VETERANS HEALTH ADMINISTRATION

PACT Act, Section 510: Determining the Long-term Effects of Jet Fuel Exposure in the Military

Presentation for: NASEM Red Hill Study Public Meeting
Presented by: Terra Vincent-Hall, PhD, DABT
Date of briefing: September 18, 2025

BRIEFING AGENDA

- **BACKGROUND**
  - Jet Fuel Exposure in the Military
  - PACT Act Section 510
- **SYSTEMATIC LITERATURE REVIEW**
  - Methodology
  - Results
- **RESEARCH GAPS AND NEXT STEPS**
- **QUESTIONS AND ANSWERS**

JET FUEL EXPOSURE IN THE MILITARY

- DoD is the largest consumer of jet fuels in the US.
- Jet fuel exposure is one of the most common exposures in military service.
- Complex mixtures of hundreds of hydrocarbons; kerosene is the primary constituent.
- Most published research details acute effects; lack of information on long-term outcomes.
- Some constituents with known toxicity (minor % of the total volume)
  - Carcinogenic: benzene, ethylbenzene, naphthalene
  - Neurotoxic: toluene, n-hexane, benzene, xylenes, naphthalene

MILITARY OCCUPATIONAL EXPOSURE TO JET FUELS

As jet fuel usage is prevalent in all branches of the U.S. military, many Veterans may have been at risk of exposure to jet fuels during their service.
Exposure may have occurred while performing certain jobs such as:

- Fueling an aircraft or generator
- Maintaining a jet fuel storage tank
- Transporting jet fuel
- Tending burn pits

Exposures may have also occurred due to accidental spills.

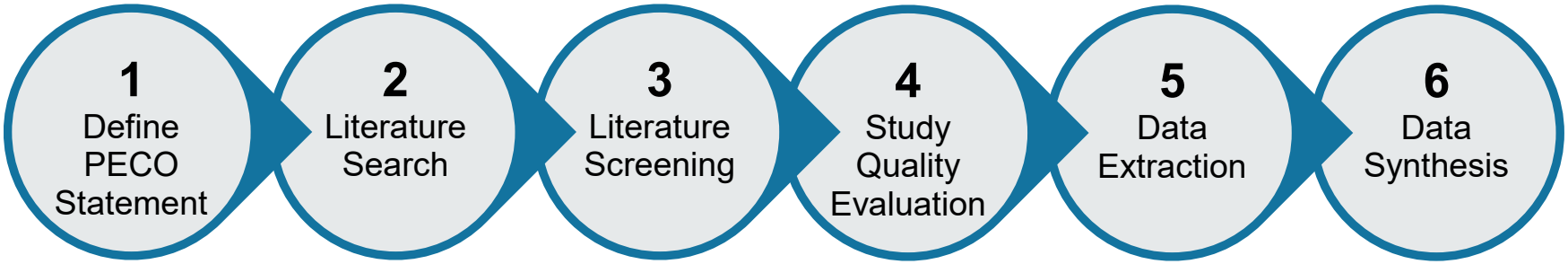
PACT ACT: SECTION 510

Section 510 of the PACT Act required VA to submit a report with the following information:

- Discussion of the effect of various types of jet fuels used by the Armed Forces on the health of individuals by length of exposure
- A chronology of health safeguards implemented by the Armed Forces intended to reduce the exposure of members of the Armed Forces to jet fuel
- Identification of the immediate symptoms of jet fuel exposure that may indicate future health risks
- Identification of any areas relating to jet fuel exposure about which new research needs to be conducted

This initial report was submitted to Congress in Fall 2023 https://www.govinfo.gov/app/details/CMR-VA1-00189958.
A five-year, follow-up report is due in August 2028.

