National Institute for Occupational Safety and Health

NIOSH

Wildland Firefighters: Exposures and Registry

Kenneth Fent, PhD, CIH
Team Lead, NIOSH NFR for Cancer

June 15, 2026

National Academies of Sciences, Engineering, & Medicine
Webinar Series on Wildfire Preparedness, Response, & Recovery

NFR
NATIONAL FIREFIGHTER REGISTRY for Cancer
Understanding & Reducing Cancer

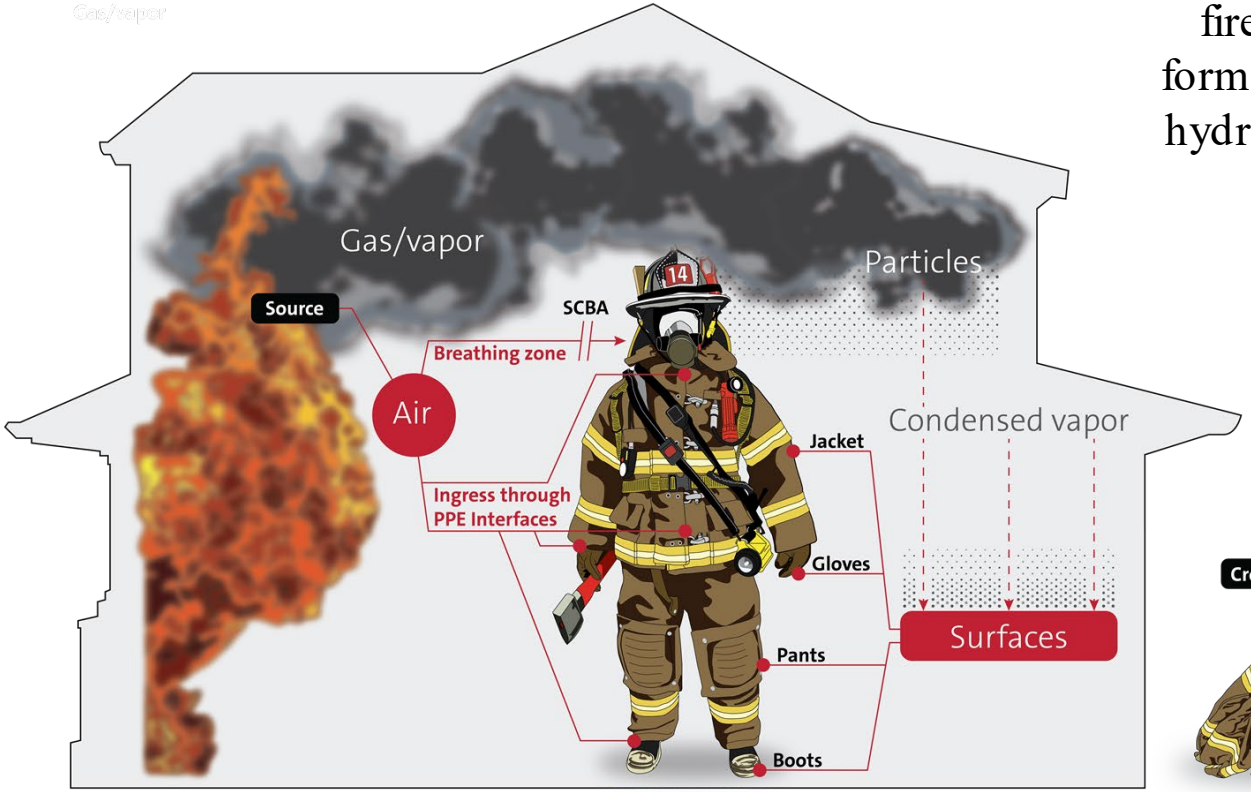
Overview of the U.S. Fire Service

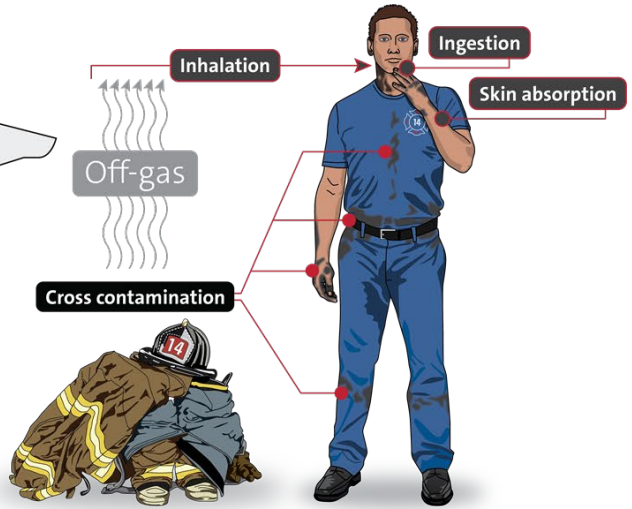
- About 1 million firefighters in the United States[1]
  - ~19,000 federal wildland firefighters[2]
  - >100,000 state and local firefighters involved in wildfire responses[3]
- Respond to approximately 1.4 million fires/year[4]
  - Roughly 60,000-70,000 wildfires annually[5]
  - Wildfire season is increasing in length and severity
  - A small fraction become major Wildland Urban Interface (WUI) conflagrations
    - Both wildland firefighters and structural firefighters are often involved in WUI fire responses

1. NFPA (2022)
2. U.S. GAO (2022)
3. Varney et al. (2025)
4. Ahrens (2024)
5. NIFC (2025)

Exposure Pathways

30+ known, probable, and possible carcinogens have been detected on the fireground, including benzene, formaldehyde, polycyclic aromatic hydrocarbons (PAHs), arsenic, and asbestos





Graphic by UL Fire Safety Research Institute (FSRI)

Wildland Firefighters

- Lighter protective clothing
- Minimal to no respiratory protection
- Long work shifts (16+hours)
