e.g., ionizing and non-ionizing radiation, noise) hazards encountered by Service members, DoW civilians, contractors, and military working animals in garrison, training, and operational activities to prevent and reduce disease or injury incidence and to improve decision-making at all levels in support of Total Force health protection*

SCOPE

What is CEM?

CEM depends on the effectiveness of exposure monitoring and sampling activities conducted across the Department. Exposure monitoring activities can be focused on the environment, the population, or the individual, and include:

Area Monitoring

Collecting and interpreting data from indirect and direct measurements (e.g., noise, chemical, biological, radiological, nuclear [CBRN]) from monitoring performed in the environment and duty-related settings (e.g., air, water, soil) to detect, estimate, and/or quantify a potential health hazard within an area of interest or aligned to the population operating within that area. Area monitoring can be accomplished using area samplers (e.g., vehicle- or drone-mounted), remote sensors (e.g., satellite-based), and/or force tracking information to estimate exposures.

Personal Monitoring

Collecting, analyzing, and interpreting an individual's exposure or physiological response to a potential health hazard. Personal monitoring can be accomplished using specialized worn or carried equipment (e.g., noise, passive chemical or radiation dosimeters, physiological monitoring devices) and/or by collecting and analyzing biological specimens (e.g., blood, serum, urine, tissue) to evaluate potential occupational or environmental exposure. For personnel in high-risk occupations such as fire and emergency services, industrial and hazardous materials operations, munitions personnel, aviation personnel, and other operational roles with elevated environmental or occupational exposure, this includes targeted monitoring for known and suspected carcinogens, toxicants, particulates, combustion byproducts, and other hazardous exposures encountered in the line of duty. These may include volatile organic compounds, heavy metals, per- and polyfluoroalkyl substances (PFAS), diesel exhaust, silica, asbestos, and biologic or chemical agents.

What is CEM?

CEM encompasses not only discrete activities such as exposure monitoring, sampling, examinations, and diagnostics, but also the derivation of risk assessments that guide risk management and healthcare actions. CEM data therefore is critical to safety, health, and operational efforts, including exposure mitigation, preventive medicine, clinical interventions, protective equipment selection, and overall risk management.

Furthermore, CEM data and information provide a link between exposures and medical outcomes for early detection of illness or injury in DoW personnel. Early detection of physical and psychological health conditions is essential to achieving optimal medical outcomes. Moreover, timely exposure identification, analysis, and mitigation reduces lost duty days and health care costs and enables leadership to focus on achieving mission goals. Additionally, exposure monitoring data supports longitudinal and epidemiological studies on chronic conditions related to exposure events. Comprehensive documentation of exposures over a Service member's career is vital to accurately populate the Individual Longitudinal Exposure Record (ILER) and supports the Department of Veterans Affairs in providing appropriate care to our Nation's veterans, adjudicating claims, and processing benefits.

Photograph Sgt. 1st Class Timothy Hughes
18th Theater Medical Command



Wearables: Compact, nonintrusive devices for *personal monitoring* that range from clip-on passive chemical dosimeters to sophisticated physiological monitoring bands that integrate seamlessly into operational gear to provide continuous, hands-free data collection on personnel hazards.

Wearables represent a distinct evolution from traditional, bulky industrial hygiene sampling equipment by enabling discrete, long-duration monitoring without impeding mission critical tasks or requiring active sampling trains (e.g., pumps, tubing)

Who Performs CEM?

CEM relies upon numerous CEM-relevant communities across the Department that conduct, support, and/or leverage CEM activities. These communities make up the broader CEM Enterprise, a body of interconnected organizations across a variety of the Department's functions. The CEM Enterprise includes a diverse array of military occupational specialties, including Public Health Specialists, CBRN Responders, Bioenvironmental Engineers, and Emergency Medicine Technicians, to name a few. Some CEM-relevant communities monitor for exposures and potential exposures, and others support CEM activities by shaping CEM Doctrine, Organization, Training, Materiel, Leadership & Education, Personnel, Facilities, and Policy. Also included are the CEM-relevant communities that leverage CEM activities, such as communities and leaders who use CEM data to derive health risk assessments and inform the hazard mitigation and risk management activities that ensure mission continuity and success. An efficient CEM Enterprise leverages streamlined cooperation and coordination between various equities and echelons. Leaders at all echelons and in all CEM-relevant communities can leverage CEM to inform FHP and readiness decisions. Table 1 documents the primary CEM-relevant communities.

Table 1. CEM-Relevant Communities' Role in CEM Activities

CEM-Relevant Communities		
Conduct CEM	Support CEM	Leverage CEM
	Force Health Protection	
	Occupational and Environmental Health	
	Occupational and Environmental Medicine	
	Industrial Hygiene	
	Toxicology	
	Environmental Compliance	
	CBRN Defense	
	Infectious Disease	
	Warfighter Brain Health	
	Hearing Conservation	
	Comprehensive Health Surveillance	
	Biosurveillance	
	Laboratory Services	
	Preventive Medicine	
	Aerospace Medicine	
	Veterinary Services	
	Public Health	
	Public Health Emergency Management	
	Radiation Health, Radiation Safety	
	Safety	
	Emergency Management	

Evolution of the CEM Enterprise

As far back as the U.S. Civil War, military medical providers have encountered exposures specific to military operations and reacted to them using the tools and knowledge of their time. As knowledge grew and military operational conditions changed, one of the first instances of formalization of CEM came with the recognition of specific environmental and chemical threats, particularly with the widespread use of chemical warfare agents in World War I. The creation of the Chemical Warfare Service in 1918 marked a major shift towards actively monitoring and testing for toxic exposures (Matchette et al., 1995). These early detection methods primarily relied on the accuracy of personnel's senses, such as their sense of smell to determine the presence of chemical agents, or observation and recognition of physiological symptoms of specific agents, such as mustard gas. Further, historical attempts to link the correlation of exposures with causality of health outcomes without a strong scientific basis led to misinformation and thereby increased risk to health and readiness. This supported the need for high quality CEM activities.

