Respiratory Outcomes Related to Occupational Jet Fuel Exposure in the Military

Presentation for: PACT Act Symposium
Presented by: Terra D. Vincent-Hall, PhD, DABT, Senior Toxicologist, Exposure Science Program, Health Outcomes Military Exposures
Date: May 3, 2023
The views expressed are solely the opinion of the authors and do not represent the official stance of the Department of Veterans Affairs, the Department of Defense, or the federal government.
BLUF: There is a need for both VA and DoD to understand the future health implications of occupational jet fuel exposure.

– One of the most common exposures in military service
– Most published research details acute effects; lack of information on long-term outcomes
– VA often receives inquiries from Veterans and other stakeholders regarding related health effects.

– War Related Illness and Injury Study Center Intake Packet
  • About 90% of Veterans who completed an intake packet reported exposure to petrochemicals.
  • Over half reported exposure as frequently as every day while deployed.

– Airborne Hazards and Open Burn Pit Registry
  • Over 85% of participants report potential exposure to fuels.
  • The perception of these participants is that the exposure that had the most impact on their health was on-base air pollution (resulting from burning fuel or burn pits).
Section 202, § 1120: Presumption of service connection for certain diseases associated with exposure to burn pits and other toxins

(a) PRESUMPTION OF SERVICE CONNECTION.—For the purposes of section 1110 of this title, and subject to section 1113 of this title, a disease specified in subsection (b) becoming manifest in a covered veteran shall be considered to have been incurred in or aggravated during active military, naval, air, or space service, notwithstanding that there is no record of evidence of such disease during the period of such service.
Section 202, § 1120: Presumption of service connection for certain diseases associated with exposure to burn pits and other toxins

(b) DISEASES SPECIFIED.—The diseases specified in this subsection are the following: [list reduced to only respiratory conditions]

- Asthma that was diagnosed after service of the covered veteran as specified in subsection (c).
- Respiratory cancer of any type.
- Chronic bronchitis.
- Chronic obstructive pulmonary disease.
- Constrictive bronchiolitis or obliterative bronchiolitis.
- Emphysema.
- Granulomatous disease.
- Interstitial lung disease.
- Pleuritis.

- Pulmonary fibrosis.
- Sarcoidosis.
- Chronic sinusitis.
- Chronic rhinitis.
- Any other disease for which the Secretary determines, pursuant to regulations prescribed under subchapter VII that a presumption of service connection is warranted based on a positive association with a substance, chemical, or airborne hazard identified in the list under section 1119(b)(2) of this title.
Honoring Our Pact Act of 2022

Section 510: Report on health effects of jet fuels used by Armed Forces

(a) INITIAL REPORT.—Not later than one year after the date of the enactment of this Act, the Secretary of Veterans Affairs shall submit to the Committee on Veterans’ Affairs of the Senate and the Committee on Veterans’ Affairs of the House of Representatives, and make publicly available, a report on health effects of jet fuels used by the Armed Forces.

(b) CONTENTS.—The report submitted under subsection (a) shall include the following:

1. A discussion of the effect of various different types of jet fuels used by the Armed Forces on the health of individuals by length of exposure.
2. An identification of the immediate symptoms of jet fuel exposure that may indicate future health risks.
3. A chronology of health safeguards implemented by the Armed Forces intended to reduce the exposure of members of the Armed Forces to jet fuel.
4. An identification of any areas relating to jet fuel exposure about which new research needs to be conducted.