- Long duration deployments (2 weeks at a time)
- Arduous duties in remote locations
- Soot on skin/clothing for extended periods of time
- Limited access to water on the fireline and in fire camp
- Fewer studies specifically on wildland firefighter health outcomes
- Challenges associated with sampling in wildfire environments

Firefighter Cancer Cohort Study: Wildland/WUI Fires

- Urine samples from 90 firefighters collected after (WUI) fire responses*
- Significant post-fire increases in metabolites of:
  - PAHs, VOCs, diphenyl phosphate, and antimony
- Findings:
  - Firefighters involved in structural defense generally had larger increases in PAH metabolites
  - Hand crew members had the biggest increases in some VOC metabolites
- Conclusion: WUI firefighters face chemical exposures comparable in some cases to structural firefighters

* Mayer et al. (2026)

2023 Maui Wildfire Biomonitoring

- Urine and blood samples were collected approximately a month after the 2023 Maui Wildfires*
- Firefighters had the highest median sum of PFAS concentrations
  - Appeared to be a relationship between PFAS concentrations and job tenure as a firefighter
  - Could not rule out other job-related exposure to PFAS

	Exposure Markers
Blood	Inorganic elements: lead, cadmium, manganese, selenium
	Per- and polyfluoroalkyl substances (PFAS)
	Polybrominated diphenyl ethers (PBDE)
Urine	Inorganic elements: chromium, nickel, arsenic
	Organophosphate esters (OPE)

* NIOSH (2024)

