NAVY AND MARINE CORPS PUBLIC HEALTH CENTER
IMPROVING READINESS THROUGH PUBLIC HEALTH ACTION

DoD Firefighter Blood PFAS Testing

FY20-21 Analysis

Presentation to
American Osteopathic College of Occupational and Preventive Medicine
21 March 2024

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Learning Objectives

1. Why did the Department of Defense (DoD) began offering PFAS testing to firefighters in addition to their annual surveillance exams starting in October 2020.
2. What specific PFAS are tested for in DoD firefighters, and why.
3. What do the first year of testing results show in comparison to the general population, National Health and Nutrition Examination Survey (NHANES) results.
4. Why blood PFAS levels cannot be currently used to determine health outcomes or medical treatment.
5. What new projects are being worked on to help characterize occupational PFAS exposures in firefighters.

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National Defense Authorization Act (NDAA) 2020

SEC. 707. PROVISION OF BLOOD TESTING FOR FIREFIGHTERS OF DEPARTMENT OF DEFENSE TO DETERMINE EXPOSURE TO PERFLUOROALKYL AND POLYFLUOROALKYL SUBSTANCES.

(a) IN GENERAL.—Beginning on October 1, 2020, the Secretary of Defense shall provide blood testing to determine and document potential exposure to perfluoroalkyl and polyfluoroalkyl substances (commonly known as "PFAS") for each firefighter of the Department of Defense during the annual physical exam conducted by the Department for each such firefighter.

(b) FIREFIGHTER DEFINED.—In this section, the term "firefighter" means someone whose primary job or military occupational specialty is being a firefighter.

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DoD Firefighter Blood PFAS Testing

Purpose & Implementation

Purpose:

Offer testing to all DoD firefighters to "*determine and document potential exposure*" during their annual occupational examination (Section 707 of the National Defense Authorization Act of 2020)

Implementation:

Analyses: Clinical Laboratory Improvement Amendments (CLIA) Certified Laboratory

Sampling and Reporting: Logistics

- Sample DoD firefighter blood during annual exam (voluntary).
- Blood sample sent to CLIA certified laboratory for analysis of PFAS.
- Results uploaded to firefighter's MHS electronic record.
- Results queried by EpiData Center (EDC) at NMCPHC
- EDC reports summary statistics on DoD firefighter blood PFAS analyses.
- EDC analyses integrated into Report to Congress.

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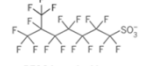
DoD Firefighter Blood PFAS Testing

Exposure Analysis Challenges

- Are DoD firefighter results comparable to those in the US population?
  - The CDC's National Health and Nutrition Examination Survey (NHANES) assesses about 2,000 people annually for 12-16 PFAS in blood and urine.

  Results assumed to be representative of those present in the US population.
  - The method of PFAS analysis used by the CDC's is different from the proprietary analysis used by the DoD's CLIA certified laboratory.
- DoD's current PFAS analysis is limited to:
  - PFHxS
  - PFHpA
  - PFNA
  - n-PFOA (linear)
  - PFBS
  - n-PFOS (linear)
- DoD firefighter exposures to PFAS are not known.

PFOS linear isomer



PFOS branched isomer

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DoD Firefighter Blood PFAS Testing
Results FY21

PFAS Testing by Branch

Table 1. Participating DOD Personnel Tested for PFAS by Service Branch, 01 October 2020 to 30 September 2021

Service Branch	Total Participants Tested	Percent (%)
Air Force	2,184	32.5
Army	334	5.0
Marine Corps	455	6.8
Navy	318	4.7
Other	3,424	51.0
Total	6,715	100.0

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.
Prepared by the EpiData Center, Navy and Marine Corps Public Health Center on 08 April 2022.