METHODS OVERVIEW



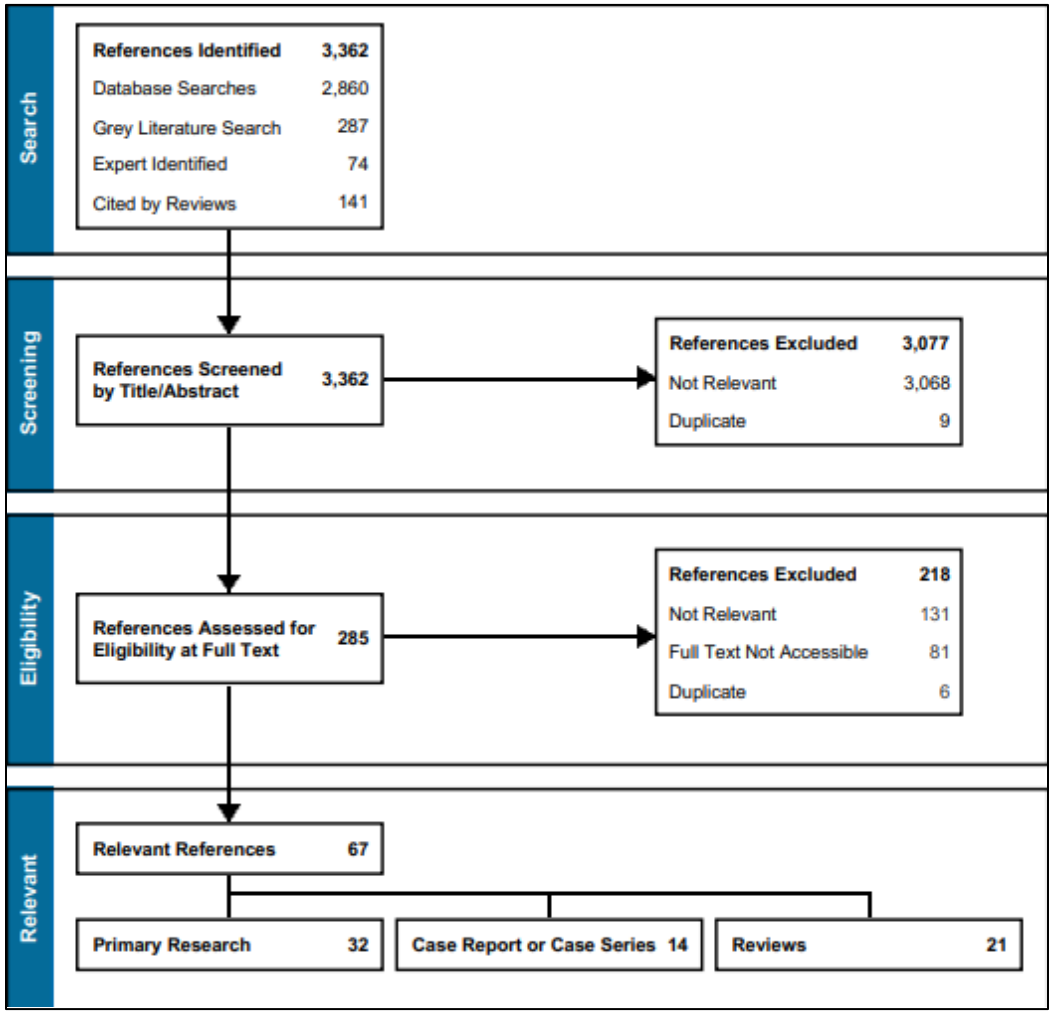
To assess the possible noncarcinogenic and carcinogenic health effects of jet fuel exposure, VA adapted the following methodologies developed by the U.S. Environmental Protection Agency (EPA):

- **Integrated Risk Information System (IRIS)**
- **Guidelines for Carcinogen Risk Assessment**

METHODS:
DEFINE PECO STATEMENT

Population	Any population and life stage (e.g., military, occupational, or general population, including children and other sensitive populations), not limited by country
Exposure	Any exposure to jet fuels by any route (e.g., oral, dermal, inhalation, or unknown/multiple routes). Includes exposures to jet fuels through accidental spills such as ground water/drinking water
Comparator	A comparison or referent population not exposed or exposed to lower levels of jet fuels
Outcome	All health outcomes (both cancer and non-cancer). Epidemiologic studies with self-reported diagnosed disease and self-reported symptoms are included

METHODS:
LITERATURE SEARCH AND SCREENING



*Interactive data visuals are available through a Tableau dashboard, including: an Interactive Reference Flow diagram (I-REFF), study quality evaluation heatmaps, evidence maps, and forest plots: https://public.tableau.com/app/profile/vha.home/viz/EpidemiologicalInformationforVHAJetFuelsReport/ReadMe

METHODS:
STUDY QUALITY EVALUATION AND DATA EXTRACTION

All relevant epidemiologic and animal toxicological studies underwent study quality evaluation and data extraction, and findings were synthesized to reach weight of the evidence conclusions.