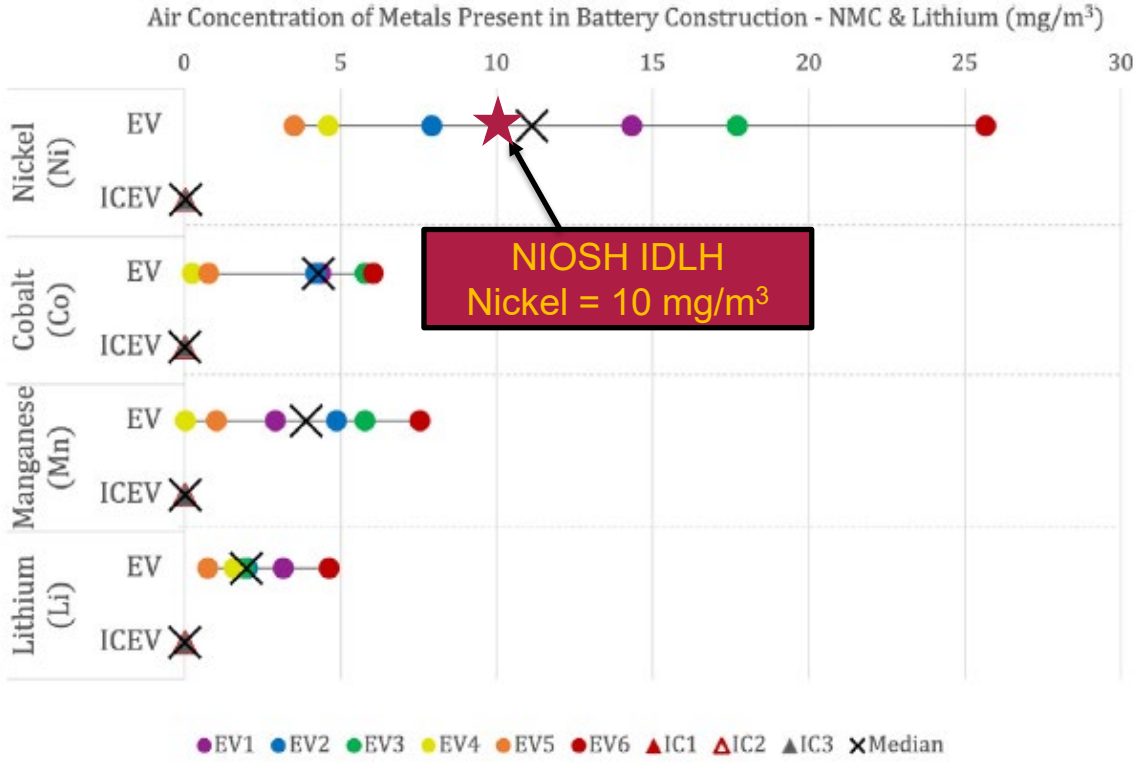
Emerging Hazards in the Fire Service: Lithium-ion Batteries & Electric Vehicles

- Lithium-ion batteries (LIB) have the potential to release toxic substances when burned
- Concerns that exposures from electric vehicle (EV) fires may be more harmful than internal combustion engine vehicle (ICEV) fires
- Comprehensive exposure assessments are needed to better understand:
  - Risks to firefighters when responding to EV fires
  - Risks to other workers exposed after the fires (e.g., investigation & cleanup)

Photo by NIOSH

Air Concentrations of Metals during EV and ICEV Fires

- Collaboration with UL Research Institutes*
- Metals used in the construction of battery cells (nickel, manganese, cobalt, lithium) were statistically greater during EV fires
- Largely not detected in ICEVs
- Air sampling results similar to surface sampling results and other studies



* Kesler et al. (2025)

Photo by NIOSH

The NFR for Cancer is the only national registry of firefighters that makes it possible to investigate the link between firefighting and cancer **and address remaining questions.**

Mission

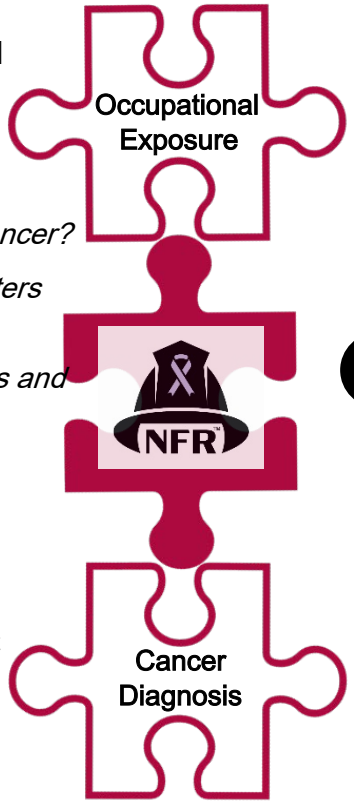
To generate detailed knowledge about cancer in the fire service through a voluntary registry that reflects our nation's diverse firefighters.

Vision

To equip the fire service and public health communities with the knowledge they need to reduce cancer in firefighters.

Why we need the NFR for Cancer

1. Studies indicate that firefighting is associated with cancer, but there are still unanswered questions about firefighters' cancer risk.
   - *How does cancer risk vary by exposure?*
   - *Is there an increased risk of rare types of cancer?*
   - *What is the cancer risk for volunteer firefighters and* ***wildland firefighters*** *?*
   - *What is the cancer risk for female firefighters and other demographic groups?*



2. State cancer registries collect information about cancer diagnoses, but they do <u>not</u> collect detailed information about occupations.

3. By registering for the NFR for Cancer, **firefighters can provide the missing link** for researchers to study the relationship between occupational exposure and cancer.