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DoD Firefighter Blood PFAS Testing
Results FY21

PFAS Univariate Statistics by Compound- Overall

Table 2. Total PFAS Laboratory Testing among Participating DoD Personnel, 01 October 2020 to 30 September 2021

Compound	Total Tests	Below Limit of Detection (%) [a]	Above Limit of Detection (%) [b]	Test Not Performed (%) [c]	Not Applicable (%) [d]
PFBS	7,021	93.6	2.9	2.6	0.9
PFHpA	7,017	78.7	17.4	3.1	0.9
PFHxS	7,018	0.1	92.2	6.8	0.9
PFNA	7,018	0.5	95.5	3.2	0.9
PFOA	7,108	3.8	92.7	2.5	0.9
PFOS	7,045	0.8	95.6	2.8	0.9

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.
[a] Percent of samples with a value below the limit of detection (0.05 ng/mL).
[b] Percent of samples with a numeric value greater than the limit of detection (0.05 ng/mL).
[c] Percent of samples with a value of "TNP" or "Test not performed".
[d] Percent of samples where values could not be extracted; results were uploaded to the Health Artifact and Image Management Solution (HAIMS) and not CHCS.
Includes all serum samples regardless of availability of test results.
Includes Active Duty and Non-Active Duty Personnel.
Values are not directly comparable to NHANES or CDC Per- and Polyfluoroalkyl reporting.
Prepared by the EpiData Center, Navy and Marine Corps Public Health Center on 06 June 2022.

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DoD Firefighter Blood PFAS Testing
Results FY21

PFAS Measures of Central Tendency by Compound- Overall

Table 3. Uni-variate Statistics for PFAS Blood Testing among Participating DOD Personnel, 01 October 2020 to 30 September 2021

Compound	Count	Geometric Mean[a]	95th Percentile[b]	No. > 95th Percentile	Maximum Test Result Value
PFBS	6,785	*	<LOD	209	0.7
PFHpA	6,744	*	0.098	332	1.0
PFHxS	6,484	**2.9** (2.8-2.9)	10.0	254	340.0
PFNA	6,737	**0.42** (0.41-0.42)	1.0	281	8.8
PFOA	6,868	**1.1** (1.1-1.2)	2.9	331	24.0
PFOS	6,795	**3.1** (3.05-3.2)	11.0	296	150.0

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.
[a]95% Confidence Limits were calculated for the geometric mean.
[b]Represents the point at which 5% of the serum samples in the cohort exceeds that value.
<LOD means less than the limit of detection (0.05 ng/mL).
*Not calculated: proportion of results below limit of detection was too high to provide a valid result.
Includes number of serum samples with a numeric test result.
All result values are in ng/mL.
Includes Active Duty and Non-Active Duty Personnel.
Values are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.
Prepared by the EpiData Center, Navy and Marine Corps Public Health Center on 06 June 2022.

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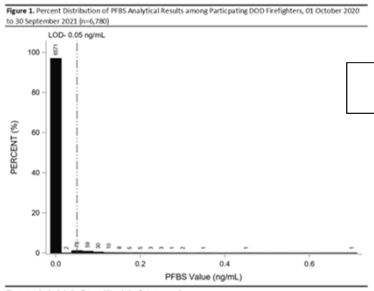
DoD Firefighter Blood PFAS Testing
Results FY21

Figure 1. Percent Distribution of PFBS Analytical Results among Participating DOD Firefighters, 01 October 2020 to 30 September 2021 (n=6,780)



PFBS

Figure contains both Active Duty and Non-Active Duty personnel.
Serum Concentrations are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.
Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.
Prepared by the EpiData Center, Navy and Marine Corps Public Health Center on 07 January 2022.

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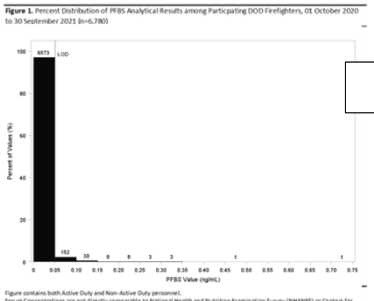

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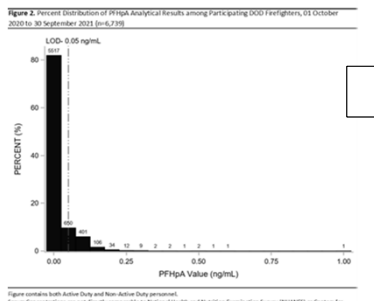
DoD Firefighter Blood PFAS Testing
Results FY21

Figure 2. Percent Distribution of PFHpA Analytical Results among Participating DOD Firefighters, 01 October 2020 to 30 September 2021 (n=6,739)