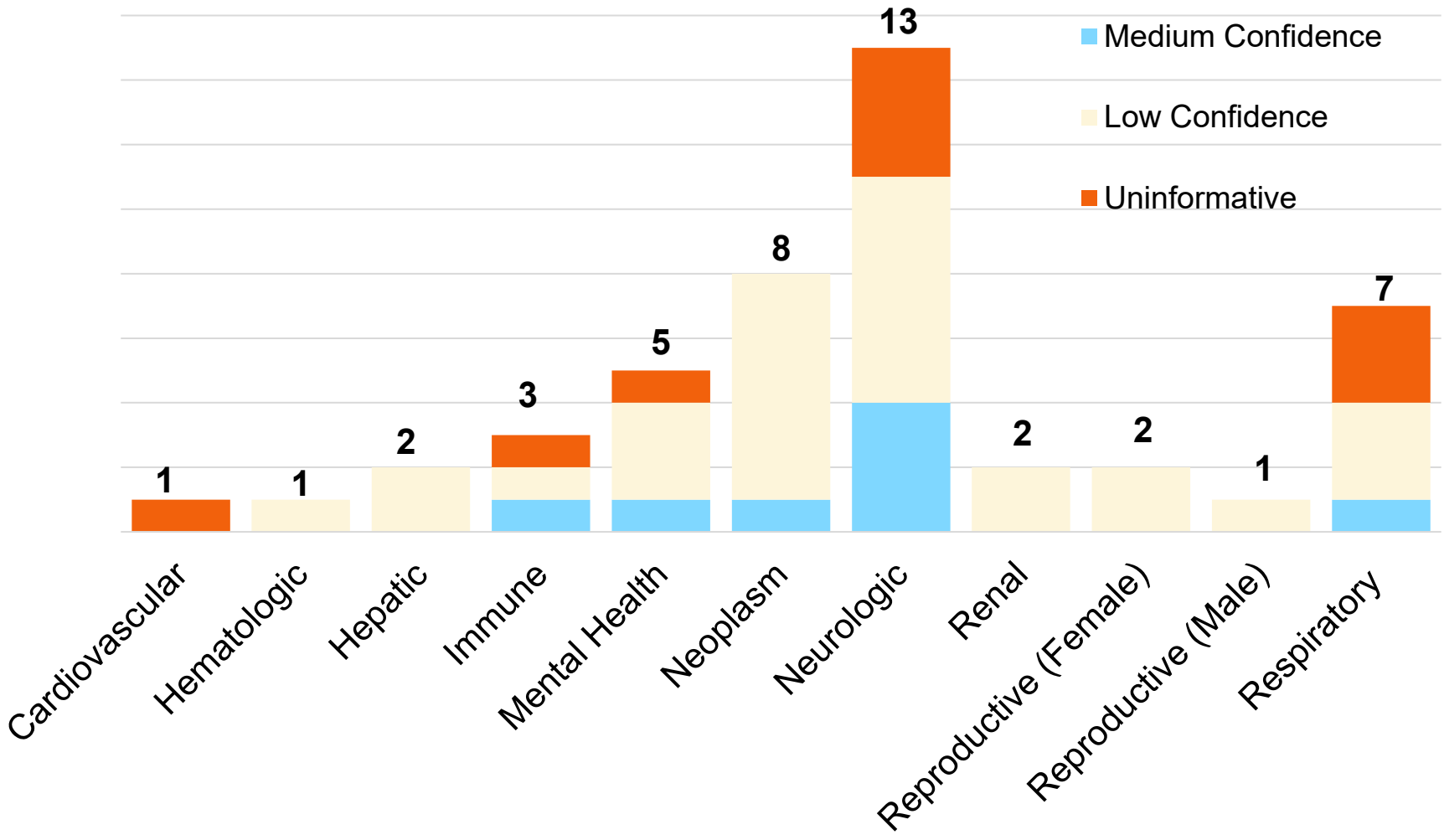
Domain Ratings

Good	Appropriate study conduct relating to the domain; minor deficiencies not expected to influence results
Adequate	Some limitations relating to the domain, but not likely to be severe or to have a notable impact on results
Deficient	Identified biases or deficiencies interpreted as likely to have had a notable impact on the results or prevent reliable interpretation of study findings
Critically Deficient	Serious flaws that make observed effects uninterpretable

Overall Study Confidence

High Confidence	No notable concerns were identified (e.g., most or all domains rated Good)
Medium Confidence	Possible deficiencies or concerns noted, but resulting bias or lack of sensitivity is unlikely to be notable
Low Confidence	Deficiencies and/or concerns were noted; the potential for substantive bias or inadequate sensitivity could have a significant impact on the study results or interpretation of data
Uninformative	Serious flaw(s) make the study results unusable for informing hazard identification

METHODS:
OVERALL STUDY QUALITY FOR EPIDEMIOLOGIC STUDIES



*Note: some references received mixed (multiple) ratings

METHODS:
EVIDENCE SYNTHESIS

Robust	*High* or *medium* confidence studies indicate a reliable link between exposure and health outcomes, discounting alternative explanations
Moderate	Primarily consistent evidence of an association between exposure and health outcomes supported by at least one *high* or *medium* confidence study that does not reach the degree of certainty required for robust
Slight	Studies report a link between exposure and health outcome with considerable uncertainty. Evidence is limited to a set of consistent *low* confidence studies
Indeterminate	No available evidence in humans or situations where the evidence is inconsistent and of *low* confidence
Compelling evidence of no effect	*High* confidence studies across various health outcomes consistently show null results, effectively ruling out alternative explanations

*Strength of Evidence Judgments as described in EPA's IRIS Handbook