More than 50,000 U.S. firefighters and growing

Signing up involves 4 steps:

1. Create account
2. Give informed consent
3. Create profile

5-10 minutes

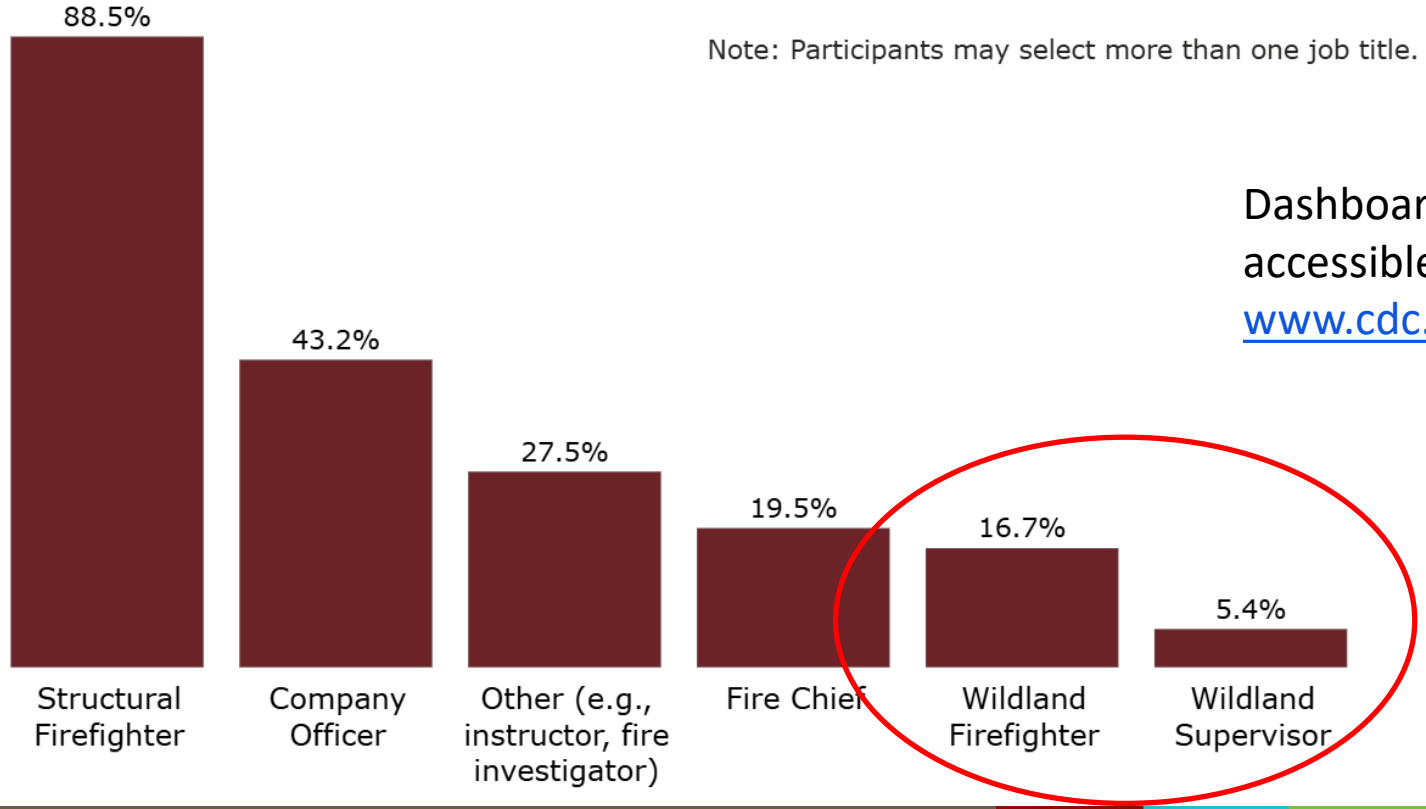
4. Complete the NFR questionnaire **20-30 minutes**
   - Log in and out as needed