PFHpA

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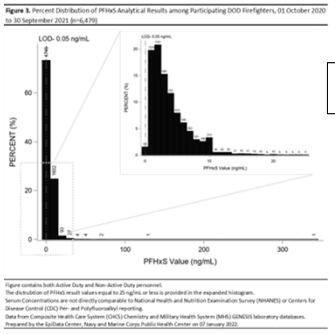
DoD Firefighter Blood PFAS Testing
Results FY21



PFHxS

Figure contains both Active Duty and Non-Active Duty personnel.
The distribution of PFHxS result values equal to 25 ng/mL or less is provided in the expanded histogram.
Serum Concentrations are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.
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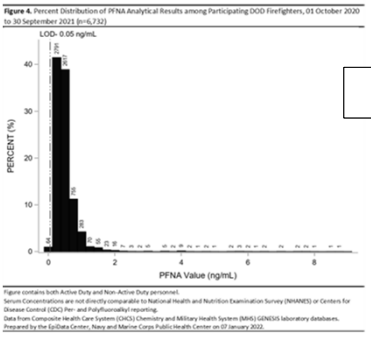
DoD Firefighter Blood PFAS Testing
Results FY21



PFNA

Figure contains both Active Duty and Non-Active Duty personnel.
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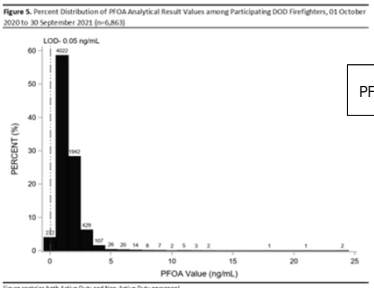
DoD Firefighter Blood PFAS Testing
Results FY21



PFOA (linear)

Figure contains both Active Duty and Non-Active Duty personnel.
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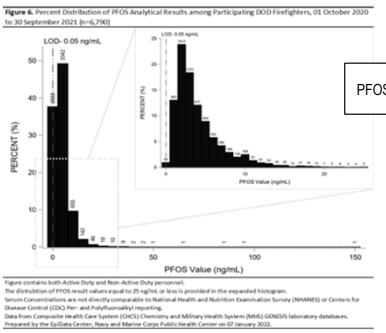
Results FY21



PFOS (linear)

Figure contains both Active Duty and Non-Active Duty personnel.
The distribution of PFOS result values equal to 25 ng/mL or less is provided in the expanded histogram.
Serum Concentrations are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.
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DoD Firefighter Blood PFAS Testing
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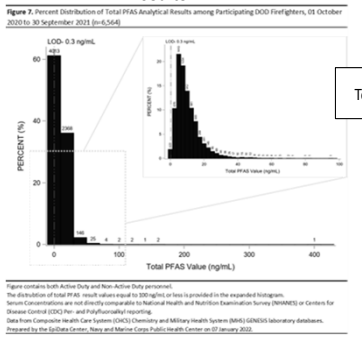

Total PFAS

Figure contains both Active Duty and Non-Active Duty personnel.
The distribution of total PFAS result values equal to 100 ng/mL or less is provided in the expanded histogram.
Serum Concentrations are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.
Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.
Prepared by the EpiData Center, Navy and Marine Corps Public Health Center on 07 January 2022.

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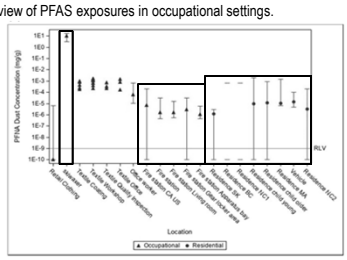
Firefighter Exposure to PFAS

Assumed: Firefighters are the DoD group most likely to have PFAS in their blood.
- As a result of AFFF use.

Paris-Davila et al. 2023. *Occupational exposures to airborne per- and polyfluoroalkyl substances (PFAS) – A review.* Ann. J. Ind. Med. 66:393-410. DOI: 10.1002/ajim.23461.
- Literature review of PFAS exposures in occupational settings.



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Firefighter Exposure to PFAS

Levasseur et al. 2022. *Characterizing firefighter's exposure to over 130 SVOCs using silicone wristbands: A pilot study comparing on-duty and off-duty exposures*. Science and the Total Environment. 834:155237. http://dx.doi.org/10.1016/j.scitotenv.2022.155237.