RESULTS:
NERVOUS SYSTEM OUTCOMES

Slight evidence of an association between occupational jet fuel exposure and neurologic health outcomes, including:

Hearing impairment

Memory impairment

Ocular conditions

There is insufficient evidence to determine specific diagnoses related to exposure, the length of exposure required to experience long-term neurological outcomes, and what immediate symptoms are indicative of long-term neurological outcomes.

RESULTS:
MENTAL HEALTH OUTCOMES

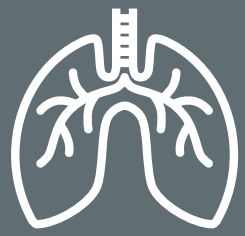
Slight evidence that occupational jet fuel exposure negatively impacts mental health, potentially leading to certain types of outcomes, such as decrements in

- Attention
- Cognitive Function
- Visual-spatial performance
- Social-emotional behavior and regulation
- Mood (e.g., Depression)

Additional studies are needed to better understand specific mental health diagnoses that are related to jet fuel exposure, how risk changes with duration of exposure, and immediate symptoms that are indicative of long-term outcomes.

RESULTS:
RESPIRATORY SYSTEM OUTCOMES

Slight evidence that occupational jet fuel exposure negatively impacts respiratory health, including:



Acute respiratory symptoms, such as dyspnea, cough with phlegm and runny nose

Chronic cough

Respiratory disease mortality

There is insufficient data to determine specific diagnoses related to exposure, the length of exposure at which long-term respiratory outcomes would be expected, and whether there are immediate symptoms that indicate long-term outcomes.

RESULTS:
NEOPLASM OUTCOMES

There is ***slight*** evidence that occupational jet fuel exposure is associated with some cancers:

- Kidney cancer incidence
- Bladder cancer incidence
- Pancreatic and oropharyngeal cancer mortality in women
- All cancer mortality in men

There is insufficient data to determine other specific cancers related to exposure, the length of exposure at which cancer outcomes would be expected, and whether there are immediate cancer-related symptoms (such as pre-cancerous lesions) that indicate long-term outcomes.