Presently, exposure monitoring has grown beyond identification and reporting to incorporate proactive surveillance measures, inter-organizational coordination, long-term documentation, and research efforts to determine risk, better characterize exposures and health hazards, and inform decision-makers of health threats in support of FHP.

As exposure monitoring evolved into a dedicated and increasingly complex capability with evolving threat patterns, the Department responded by investing more in research, training, and technology. Lessons learned from past exposure events informed the CEM Enterprise, enabling improvements in data capture, evaluation, and mitigation strategies. Over time, CEM activities expanded across echelons, involving personnel from a broad range of occupational specialties and CEM-relevant communities that address both traditional and emerging potential threats across diverse environments and scenarios. The exposure landscape was, and continues to be multifaceted, encompassing battlefield operational exposures such as blast overpressure (BOP), open-air burn pit emissions, mixed-source particulate matter, and other complex environmental, industrial, and operational pollutants, as well as novel CBRN threats arising from synthetic chemical agents, engineered biological organisms, and radiological materials (for selected vignettes on historical exposure events, see Appendix E). Furthermore, as operational priorities continue to evolve, leading to expanded activities in environments such as the Arctic regions and the space domain, personnel may face increasingly severe exposures such as extreme heat and cold, as well as novel and less understood health hazards.



Photograph by Edward McBride, U.S. Army
Southern European Task Force Africa

Modernizing the CEM Enterprise

The Department must build upon past and recent investments in CEM capabilities to best protect the Total Force and enable commanders to make informed decisions. As CEM is critical to FHP goals, the Department will prioritize advancements in the CEM workforce, exposure research, and advanced technologies to mitigate challenges associated with sustaining exposure monitoring and sampling activities across the range of military operations.

The Department excels at adapting U.S. Government and academic research and policies to respond to changing strategic and operational landscapes. The Department will strengthen this archive of knowledge by advancing its understanding of military-specific exposures and adverse health outcomes through high-quality and operationally-relevant basic and advanced research. While existing data architectures, systems, processes, and manpower provide a foundation for current CEM activities, these resources require additional investment and alignment to allow the Department to optimally anticipate, recognize, and evaluate exposures to inform health risk management efforts. DoW must take advantage of opportunities to integrate advanced technologies and techniques to capture exposure information associated with novel exposures (e.g., emerging chemicals [such as PFAS] and BOP) and the myriad of potential exposure routes (e.g., dermal absorption, ingestion, secondary contact through contaminated equipment, facilities, and environmental media). This additionally includes a deliberate and coordinated effort to characterize exposures associated with legacy and current operational and training materials, equipment, and chemicals used by DoW personnel across environments. Improvements/updates in policy, doctrine, exposure research, and technologies are critical to overcoming obstacles associated with monitoring operational and environmental exposures at deployed locations and capturing exposure information on deployed forces.

CEM STRATEGY PURPOSE

The Joint Staff formally acknowledged the importance of CEM to the Total Force in July 2024 by recommending the development of a strategy to modernize CEM in support of FHP and warfighter lethality efforts (See Appendix D for more detail). This strategy will advance CEM activities in support of national security and national defense objectives by:

- Establishing a shared vision for CEM
- Setting forth Guiding Principles
- Detailing Strategic Objectives (SO)

Collectively, these efforts strengthen individual and operational readiness and enhance Total Force lethality. This Strategy is intended to establish a common definition of CEM and clarify its role in DoW FHP and mission assurance activities.

The Strategy promotes the aims described in the National Security Strategy (NSS, 2025), the National Defense Strategy (NDS, 2026), Department of Defense Data Strategy (2020), Military Health System Strategy (2024), and DoD Biodefense Posture Review (2023) by advancing the means to anticipate, identify, evaluate, and mitigate risks to DoW personnel and their missions. The Strategy lays the groundwork for the Department to streamline data access and discovery to effectively inform those who assess potential health hazards, impacts, and risks. These activities align with the NSS's priority to leverage artificial intelligence (AI), machine learning (ML), and autonomous systems to strengthen military technology and the Department of Defense Data Strategy's focus area of using data to improve senior leader decision support. Finally, it supports the Military Health System Strategy's mission "to enable the DoW to provide medically ready and ready medical forces by improving the health of all those entrusted to their care."



Photograph by Janesse Dugan, Marine Corps Installations Pacific

STRATEGIC APPROACH

Vision, Strategic Objectives, Guiding Principles



Vision

DoW will achieve unparalleled mission readiness by optimizing exposure monitoring approaches to deliver accurate and actionable exposure information at all echelons, empowering superior health threat awareness and risk-informed decision-making in support of FHP.

Strategic Objectives

Achieving the CEM vision will enhance the Department's ability to assess and mitigate health risks and ensure the Total Force is mission capable. Supporting this Vision are the four Sos depicted in Figure 2: Anticipate, Recognize, Evaluate, and Inform, which are integral to conducting effective CEM in the current and future operating environment. The SOs are aligned with key Department CEM activities and drive continuous modernization and optimization of CEM capabilities. The SOs build upon each other to emphasize that streamlining potential health hazard information from initial collection to dissemination will create a continuous cycle of quality improvement that routinely strengthens CEM over time. Aligned to each SO are Initiatives that articulate CEM activities to advance and enable novel capabilities.



Anticipate: Optimize health hazard prediction and health risk prevention for all operations.



Recognize: Advance exposure detection and quantification in all environments.



Evaluate: Prepare timely, scientifically sound exposure data and supporting information for analysis.



Inform: Empower decision makers with actionable information to protect the health of the Total Force.

Figure 2. CEM Strategy SOs



Photograph by Christopher Sanchez, 173rd
Airborne Brigade

Guiding Principles

Six key Guiding Principles bolster the CEM Vision. These Guiding Principles, shown in Figure 3 below, establish a shared foundation which anchors the CEM Enterprise, enhancing its ability to best serve the Department. Continuous and successful execution of the SOs and their subordinate Initiatives will enable the CEM Enterprise to realize these Principles and achieve the Vision.

The CEM Enterprise will be....