- 27 Firefighter's from stations in Durham, North Carolina.
  - Measured 19 PFAS
  - **No AFFF was used by firefighters during the study period.**
  - Detected PFOA, PFOS, PFHxS, PFNA, PFDA, and 6:2diPAP
    - Off Duty
    - On Duty + No Fire
    - On-Duty + Fire

Comparing Exposures

	PFOA	PFOS	PFHxS	PFNA	PFDA	6:2diPAP
Off-Duty	--	--	--	--	--	--
On Duty + No Fire	--	↑	↓	↓	↓	↓
On -Duty + Fire	↓	↑	↓	↓	↓	↓

CONDITION	N	%
Type of Fire		
Structure	22	81
Residential	17	63
Business	5	19
Vehicle	3	11
Other	3	11
Multiple	1	4
Type of PPE worn		
Bunker pants	1	5
Full turn-out gear with SCBA	18	86
Duty uniform, helmet, gloves	2	10
Time spent at fire		
<30minutes	8	38
≥30 minutes	13	62
Type of extinguisher used at fire		
None	1	5
Water	16	76
Dry chemical	1	5
Water and dry chemical	3	14
Fire events (per wristband)		
1	13	65
2	7	35

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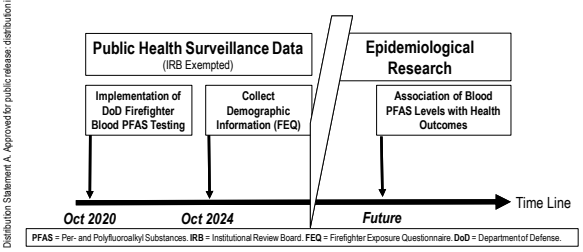
Timeline: A Phased Approach to Track, Trend, and Analyze Firefighter Blood PFAS Test Results



PFAS = Per- and Polyfluoroalkyl Substances. **IRB** = Institutional Review Board. **FEQ** = Firefighter Exposure Questionnaire. **DoD** = Department of Defense.

NDIA 26TH Annual Systems & Mission Engineering Conference, 16-19 October 2023.

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DoD Firefighter Blood PFAS Testing
Evolving Scope of Work

- Who Will be Offered Testing
  - Draft text from DoDM 6055.05 Occupational Medical Examinations revision

    "PFAS blood testing will be offered to current DoD firefighters during their annual occupational medicine examination, to newly hired DoD firefighters in order to establish a baseline, and to other DoD personnel who perform firefighting duties as part of their job assignment (e.g., damage control officers)."
- Analytical Analyses
  - CDC NHANES-like analytical methodology.
    - Comparability of analytical results with those from NHANES.
  - Expanded PFAS target analyte list.
    - Inclusion of PFAS associated with AFFF.
- Data Reporting
  - Electronic data acquisition.
- Data Evaluation
  - Firefighter Questionnaire.
  - Trend analysis.

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Expanded PFAS Target Analyte List

PFAS Analytes	CDC NHANES 2017-2018	Current PFAS Panel	Proposed PFAS Panel
PFBS – Perfluorobutanesulfonic acid		X	X
PFHpA – Perfluoroheptanoic acid		X	X
PFDA – Perfluorodecanoic acid	X		X
PFUnDA/PUFA – Perfluoroundecanoic acid	X		X
PFHpS – Perfluoroheptanesulfonic acid	X		X
PFHxS – Perfluorohexanesulfonic acid	X	X	X
PFHxA – Perfluorohexanoic acid	X		X
PFNA – Perfluorononanoic acid	X	X	X
n-PFOA – Perfluorooctanoic acid (linear isomer)	X	X	X
Sb-PFOA – Perfluorooctanoic acid (branched isomers)	X		X
n-PFOS – Perfluorooctanesulfonic acid (linear isomer)	X	X	X
Sm-PFOS – Perfluorooctanesulfonic acid (branched isomers)	X		X
MeFOSAA – 2-(N-Methyl-perfluorooctane sulfonamide) acetate	X		X
GenX – 2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)-propanoate*	X		
ADONA – Dodecafluoro-3H-4,8-dioxanoate*	X		X
9Cl-PF – 9-Chlorohexadecafluoro-3-ocanonane-1sulfonate*	X		
PFDOA – Perfluorododecanoic acid			X
*These PFAS are considered emerging PFAS substances.	14	6	15

GREEN PFAS are associated with AFFF, detected in firefighter blood samples or in AFFF impacted drinking waters.