(c) FOLLOW-UP REPORT.—Not later than five years after the date of the submittal of the report under subsection (a), the Secretary shall submit to the committees referred to in such subsection an update to such report.
Systematic Literature Review – Respiratory Outcomes

- Seven primary occupational studies + several secondary sources (risk assessments, reviews, case reports)
- Slight evidence of an association (studies generally agree; however, limited number of studies and included significant biases/limitations)
- Acute outcomes:
  - Decreased lung function
  - Respiratory symptoms (e.g., dyspnea, cough with phlegm, runny nose)
- Long-term outcomes:
  - Chronic obstructive diseases
  - Respiratory symptoms (e.g., chronic cough)
- Additional studies are needed to:
  - Confirm specific respiratory outcomes related to jet fuel exposure
  - Identify immediate symptoms/acute outcomes indicative of long-term illnesses
  - Understand how duration of exposure impacts risk of respiratory outcomes
VA/DoD Tri-Service Occupational Jet Fuel Retrospective Investigation

PI: VHA HOME Exposure Science Program
Collaborators:
VHA HOME Epidemiology, VBA Military Exposure Team,
US Air Force School of Aerospace Medicine,
Defense Health Centers – Aberdeen and Portsmouth
Key elements for a tri-service study:

- Define populations using Military Occupational Specialty (MOS) codes in all services
  - Exposed and unexposed codes
  - Service starting in 1995 or later through 2021
  - Active Duty only; service in only one branch
  - Minimum 2 years of service
- Evaluate medical data throughout and after military career for trends
  - Healthcare encounters
  - Mortality
  - Compensation claims
- May impact care, disability compensation, and preventive measure policies for individuals in certain occupations
Methods

- Veterans with encounters after separation (VHA encounters and Tricare claims); n = 540,204
- Exposure: Duration in years with jet fuel-exposed MOS code
- Cox Proportional Hazard Regression Models
  - AFHSD Surveillance and NIOSH Work-Related Respiratory Disease Manuals
  - Censor: Loss to follow-up, end of surveillance (1st Jan, 2020), death
  - Person-time: Time from separation to event or censor
  - Significance level: p < 0.05 (Correction for multiple comparisons applied)
  - Data displayed as quintiles of duration vs. unexposed

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<tr>
<th>Sex</th>
<th>N</th>
<th>Percent</th>
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<td>≥ 28</td>
<td>156,643</td>
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<td>24 to 27</td>
<td>186,439</td>
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<td>≤ 23</td>
<td>197,121</td>
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<td>Enlisted</td>
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<td>Officer</td>
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<td>Warrant Officer</td>
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<td>Never Used</td>
<td>235,155</td>
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<td>Current/Former User</td>
<td>305,050</td>
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<th>Length of Service</th>
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<td>≥ 6</td>
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<td>3 to 5</td>
<td>262,432</td>
<td>48.58</td>
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<td>2 to 3</td>
<td>205,082</td>
<td>37.96</td>
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# Respiratory Healthcare Encounters

## Diagnosis Frequency

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<th>Condition Category</th>
<th>Frequency</th>
<th>Percent</th>
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<td><strong>Respiratory Conditions</strong></td>
<td>284,596</td>
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<td>Malignant Respiratory Neoplasms</td>
<td>196</td>
<td>0.04</td>
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<td><strong>Condition</strong></td>
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<tr>
<td>Allergic Rhinitis</td>
<td>125,501</td>
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<tr>
<td>Asthma</td>
<td>31,597</td>
<td>5.85</td>
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<tr>
<td>COPD</td>
<td>28,942</td>
<td>5.36</td>
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<td>Chronic Sinusitis</td>
<td>17,084</td>
<td>3.16</td>
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<td>Conditions Due to Chemical Fumes and Vapors</td>
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<td>0.02</td>
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<td>Hypersensitivity Pneumonitis</td>
<td>34</td>
<td>0.01</td>
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<td>Influenza/Pneumonia</td>
<td>44,599</td>
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<td>Other Interstitial Pulmonary Disease</td>
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<td>0.06</td>
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<tr>
<td>Pneumoconioses</td>
<td>199</td>
<td>0.04</td>
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<td>Respiratory Tuberculosis</td>
<td>538</td>
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<td>Sleep Apnea</td>
<td>99,505</td>
<td>18.42</td>
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<tr>
<td>Upper Respiratory Infection</td>
<td>196,065</td>
<td>36.29</td>
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<tr>
<td>Malignant Neoplasm: Larynx</td>
<td>28</td>
<td>0.01</td>
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<tr>
<td>Malignant Neoplasm: Mesothelioma</td>
<td>7</td>
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<td>Malignant Neoplasm: Other Respiratory</td>
<td>67</td>
<td>0.01</td>
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<tr>
<td>Malignant Neoplasm: Pleura</td>
<td>1</td>
<td>0.00</td>
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<tr>
<td>Malignant Neoplasm: Trachea, Bronchus and Lung</td>
<td>100</td>
<td>0.02</td>
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Results: All Respiratory Conditions (n = 284,596 events)