Proactive	<i>Stand ready to identify and communicate potential exposures and by - population risks before they occur</i>
Integrated	<i>Seamlessly connect to activities, data, and stakeholder requirements through compatible Joint systems</i>
Resilient	<i>Sustain CEM activities across diverse and challenging environments</i>
Actionable	<i>Initiate actions based on timely, accurate, and defensible data that is fit for purpose</i>
Adaptive	<i>Efficiently address all potential health threats and predicts health risks, based on best available evidence and data</i>
Committed	<i>Continuously support the health and readiness of the Total Force across their careers and spectrum of missions</i>

Figure 3. CEM Enterprise Guiding Principles

Critical Enablers

The following Critical Enablers (Figure 4) are cross-cutting mechanisms that are necessary to achieve the identified SOs and their subordinate Initiatives. Enablers apply across multiple SOs simultaneously, whereby not having the enabler present, active, or improved will drastically weaken CEM capabilities. While some Enablers rely on processes or actions outside the scope of the CEM Strategy or at senior decision-making levels above the day-to-day CEM Enterprise's activities, these Enablers stabilize, strengthen, and support the exposure monitoring community.

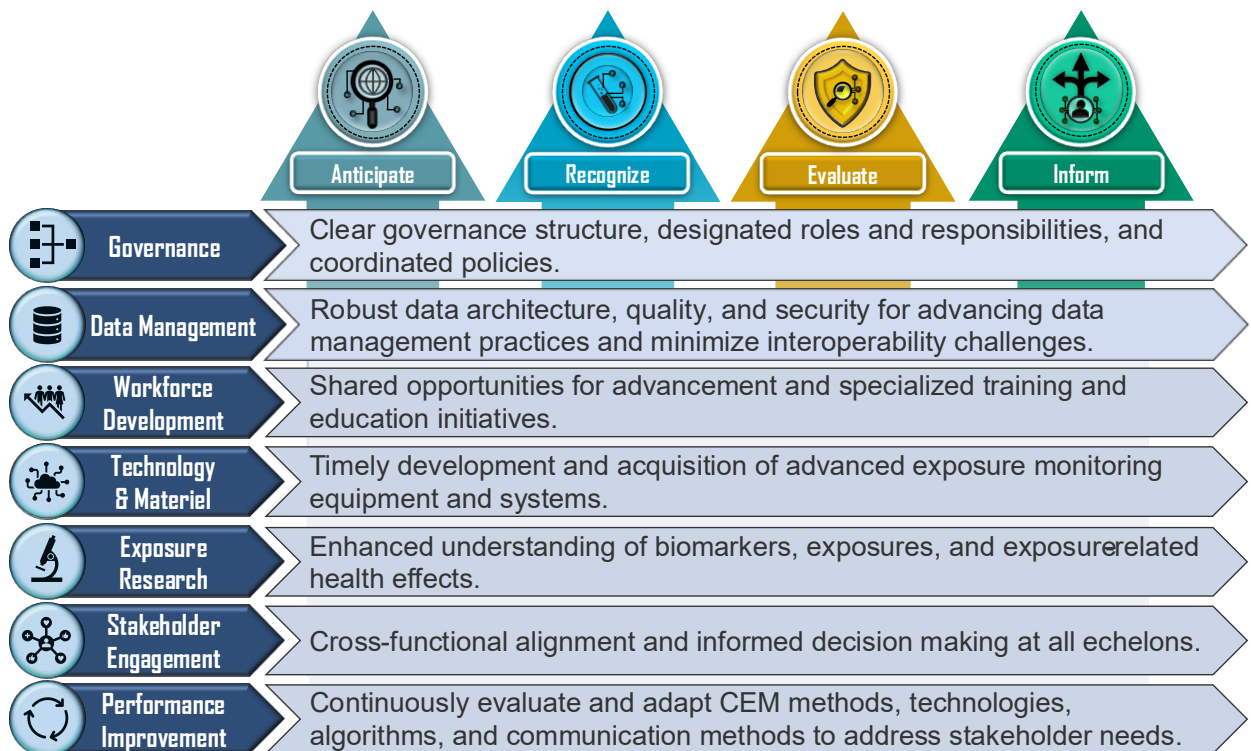


Figure 4. Critical Enablers

Critical Enablers as Inputs to SOs and Initiatives

The cross-cutting Enablers also function as essential inputs that prepare personnel to best conduct the spectrum of CEM activities. For example, governance such as Department of Defense Instruction 6055.05, "Occupational and Environmental Health," establishes clear authorities, standards, and decision pathways that ensure exposure data are collected and managed in accordance with Federal regulations and used consistently across the Enterprise. Stakeholder engagement is critical to garnering the support necessary from leadership to enable this effort. Workforce development ensures personnel possess the technical skills and shared understanding needed to implement monitoring processes and interpret data reliably. Regarding data management, the CEM Enterprise currently employs, or is developing, several CEM-relevant data and information management/information technology (IM/IT) systems and tools that enable exposure data capture, storage, analysis, and exchange. These systems are central to conducting effective CEM activities in today's data environment.

Examples of DoW CEM-Relevant IM/IT Systems, Tools, & Products:



Individual Longitudinal Exposure Record: A web-based application available to Service members, veterans, and providers that aggregates individual exposure data from multiple systems into one place, covering a Service member's entire career



Defense Occupational and Environmental Health Readiness System – Industrial Hygiene: The enterprise system for storing Service members and DoW civilian occupational and environmental exposure data



Defense Occupational and Environmental Health Readiness System – Hearing Conservation: Enables the collection, management, and reporting of hearing readiness and conservation data, supporting standardized testing and readiness monitoring



Dried Blood Spot Repository (under exploration): A system which aims to enable preventative and real-time screening of environmental exposures using dried blood spot technology



Master Radiation Exposure Registry: A United States Air Force Service-level radiation dosimetry database



Periodic Occupational and Environmental Monitoring Summary: Health hazard and Risk Products that provide service members, healthcare providers, and public health personnel with an overview of potential exposures in a deployed environment and associated health risk assessments

Critical Enablers as Inputs to SOs and Initiatives cont.