SYSTEMATIC LITERATURE REVIEW FINDINGS RECAP

VA conducted a fit-for-purpose systematic literature review to better understand how exposure to jet fuels may impact the health of Veterans. (Vincent-Hall *et al*., 2025)

From the 3,362 references reviewed, 67 were relevant:

- 32 references reported on primary epidemiological data of **28 studies;**
- 21 were reviews; and
- 14 were case reports or case series.

It was determined that there is ***slight evidence*** of an association between jet fuel exposure and certain organ system-level health outcomes

- Nervous system;
- Respiratory system;
- Mental health; and
- Neoplasms.

For all other health outcome categories, the evidence was ***indeterminate***.

RESEARCH GAPS

Future research should focus on:

- **Epidemiologic data gaps:** Confirm associations with specific outcomes identified in animal studies that are not studied in human populations
- **Associations between jet fuel exposure and other outcomes:** Especially those that are currently not well studied
- **Long-term follow-up after the onset of exposure:** Make statistical comparisons based on duration of exposure to jet fuels; observe the natural history of jet fuel-related health effects and the resolution, persistence, or progression of immediate symptoms
- **Populations from underrepresented groups:** Explore if there are differences in exposures, diagnoses, and treatment for women and racial/ethnic minorities
- **Integrating epidemiologic data with biological endpoints:** Explain mechanisms of toxicity in jet fuel-exposed service members and Veterans

EXPANDED SYSTEMATIC REVIEW

VA's **expanded review** is focused on epidemiologic (military, occupational, and environmental) exposures, as well as animal toxicological and mechanistic evidence, within the following health categories of priority.

- Approach closely follows EPA's IRIS Handbook and Guidelines for Carcinogen Risk Assessment.
- Findings are expected to be published in late 2025.