1. Deployment
   Deployed
   Q5: ≥ 7y,0m  1.29 (1.27, 1.31)  < 0.001
   Q4: 4y,7m - 6y,11m  1.06 (1.05, 1.08)  < 0.001
   Q3: 3y,4m - 4y,6m  1.03 (1.01, 1.05)  0.002
   Q2: 2y,6m - 3y,3m  0.98 (0.96, 1.00)  0.022
   Q1: 1m - 2y,5m  1.02 (1.00, 1.04)  0.018
   Unexposed  Reference
   Not Deployed
   Q5: ≥ 7y,0m  1.21 (1.16, 1.25)  < 0.001
   Q4: 4y,7m - 6y,11m  1.09 (1.06, 1.12)  < 0.001
   Q3: 3y,4m - 4y,6m  1.00 (0.98, 1.02)  0.999
   Q2: 2y,6m - 3y,3m  0.98 (0.95, 1.00)  0.060
   Q1: 1m - 2y,5m  1.00 (0.98, 1.02)  0.999
   Unexposed  Reference

2. Service Branch
   Air Force
   Q5: ≥ 7y,0m  1.28 (1.25, 1.30)  < 0.001
   Q4: 4y,7m - 6y,11m  1.10 (1.08, 1.12)  < 0.001
   Q3: 3y,4m - 4y,6m  1.02 (0.99, 1.05)  0.294
   Q2: 2y,6m - 3y,3m  1.12 (1.09, 1.16)  < 0.001
   Q1: 1m - 2y,5m  1.10 (1.08, 1.13)  < 0.001
   Unexposed  Reference
   Army
   Q5: ≥ 7y,0m  1.31 (1.29, 1.33)  < 0.001
   Q4: 4y,7m - 6y,11m  1.02 (1.00, 1.04)  0.017
   Q3: 3y,4m - 4y,6m  0.96 (0.94, 0.98)  < 0.001
   Q2: 2y,6m - 3y,3m  0.89 (0.87, 0.90)  < 0.001
   Q1: 1m - 2y,5m  0.93 (0.92, 0.95)  < 0.001
   Unexposed  Reference
Results: Asthma (n = 31,597 events)

1. Deployment
   Deployed
   - Q5: ≥ 7y,0m: 1.50 (1.44, 1.56) < 0.001
   - Q4: 4y,7m - 6y,11m: 1.10 (1.05, 1.15) < 0.001
   - Q3: 3y,4m - 4y,6m: 1.04 (0.98, 1.12) 0.221
   - Q2: 2y,6m - 3y,3m: 0.88 (0.82, 0.93) < 0.001
   - Q1: 1m - 2y,5m: 0.94 (0.88, 1.00) 0.047
   Unexposed: Reference

   Not Deployed
   - Q5: ≥ 7y,0m: 1.42 (1.29, 1.57) < 0.001
   - Q4: 4y,7m - 6y,11m: 1.18 (1.09, 1.28) < 0.001
   - Q3: 3y,4m - 4y,6m: 1.00 (0.93, 1.07) 0.999
   - Q2: 2y,6m - 3y,3m: 0.99 (0.92, 1.06) 0.999
   - Q1: 1m - 2y,5m: 0.99 (0.92, 1.05) 0.999
   Unexposed: Reference