While data architecture, systems, governance, intra-agency and interagency collaboration mechanisms, and effective CEM personnel are already in place, additional refinement and investment in these resources are necessary to optimally execute the SOs and Initiatives, thereby accomplishing the Vision for CEM. For example, well-defined data architectures enable the integration of disparate exposure data sources across time, locations, and mission sets, while consistent data standards and quality controls ensure information is accurate, complete, timely, and fit for use. Effective data management allows exposure data to be accessible, interoperable, and trustworthy, positioning the CEM Enterprise to support decision-making, mitigate health risks, and inform future operations. Furthermore, by leveraging rapid prototyping pathways and fielding authorities, DoW can accelerate the integration of emerging technologies, such as wearables and AI/ML software, into the CEM Enterprise, enhancing real-time exposure detection. Continued investment in data management, architecture, and quality, coupled with the advancement of CEM technology, materiel, governance, and workforce development offers opportunities to strengthen CEM outcomes, reduce long-term health risk, and improve the CEM Enterprise's ability to anticipate, recognize, and evaluate emerging exposure concerns.



STRATEGIC OBJECTIVES

The four SOs, Anticipate, Recognize, Evaluate, and Inform, are characterized by subordinate Initiatives that target specific, vital areas to advance for the CEM Enterprise. Each Initiative is designed to leverage and expand on the Critical Enablers, ensuring standardization across shared resources while advancing platforms, processes, and capabilities already in use. As seen in Figure 5, the SOs are interconnected, and strengthening one SO will strengthen all SOs.

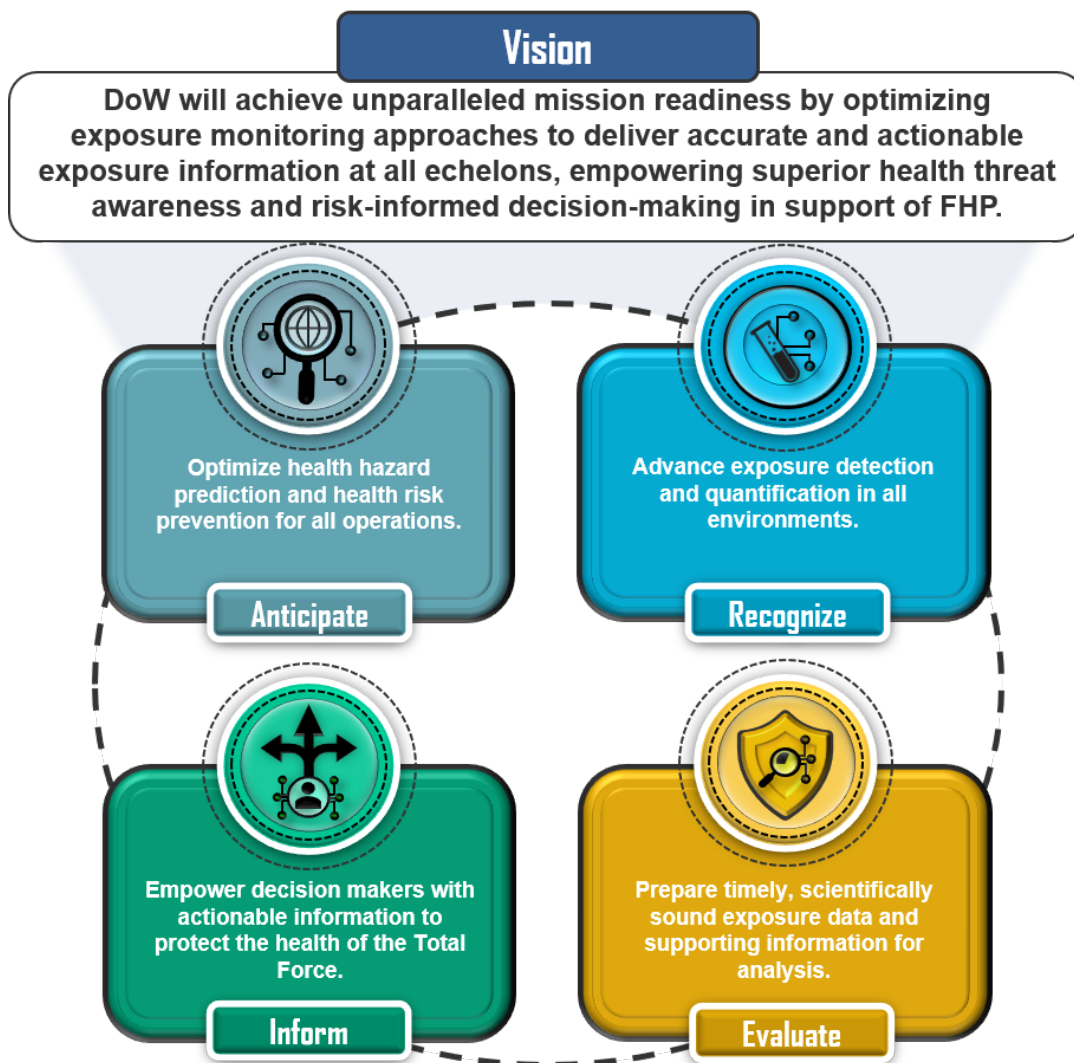


Figure 5. Strategic Objectives

The Initiatives underpin this interconnection, identifying opportunities to minimize interoperability challenges, improve data management, and adopt advanced monitoring tools (e.g., AI/ML). Together, these Initiatives demonstrate how targeted actions build toward the envisioned future of CEM while generating a continuous, bottom-up cycle of improvement that ultimately strengthens the CEM Enterprise at all levels.



Strategic Objective 1 – Anticipate: Optimize hazard prediction and health risk prevention for all operations

“Anticipate” encompasses the Department’s activities that proactively leverage historical experiences and knowledge of processes, procedures, and potential health hazards to foresee possible exposure health and safety risks to DoW missions. Improving anticipatory and predictive efforts will better enable the CEM Enterprise to execute effective FHP and risk management activities.

The Initiatives aligned to this SO are designed to enhance predictive technologies, sustain reliable decision-making, and better position the Department to anticipate exposures, both recurring and emergent.