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DoD Firefighter Blood PFAS Testing
DoD Firefighter Questionnaire

Firefighter Questionnaire:

Purpose: Obtain information related to DoD firefighter's exposure to PFAS.

Questions: Develop information necessary to characterize exposure.

Implementation of Questionnaire: An Electronic IT Solution

1. Complete an electronic Questionnaire prior to blood draw.
2. Questionnaire sent to the EDC server.
3. EDC evaluates potential DoD firefighter PFAS exposures.
4. Occupational Medicine (OM) providers may access a Firefighter's completed Questionnaire.

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Guidance for Firefighters

- Firefighters
  - Blood PFAS levels cannot not determine health outcome or medical treatment.
    - No health effects are known **to be caused** by PFAS exposure in humans.
      - Some health effects have been associated with certain PFAS exposures.
        - » **Increased blood cholesterol levels**
        - » **Changes in Liver enzymes**
        - » **Decreased vaccine response in children**
        - » **Increased risk of high blood pressure and pre-eclampsia in pregnant women**
        - » **Small decreases in birth weights**
        - » **Increased risk of kidney and testicular cancer.**
  - Cannot determine when, where, or how PFAS exposure occurred.
    - Many PFAS are slowly excreted and not metabolized.
    - PFAS remain in the body for a long time (a half-life of several years).

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Guidance for Occupational Health Providers

- Blood PFAS levels cannot not determine health outcome or medical treatment.
  - No health effects are known **to be caused** by PFAS exposure in humans.
  - Recommendations are to follow routine U.S. Preventive Services Task Force (USPSTF) screening guidelines.
- Cannot determine when, where, or how PFAS exposure occurred.
  - Exposure to PFAS can occur through contact with various consumer products, contaminated food and drinking water.
  - Difficult, if not impossible, to differentiate between occupational and non-occupational exposure.
- NASEM's Guidance on PFAS Exposure, Testing, and Clinical Follow-Up (2022). https://www.nationalacademies.org/our-work/guidance-on-pfas-testing-and-health-outcomes#sectionPublications
  - Controversial recommendations – focused on primary care providers

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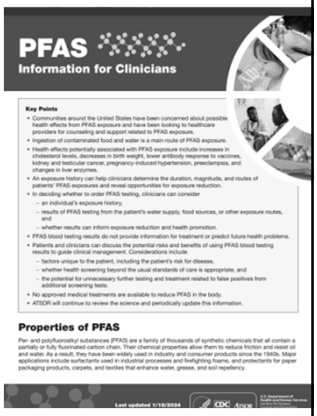
New ATSDR Guidance for Clinicians Jan 2024

Significant Changes from 2019

- Takes into consideration community concerns
- Benefits of an exposure history
- Helps clinicians determine when PFAS testing might be helpful or appropriate

Weaknesses

- No occupational exposure limits or guidelines
- No way to differentiate between occupational and non-occupational exposures
- No dose-response relationships for any PFAS



https://www.atsdr.cdc.gov/pfas/docs/PFAS-info-for-clinicians-508.pdf

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DoD Firefighter Blood PFAS Testing
Key Personnel

Office of the Deputy Assistant Secretary of Defense (DASD) Health Readiness Policy & Oversight (HRP&O)

Health Assurance Policy
- Director: Jody Wireman, Ph.D., MSPH, MPA, CIH, DABT

Defense Center for Public Health – Portsmouth (DCPH-P)

EpiData Center (EDC), Exposure and Injury Analysis Division
- Div. Officer, Beth Poitras, MPH. Epidemiologist
- Michele Madden, MPH, Epidemiologist / Otto Essen, MA, Statistician

Directorate of Environmental Health, Environmental Programs (EP)
- Dr. Alan Philippi, Occ. Med. Consultant (CAPT, MC, USN ret)
- James Smith, Ph.D., Toxicologist

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