Cancer


Cardiovascular


Cognitive and behavioral


Hematologic


Hepatic

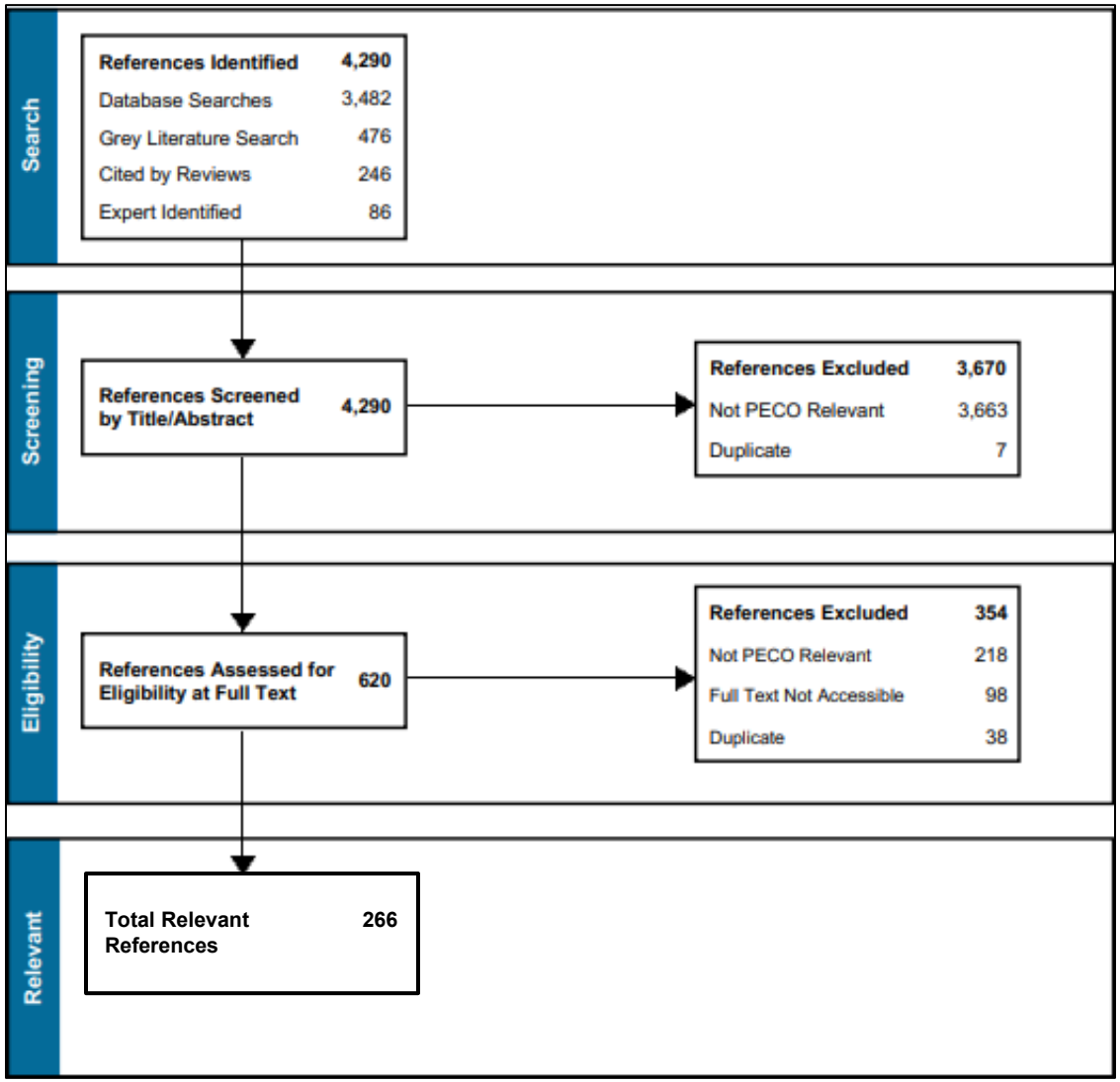

Immune


Neurologic


Renal


Respiratory

EXPANDED SYSTEMATIC REVIEW



VA STUDIES CURRENTLY IN PROGRESS

HOME, in collaboration with Department of Defense (DoD) partners, is conducting the **Long-Term Impact of Fuel Exposure (LIFE) Study** to:

- To better understand the potential long-term health effects associated with occupational exposure to jet fuels; and
- To support VA decision-makers as they shape policies around Veteran care and benefits.

LIFE: RETROSPECTIVE COHORT STUDY

Objective

To investigate how occupational jet fuel exposure in the military impacts Veteran health.

Population

Male and female Veterans who began active-duty service in the Army or Air Force in or after 1995 and separated by 2023.

Methods

Link administrative data from VA and DoD to assess the health of those with occupational jet fuel exposure to a random sample of those without exposure. Leverage exposure monitoring data to characterize potential exposure risk. Health endpoints include healthcare encounters (VHA, TRICARE), disability compensation claims, and mortality.

LIFE: EXPOSURE VALIDATION STUDY

Objective

To identify potential biomarkers of exposure/effect related to jet fuel exposure in occupationally exposed military personnel.

Population

Service members with certain MOS codes enrolled in the Millennium Cohort Study with serum specimens banked at the DoD Serum Repository.

Methods

Analyze serum samples to measure microRNAs and other relevant biomarkers and examine correlations with certain military characteristics and predictors of long-term health outcomes, such as cancers and mental health disorders.

FUTURE WORK

- Systematic literature reviews have been submitted for publication in a supplement of the *Journal of Occupational and Environmental Medicine.*

- Analyses for the LIFE study are ongoing.
  - Deep dives into health outcomes by system
    - Anxiety and depression
    - Asthma and COPD
    - In planning: reproductive outcomes
  - Disability compensation claims data trends (annual review)
  - Mortality analyses (approx. every 5-10 years)
  - Biomarker studies
    - Validation – develop an exposure "signature"
    - Biomarkers of effect – respiratory, mental health, cancers

- Follow-up report to Congress due in August 2028.

Thank you!

Questions?

Terra Vincent-Hall, PhD, DABT
Terra.vincent@va.gov