- **Initiative 1.1:** Improve the visibility and awareness of exposures, exposure environments, and populations of concern through coordination with mission partners.
- **Initiative 1.2:** Implement CEM capabilities into tactical military equipment and in dynamic exposure environments to quickly and appropriately adapt necessary preventive measures during the full scope of operations.
- **Initiative 1.3:** Integrate predictive modeling capabilities into public health mission planning to anticipate the full scope of exposure trends, enable earlier recognition of risks, and inform senior leaders of best practices for preventive measures, unique to their operation.



Key Critical Enablers: *Data Management, Exposure Research, Technology & Materiel, Workforce Development*

Inputs: In order to effectively “Anticipate”, the CEM Enterprise must continue to strengthen data architecture and quality while standardizing data and information and indications management to securely, rapidly, and accurately conduct the full spectrum of exposure monitoring activities. Similarly, training the workforce to leverage emerging technologies such as AI can improve predictive capabilities.

Recognize



Strategic Objective 2 – Recognize: Advance exposure detection and quantification in all environments

“Recognize” accelerates the Department’s ability to identify, measure, characterize, and document when and how individuals or populations encounter harmful exposures, both from routine operations (e.g., range activities) and specific events (e.g., natural disasters, industrial accidents, intentional releases) as part of a comprehensive exposure history. Activities within this SO will position the CEM Enterprise to conduct continuous, precise, and rapid exposure monitoring, sampling, and information collection techniques.

The respective Initiatives ensure that the CEM Enterprise maintains awareness of the changing health threat environment. Execution of these Initiatives will enable the CEM Enterprise to employ innovative monitoring and sampling methods that persistently detect exposures across different military operations.

- **Initiative 2.1:** Ensure accurate and timely exposure data, information, and indications through dynamic exposure monitoring and sampling techniques.
- **Initiative 2.2:** Enhance situational awareness through precise metrics for identification and characterization of exposures and at-risk groups across operational environments.



Key Critical Enablers: *Technology & Materiel, Exposure Research, Workforce Development, Performance Improvement*

Inputs: In order to effectively “Recognize”, the CEM Enterprise must continuously develop and update exposure thresholds that consider individual and unit factors, including work activity, operational or combat deployments, exposure history, exposure duration and frequency, health status, and medical history and federal guidance. Additionally, the CEM Enterprise must ensure effective training on these thresholds and on operations of deployable monitoring and sampling technologies.



Strategic Objective 3 – **Evaluate: Prepare timely, scientifically sound exposure data and supporting information for analysis**

“Evaluate” encompasses the Department’s ability to measure exposure levels and qualify (or determine) the level of associated risk. This involves the rapid, detailed and integrated curation, categorization, and maintenance of information following the recognition of a potential hazard and subsequent data collection, supported by strong metadata, quality control, and governance practices.

The aligned Initiatives improve the CEM Enterprise’s ability to produce validated, actionable, and readily accessible information products for leaders and stakeholders while increasing understanding and awareness of the scope of potential hazards. The Initiatives aim to enable the Department to remain responsive to operational needs and the changing threat environment through the rapid integration of information, the adoption of advanced analytic capabilities, and the improved ability to characterize and prioritize exposure monitoring efforts. In turn, the Department is postured to reduce adverse impacts, meet unique operational needs, and drive sustained mission success in all environments.

- **Initiative 3.1:** Enable rapid analysis by integrating exposure monitoring results, including sample results and monitoring readings, with intelligence and other related data and metadata, into relevant databases, repositories, and registries.
- **Initiative 3.2:** Increase understanding and awareness of the scope of potential hazards to Total Force health by characterizing and prioritizing potential hazards to health and threats to mission.
- **Initiative 3.3:** Advance artificial intelligence capabilities (e.g., large language models) to optimally utilize operation-relevant information in support of data-informed decision-making, efficient resource allocation, and continuous enhancement of CEM capabilities.



Key Critical Enablers: *Technology & Materiel, Data Management, Performance Improvement, Workforce Development*

Inputs: In order to effectively “Evaluate”, the CEM Enterprise must leverage compatible Joint IM/IT platforms and approved deployable AI-enhancing systems, as well as standardize necessary user guidelines and instructions. Additionally, the CEM Enterprise must maintain visibility of its existing workforce across CEM-relevant communities and invest in appropriate training to ensure personnel effectively execute CEM activities.



Strategic Objective 4 – **Inform: Empower decision-makers with actionable information to protect the Total Force**

“Inform” enhances the Department’s ability to deliver high-quality, reliable, and actionable information for stakeholders and leaders at tactical, operational, and strategic echelons by tailoring data requirements and delivering visualization products to meet command needs. Activities within this SO are essential to the subsequent development of health risk assessments and recommendations to enable leaders and stakeholders to conduct further analysis of potential health hazards and make informed risk management decisions. Critically, this SO ensures that exposure data are translated into clear, operationally-relevant guidance, establishing actionable thresholds and recommending response measures that allow commanders to balance risk mitigation without diminishing operational initiative or accepting risk to mission. In turn, these essential activities enable leaders and stakeholders to take comprehensive risk mitigation measures, strengthening Total Force resiliency against potential health hazards.

The Initiatives enable the Department to rapidly inform stakeholders, leaders, and impacted populations of potential hazards. They similarly implement a continuous improvement of exposure, guidance, knowledge products, and research activities to match pace with the ever-evolving state of the operational environment. Effective execution of these Initiatives ensures stakeholders and leaders are equipped with the information and tools needed to protect their forces against all exposure types and health hazards at any time and in any environment.

- **Initiative 4.1:** Deliver consistent, tailored exposure information and indications aligned to stakeholders needs to inform follow-on decision-making.
- **Initiative 4.2:** Provide secure and reliable access to information outputs (e.g., via dashboards, generated result summaries) to support unique operational needs and communication preferences of senior leaders and stakeholders.
- **Initiative 4.3:** Develop and implement automated alert mechanisms for exposures to significantly reduce time between exposure detection and action.
- **Initiative 4.4:** Support exposure guidance and health study development processes to improve risk mitigation activities and health protection outcomes.