2. Service Branch
   Air Force
   - Q5: ≥ 7y,0m: 1.53 (1.45, 1.62) < 0.001
   - Q4: 4y,7m - 6y,11m: 1.33 (1.25, 1.42) < 0.001
   - Q3: 3y,4m - 4y,6m: 1.14 (1.05, 1.23) 0.001
   - Q2: 2y,6m - 3y,3m: 1.23 (1.13, 1.35) < 0.001
   - Q1: 1m - 2y,5m: 1.19 (1.12, 1.28) < 0.001
   Unexposed: Reference

   Army
   - Q5: ≥ 7y,0m: 1.43 (1.37, 1.50) < 0.001
   - Q4: 4y,7m - 6y,11m: 0.94 (0.89, 1.00) 0.048
   - Q3: 3y,4m - 4y,6m: 0.85 (0.80, 0.89) < 0.001
   - Q2: 2y,6m - 3y,3m: 0.72 (0.69, 0.77) < 0.001
   - Q1: 1m - 2y,5m: 0.77 (0.73, 0.81) < 0.001
   Unexposed: Reference

   0.75 1 1.25 1.5 2 2.5
Results: COPD (n = 28,942 events)

1. Deployment
   - Deployed
     - Q5: ≥ 7y,0m
       - HR (95% CI): 1.15 (1.10, 1.21) P < 0.001
     - Q4: 4y,7m - 6y,11m
       - HR (95% CI): 1.16 (1.10, 1.22) P < 0.001
     - Q3: 3y,4m - 4y,6m
       - HR (95% CI): 1.13 (1.07, 1.19) P < 0.001
     - Q2: 2y,6m - 3y,3m
       - HR (95% CI): 1.00 (0.91, 1.10) P = 0.999
     - Q1: 1m - 2y,5m
       - HR (95% CI): 1.10 (1.03, 1.17) P = 0.003
   - Unexposed Reference
   - Not Deployed
     - Q5: ≥ 7y,0m
       - HR (95% CI): 1.13 (1.00, 1.29) P = 0.057
     - Q4: 4y,7m - 6y,11m
       - HR (95% CI): 1.11 (1.02, 1.21) P = 0.013
     - Q3: 3y,4m - 4y,6m
       - HR (95% CI): 1.01 (0.95, 1.09) P = 0.999
     - Q2: 2y,6m - 3y,3m
       - HR (95% CI): 1.02 (0.95, 1.09) P = 0.999
     - Q1: 1m - 2y,5m
       - HR (95% CI): 1.12 (1.05, 1.19) P < 0.001
   - Unexposed Reference

2. Service Branch
   - Air Force
     - Q5: ≥ 7y,0m
       - HR (95% CI): 1.20 (1.12, 1.29) P < 0.001
     - Q4: 4y,7m - 6y,11m
       - HR (95% CI): 1.10 (1.01, 1.19) P = 0.026
     - Q3: 3y,4m - 4y,6m
       - HR (95% CI): 0.96 (0.83, 1.11) P = 0.579
     - Q2: 2y,6m - 3y,3m
       - HR (95% CI): 1.14 (1.04, 1.25) P = 0.007
     - Q1: 1m - 2y,5m
       - HR (95% CI): 1.13 (1.05, 1.21) P < 0.001
   - Unexposed Reference
   - Army
     - Q5: ≥ 7y,0m
       - HR (95% CI): 1.16 (1.10, 1.23) P < 0.001
     - Q4: 4y,7m - 6y,11m
       - HR (95% CI): 1.18 (1.12, 1.24) P < 0.001
     - Q3: 3y,4m - 4y,6m
       - HR (95% CI): 1.12 (1.06, 1.18) P < 0.001
     - Q2: 2y,6m - 3y,3m
       - HR (95% CI): 0.97 (0.88, 1.08) P = 0.586
     - Q1: 1m - 2y,5m
       - HR (95% CI): 1.08 (1.02, 1.15) P = 0.009
   - Unexposed Reference
Results: Chronic Sinusitis (n = 17,084 events)