The NFR for Cancer is the **largest** group of U.S. firefighters ever assembled to study cancer in the fire service

https://NFR.cdc.gov

NFR Public Data Dashboard

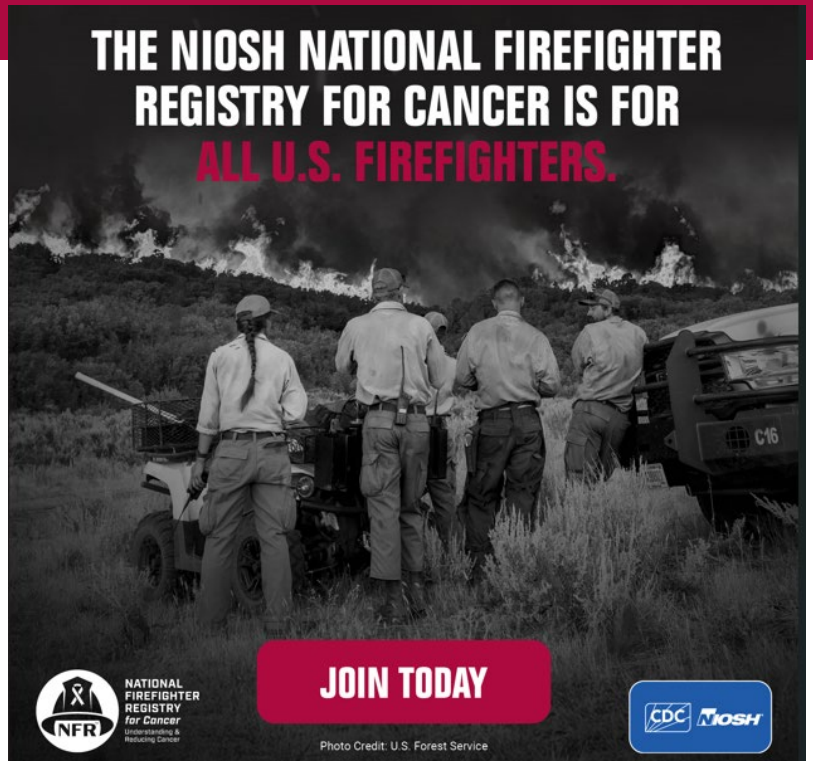
Job Titles Selected by Participants



Note: Participants may select more than one job title.

Dashboard link accessible at www.cdc.gov/NFR

The power of data



- Not every firefighter will develop cancer, but every firefighter has unique **experiences** and **exposure profiles**
- Questions include type and number of responses (e.g., wildland fires), major named events, protective practices, etc.
- Linkages to state cancer registries over time to assess cancer incidence
- Identify important factors associated with increasing or even decreasing cancer risk
- Ultimate goal is to help reduce firefighters' risk of cancer

NATIONAL FIREFIGHTER REGISTRY *for Cancer*

Understanding & Reducing Cancer

Thank you!

Questions? Email the NFR for Cancer at NFRegistry@cdc.gov

References

- **Ahrens, M.** (2024). *Fire loss in the United States during 2023*. National Fire Protection Association.
- **Kesler, R. M., Sauer, N., Barowy, A., et al.** (2025). Evaluation of combustion products in air from electric and internal combustion engine vehicles during full-scale fire experiments. *Fire Safety Journal, 147*, 104558. https://doi.org/10.1016/j.firesaf.2025.104558
- **Mayer, A., Calkins, M. M., Urwin, D. J., et al.** (2025). *Urinary biomarkers of PAHs, VOCs, OPEs, and metal(loid)s in firefighters responding in the wildland–urban interface (WUI)*. SSRN. https://doi.org/10.2139/ssrn.6766550
- **National Fire Protection Association.** (2022). *U.S. fire department profile through 2020*.
- **National Interagency Fire Center.** (2025). *Wildfires and acres: Historical statistics*. National Interagency Coordination Center. https://www.nifc.gov/fire-information/statistics/wildfires
- **National Institute for Occupational Safety and Health.** (2024). *Evaluation of first responders' biological monitoring results after Maui County, Hawaii, wildfires* (Health Hazard Evaluation Report No. 2023-0136-0142-3400). U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. https://www.cdc.gov/niosh/hhe/reports/pdfs/2023-0136-0142-3400.pdf
- **U.S. Government Accountability Office.** (2022). *Wildland fire: Barriers to recruitment and retention of federal wildland firefighters* (GAO-23-105517). https://www.gao.gov/products/gao-23-105517
- **Varney, A. A., Bick, I. A., Jurenci, C., et al.** (2025). *What color is your Nomex? Categorizing and quantifying the wildland fire response workforce*. Stanford Woods Institute for the Environment.