Key Critical Enablers: *Governance, Data Management, Stakeholder Engagement, Performance Improvement*

Inputs: In order to effectively “Inform”, the CEM Enterprise must capitalize on pre-existing communication platforms, governing bodies, and mechanisms to support information flow and decision making and foster collective buy-in to research and study activities. Effective information exchange throughout the Department additionally relies on clearly defined roles and responsibilities set forth by policy and guidance.



CONCLUSION

The Department remains committed to the continuous health, safety, and readiness of the Total Force, thereby ensuring the enduring success of its missions and operations. To fulfill this commitment and realize the stated vision for CEM, the Department must adapt to the changing operational landscape by advancing and modernizing its comprehensive exposure monitoring approaches.

CEM capabilities must be optimized in alignment with the Guiding Principles so that activities are proactive, integrated, resilient, and actionable and the CEM Enterprise remains adaptive and committed in the face of evolving health threats. The combined execution of the SOs – Anticipate, Recognize, Evaluate, and Inform – supported by cross-cutting critical enablers, will drive continuous improvement and sustainment of the CEM Enterprise. Together, these elements will enable more accurate health risk assessments and exposure mitigation and will support overall mission continuity.

APPENDIX A:

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APPENDIX B:

Acronyms

AI	Artificial Intelligence
BOP	Blast Overpressure
CBA	Capabilities Based Assessment
CEM	Comprehensive Exposure Monitoring
CBRN	Chemical, Biological, Radiological, and Nuclear
DOEHRS-HC	Defense Occupational and Environmental Health Readiness System- Hearing Conservation
DOEHRS-IH	Defense Occupational Environmental Health Readiness System – Industrial Hygiene
DoW	Department of War
FHP	Force Health Protection
ILER	Individual Longitudinal Exposure Record
IM/IT	Information Management/Information Technology
ML	Machine Learning
MRER	Master Radiation Exposure Registry
NDS	National Defense Strategy
NSS	National Security Strategy
SO	Strategic Objective
TBI	Traumatic Brain Injury
U.S.	United States
WAsP	Water Assessment and Purification

APPENDIX C:

Glossary

Comprehensive Exposure Monitoring (CEM). The collection of data to characterize and assess exposures to potential health hazards, including chemical, biological, and physical (e.g., ionizing radiation, non-ionizing radiation, noise) hazards encountered by Service members, DoW civilians, contractors, and military working animals in garrison, training, and operational activities to prevent and reduce disease or injury incidence and to improve decision-making at all levels in support of Total Force health protection. [Source: Adapted from Proposed Revision to DoD Directive (DoDD) 6200.04]

CEM Enterprise. The full scope of CEM-relevant communities that conduct and support exposure monitoring activities and/or rely on exposure data and information to conduct activities. [Source: CEM Strategy]

CEM-relevant Communities. The related occupational series or specialties with common exposure monitoring functions, tactical actions, capabilities, and career paths that accomplish a specific part of the DoW mission. [Adapted from DoDI 1400.25, Volume 250]

Completed Exposure Pathway. A completed exposure pathway exists when all five essential elements are present: (1) a contaminant source, (2) environmental media (air, water, soil) through which the contaminant moves, (3) a point of exposure where contact occurs (such as a well), (4) a route of exposure (such as drinking, inhalation, or dermal contact), and (5) a receptor population that can be exposed. [Source: EPA, 2025]

Data Integration. Data integration involves combining data residing in different sources and providing users with a unified view of these data. [Source: Lenzerini, 2002]

Decision-support. Rapid data communication in an intuitive, legible product. [Source: Joint Publication (JP) 5-0, JP 6-0]

Defense Occupational and Environmental Health Readiness System (DOEHRS). DOEHRS is a Defense Health Agency (DHA) system managed by the Defense Health Services Systems for entering, assessing, managing and reporting occupational and environmental exposures for Service members and DoW civilians. DOEHRS consists of multiple business areas: industrial hygiene, environmental health, radiation, and incident reporting. It is used for both garrison and deployed operations and mandated by various DoW policies and public laws. It is the system of record for the DoW ILER. [Source: DHA Public Health, 2024]

DoW Personnel. For the purposes of this Strategy, DoW personnel include Active Duty and Reserve Component Service members, DoW civilians, and military working animals. [Source: CEM Strategy]

Dried Blood Spot Repository. A repository under exploration that aims to enable preventive and real-time screening of environmental exposures using dried blood spot technology. [Source: Defense Centers for Public Health – Aberdeen, Toxicology, 2026]

Emerging Chemicals. Chemicals relevant to the DoW that are characterized by a perceived or real threat to human health or the environment and that have new or changing toxicity values or new or changing human health or environmental regulatory standards. Changes may be due to new science discoveries, detection capabilities, or exposure pathways. [Source: Department of Defense Instruction (DoDI) 4715.18]

Environment. Air, water, land, living things, built infrastructure, cultural resources, and the interrelationships that exist among them. [Source: DoDD 4715.1E]

Environmental Exposure. Contact with a chemical, biological, or physical hazard in the ambient environment. [Source: DoDI 6055.20]

Exposure. The intensity, frequency, and length of time personnel are subjected to a hazard. [Source: DoDI 6055.05]

Guidance. Enforceable, authoritative requirements based on the translation of medical performance requirements into the appropriate ways and means for optimizing, protecting, or sustaining the health of the deployed Service member (e.g. clinical, nutritional, hydration, fatigue.) Guidance does not need to originate within DoW to be applicable to the Service member provided the guidance is included in a DoW guidance or reference. [Source: Adapted from Merriam-Webster Dictionary and Clinical Practice Guidelines by Field MJ, Lohrn KN (Eds)]

Hazard. Any real or potential condition that can cause injury, illness, or death to personnel or damage to or loss of equipment or property, mission degradation, or damage to the environment. [Source: DoDI 6055.01]

Health Measures. Objective indicators of health status obtained through the physical examination, clinical laboratory testing, and ancillary studies (e.g., radiologic imaging, electrocardiography, and pulmonary function testing). Together, these three main modalities provide complementary information that supports diagnosis, risk assessment, treatment planning, and longitudinal surveillance. [Source: Harrison's Principles of Internal Medicine, 22nd Edition.]