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<th>1. Deployment</th>
<th>HR (95% CI)</th>
<th>P Value</th>
</tr>
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<tr>
<td>Q5: ≥ 7y.0m</td>
<td>1.25 (1.18, 1.33)</td>
<td>&lt; 0.001</td>
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<td>Q4: 4y.7m - 6y.11m</td>
<td>1.11 (1.03, 1.18)</td>
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<td>Q3: 3y.4m - 4y.6m</td>
<td>1.08 (0.99, 1.17)</td>
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<td>Q2: 2y.6m - 3y.3m</td>
<td>0.97 (0.67, 1.41)</td>
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<td>1.07 (0.97, 1.17)</td>
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</tr>
<tr>
<td>Unexposed</td>
<td>Reference</td>
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</table>

| Not Deployed   |             |         |
| Q5: ≥ 7y.0m    | 1.23 (1.06, 1.42) | 0.006   |
| Q4: 4y.7m - 6y.11m | 0.98 (0.88, 1.08) | 0.999   |
| Q3: 3y.4m - 4y.6m  | 0.93 (0.83, 1.05) | 0.268   |
| Q2: 2y.6m - 3y.3m  | 1.01 (0.93, 1.11) | 0.999   |
| Q1: 1m - 2y.5m   | 1.07 (0.97, 1.19) | 0.159   |
| Unexposed      | Reference    |         |

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<td></td>
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<tr>
<td>Q5: ≥ 7y.0m</td>
<td>1.23 (1.14, 1.34)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Q4: 4y.7m - 6y.11m</td>
<td>0.97 (0.89, 1.06)</td>
<td>0.999</td>
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<tr>
<td>Q3: 3y.4m - 4y.6m</td>
<td>0.96 (0.78, 1.18)</td>
<td>0.692</td>
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<td>Q2: 2y.6m - 3y.3m</td>
<td>1.05 (0.79, 1.40)</td>
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<td>Q1: 1m - 2y.5m</td>
<td>1.07 (0.95, 1.19)</td>
<td>0.259</td>
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| Army              |             |         |
| Q5: ≥ 7y.0m       | 1.33 (1.24, 1.43) | < 0.001 |
| Q4: 4y.7m - 6y.11m | 1.14 (1.05, 1.22) | < 0.001 |
| Q3: 3y.4m - 4y.6m  | 1.06 (0.95, 1.17) | 0.319   |
| Q2: 2y.6m - 3y.3m  | 0.98 (0.91, 1.06) | 0.999   |
| Q1: 1m - 2y.5m    | 1.08 (0.98, 1.18) | 0.112   |
| Unexposed         | Reference    |         |
Discussion

• Published literature on long-term respiratory outcomes related to occupational jet fuel exposure is sparse.
• The present study is the largest cohort study to examine this relationship in a military population.
• Our analyses suggest that occupational exposure to jet fuel is related to the occurrence of chronic respiratory conditions in Air Force and Army Veterans.
  – Conditions associated with occupational jet fuel exposure in this study are consistent with those presumed to be associated with service in Gulf War and the recent conflicts under the PACT Act.
  – Hazard ratios for certain respiratory outcomes increase with duration in fuel-exposed military occupational specialties.
  – Patterns of some respiratory diseases may differ by branch.
• Limitations
  – MOS used as a proxy for exposure
  – Limited to encounters captured by VHA/Tricare
Future Work

- Retrospective study
  - Continuation of encounters, mortality, and claims analyses
  - Incorporate DOEHERS-IH data to characterize exposure intensity by MOS
  - Request Navy/Marine Corps roster and other data
- Complementary biomarker study – collaboration with RM MIRECC, NHRC, and 711th HPW
- Section 510
  - Draft report submitted for internal clearance on 4/28/23, due to Congress by 8/10/2023
  - Expand literature review (animal and mechanistic studies; other populations)
  - Incorporate study findings into the total evidence
  - Follow-up report due by 8/10/2028