Health Surveillance. The regular or repeated collection, analysis, and interpretation of health-related data and the dissemination of information to monitor the health of a population and to identify potential risks to health, thereby enabling timely interventions to prevent, treat, or control disease and injury. It includes occupational and environmental health surveillance and medical surveillance. [Source: DoDD 6490.02E]

Individual Longitudinal Exposure Record (ILER). ILER a DOW- Veterans Affairs (VA) initiative to collate, present, and/or provide occupational and environmental exposures for individuals over the course of their careers. DoW led the development of the ILER in collaboration with the VA. ILER uses a person-centric business intelligence strategy that enables the connection of person, time, place, event, and all-hazard occupational and environmental data with medical encounter information (diagnosis, treatment, and laboratory data) and other authoritative/authorized sources as appropriate. [Source: ILER Concept of Operations, 2014]

Information. Knowledge or understanding obtained from investigation, study, or instruction. [Source: Merriam-Webster, 2016]

Information Product. Output of data analysis that provides actionable awareness or knowledge to an intended audience that enables follow on capabilities. [Source: CEM Strategy]

Joint. Connotes activities, operations, organizations, etc., in which elements of two or more Military Departments participate. [Source: JP-1]

Master Radiation Exposure Registry (MRER). A USAF Service-level radiation dosimetry database. [Source: Department of the Airforce Manual 48-125]

Mission Partner. A foreign, U.S., or multinational organization that works with the DoW to achieve shared objectives. [Source: DoD Dictionary of Military and Associated Terms]

Medical Data. Epidemiological information related to medical/health conditions, reproductive outcomes, causes of death, and quality of life. [Source: McGraw-Hill Concise Dictionary of Modern Medicine, 2002]

Readiness. (1) Condition of being prepared and capable to act or respond, as required. [Source: DHS]. (2) The ability of a unit/formation, ship, weapon, system, or equipment to perform the missions or functions for which it is organized or designed. [Source: JP 1-02, definition of operational readiness.]

Risk Management. (1) A process by which decision makers accept, reduce, or offset risk and subsequently make decisions that weigh overall risk against mission benefits. Risk management is composed of risk assessment and risk response. [Source: DoDD 3020.40] (2) A process that assists organizations and individuals in making informed risk decisions in order to reduce or offset risk, thereby increasing operational effectiveness and the probability of mission success. [Source: DoDI 6055.1]

Total Force. The organizations, units, and individuals that comprise DoW resources for implementing the National Security Strategy. It includes DoW Active and Reserve Component military personnel, retired military members, and DoW civilian personnel. [Source: Adapted from DoDD 5124.04]

APPENDIX D:

CEM CBA

In 2022, The Deputy Assistant Secretary of War for Health Readiness Policy and Oversight sponsored a CEM Capabilities Based Assessment (CBA) to outline, define, and improve the Department of War's (DoW) CEM effort. The CBA (1) identified the requirements and gaps in DoW's ability to use and synchronize DoW exposure monitoring capabilities in support of force health protection and other health service support activities, and (2) identified suitable, feasible, and acceptable solution recommendations to mitigate identified gaps.

The CBA resulted in a Joint Doctrine, Organization, Training, materiel, Leadership & Education, Personnel, Facilities, and Policy Change Recommendation (DCR) for CEM and a Chemical and Physical Exposure Monitoring Initial Capabilities Document (ICD). The CEM DCR and resulting Joint Requirements Oversight Council Memorandum, signed July 2024 recommended the creation of this Strategy to facilitate unity of effort by clearly and accurately articulating DoW's mission, vision, and goals/objectives for CEM and establishing a common definition of CEM and its constituent functional areas and communities of interest. The activities put forth by the CEM DCR and ICD will be executed in concert with the objectives laid out within this Strategy to optimize the Department's overall CEM capability.

Challenge: Given a current and expected future security environment characterized by known and unknown exposures to a variety of hazards across garrison, training, and operational environments, how can DoD effectively and efficiently monitor and assess the full spectrum of exposures to DoD personnel to better understand risks to health, readiness, operational capability, and missions?

Ends: Exposure-informed, data-driven recommendations to support risk management activities that optimize health, readiness, and performance of DoD personnel



Means: Well-coordinated tools, capabilities, and processes across the DoD exposure monitoring enterprise that provide a collective and comprehensive understanding of the full spectrum of hazards to DoD personnel



Photograph by Nilsa Mendez, 156th Wing

APPENDIX E:

The following vignettes present snapshots of historical exposure events experienced by the Department. They are meant to further contextualize comprehensive exposure monitoring (CEM), demonstrate the real-world impact of harmful exposures on Department of War (DoW) Service members, and illustrate how CEM activities helped mitigate risk.

Vignette 1

The availability and quality of water vary widely across operating environments and can have significant effects on mission success. For example, in 2011, raw sewage contaminating the well water at Forward Operating Base (FOB) Andar in Afghanistan's Ghazni Province posed a notable health risk to deployed personnel. Fortunately, preventive medicine teams and water treatment specialists with 3rd Brigade Combat Team, 1st Infantry Division Task Force Duke employed rigorous sampling protocols and proactive, consistent monitoring.

Preventive medicine teams regularly tested water before treatment for common contaminants, such as fecal coliform bacteria. Water treatment specialists also tested for nuclear, biological, or chemical contaminants, and used calcium hypochlorite tablets to neutralize remaining biological contaminants (or eliminate pathogens). Afterwards, technicians measured the treated water's turbidity, pH, and chlorine levels using the Water Assessment and Purification (WAsP) toolkit (ERDC, 2016).

This exposure monitoring effort ensured a safe water supply at the FOB was available and adverse health effects of ingesting contaminated water, such as diarrhea and vomiting, were prevented. These efforts were vital in safeguarding Service member wellbeing and enabling mission success.

Vignette 2

The longitudinal scale and complexity of CEM is illustrated in BOP monitoring. DoW personnel may be exposed to BOP throughout their career lifecycle, although the frequency and intensity of exposure events can depend on one's occupational specialty, their training and operational activities, and time in service. Exposure may result from personnel proximity to BOP waves generated by munitions used in live-fire exercises or in operational environments from incoming fire or outgoing weapons system use. Multiple mechanisms are used alone or in combination to collect data on potential or actual exposure to BOP-producing events. These mechanisms include indirect estimation via questionnaires or shot counts or through direct measurement of characteristics of a BOP wave via wearable dosimeters, such as a three-sensor system worn on the helmet, chest, and shoulder (USU, 2023) (Jones et al., 2023). This data can be uploaded into DOEHRS-IH and eventually transferred into the Individual Longitudinal Exposure Record (ILER) where Healthcare providers can retrieve exposure data when reviewing a patient's blast history (DoD, 2023).

The effects of exposure to BOP range widely from sensory and nervous system issues to circulatory and extremity injuries. Through monitoring efforts, DoW discovered acute, high-level blast/BOP exposure can result in injury to the brain (including traumatic brain injury [TBI]), ears, lungs, and intestines. Greater than 500,000 TBIs were diagnosed in Service members between 2000 and quarter 1 of 2025, many of which are believed to be attributable to BOP exposures (TBI Center of Excellence, 2025). Additionally, researchers discovered that repeated low-level blast (LLB) exposure can result in symptoms including, but not limited to, headache, tinnitus, concentration and memory problems, dizziness, and irritability, (TBI Center of Excellence, National Defense Authorization Act FY 2018), with studies demonstrating a link between symptomology and total length of service time indicating a role for cumulative LLB exposure in adverse health outcomes (Belding et al., 2021).

Due to the impact of BOP on DoW personnel, Congress and DoW developed monitoring and documentation requirements for BOP exposures in National Defense Authorization Acts and other directives. Additionally, DoW applied information from monitoring and research efforts to development of interim BOP exposure safety guidelines (Deputy Secretary of Defense, 2024) and risk mitigation measures to limit potential exposures, such as standoff distances and recommended personal protective equipment when using priority weapon systems described in the DoD Blast Overpressure Reference and Information Guide (D-BOP RIG; USU 2024).



Vignette 3

Airborne hazards constitute a part of the recurring and emergent risks to joint force health. The Periodic Occupational and Environmental Monitoring Summaries (POEMS) identified numerous sources of airborne hazards, including desert sand and dust, fuel and aircraft exhaust, and industrial pollutants. These toxicants can be derived from standard military activities, such as aircraft painting, pest management programs, or field exercises, and require constant vigilance to mitigate unacceptable exposure levels. However, at times, operational decisions result in severe airborne hazards that result in mass exposure to the operating force.

Joint Base Balad (JBB), Iraq, served as a major hub for the United States (U.S.) during Operation Iraqi Freedom and Operation New Dawn. Consistent with other military campaigns, operations at JBB generated substantial amounts of waste, so an open-air burn pit was established on base to maintain sanitary conditions. From 2003 to late 2009, this burn pit, the largest in the U.S. Central Command (USCENTCOM) area of responsibility (AOR), incinerated solid waste, plastics, metals, chemicals and solvents, jet fuel, and possibly electronics and batteries, producing “nearly ubiquitous” smoke (Military Deployment POEMS: JBB and vicinity Iraq Calendar Years: 2003 to 2009, Public Health). In response, DoW assessed occupational and environmental health (OEH) risks associated with burn pits through robust ambient air sampling that would eventually lead to the prohibition of burn pits in the USCENTCOM area of responsibility, in most cases.

The Department of Veterans Affairs (VA) established the Airborne Hazards and Open Burn Pit Registry (AHOBP Registry) in 2014 to improve understanding of these exposures and their health effects. DoW personnel and veterans deployed to specific regions between 1990 and 2021 are automatically enrolled in the registry. Deployment location, personnel information, and demographic data collected for the registry are accessible to select researchers within and outside of the VA. Presumptive conditions related to burn pit exposure and other toxicants qualify for VA health care due to the “Promise to Address Comprehensive Toxics” (PACT) Act of 2022, which expands healthcare and benefits for veterans exposed to toxic substances including those related to burn pits, airborne hazards, and other environmental exposures during their military service. The AHOBP Registry Complements the PACT Act by providing a mechanism for DoW personnel and veterans to document exposures to airborne hazards and burn pits.



Vignette 4

The following vignette is a hypothetical scenario that illustrates how this Strategy will optimize DoW's ability to defend the Joint Force against future health hazards that may jeopardize its mission.

In the near future, DoW operates a facility in a far-forward region. Intelligence community reports indicate that this region contains threat actors who frequently utilize radioactive materials to disrupt DoW activities. To prepare for potential radiological hazards, the preventative medicine teams are equipped with the Man-portable Radiological Detection System, a novel capability that detects, localizes, and confirms radiological activity. During a routine sampling of the air, water, and soil, preventive medicine teams detect airborne alpha particle activity near the vehicle bays, indicating an ongoing release of radiation. The teams use an analytical model for the radiation activity, indicating the threat to be a near-by release. Identifying the epicenter of radiation then conducting further air and water sampling, the teams discover the source is a tampered humidifier aerating an aqueous Polonium-210 solution, irradiating Service members who inhaled the air inside the bay. The preventive medicine team hypothesizes that the release was intentional from a threat actor.

An automated alert informs other units in the area of the release of the hazard. After evacuation to an allied medical facility, irradiated Service members symptomatic of acute radiation syndrome (ARS) are monitored for radiation illness/injury progression. Exposed Service members not symptomatic of ARS are monitored for late on-set ARS.

Radiological Advisory Medical Teams and chemical, biological, radiological, and nuclear teams incorporate data for rapid predictive models to estimate long-term impacts and inform quarantine, decontamination, and radiation illness/injury mitigation activities. The facility commander uses the rapid predictive modeling tool to conduct follow-on risk analysis of continuing operations in the region, adjusting the model parameters to account for the radiation type, environmental considerations, predicted health impacts to force, and information provided by the intelligence community on the threat actor.

