

Assessment of Risk of Carcinogens Exposure and Incidents of Occupational Cancer Among Mechanics and Cleaners of Firefighting Vehicles

Background

Fire equipment mechanics provide support services for firefighting activities by cleaning and maintaining vehicles and equipment at fire stations and repair facilities and by conducting onsite repairs during active fires. Workers might be exposed to similar contaminants as firefighters in the course of their work – through encounters with post-burn residues on vehicles and equipment, inhaling smoke from active fires while onsite, contact with fire suppressing foams and liquid “wash” at fire scenes, etc. Moreover, mechanics may incur additional exposures due to lack of protective equipment, or from laundering work clothes at home, and they may be exposed to contaminants that are particular to mechanic and repair work, such as cleaning solvents or heavy metals released during grinding or welding activities.

Extensive studies with firefighters have shown that cancer diagnoses and cancer-related deaths occur at rates higher than the general population, in large measure due to occupational exposures in the course of firefighting work.¹ However, no published studies to date have examined the risks of carcinogen exposures among those who repair and clean firefighting vehicles. This proposed project seeks to fill an important gap in knowledge and develop findings to lay the groundwork for future studies.

Project Aims

The proposed project is tailored to address the fundamentally novel nature of this study topic. The overall goal is to **develop a portrait of fire equipment mechanics in California and potential occupational exposures**. The primary aims are to:

- a) Describe the range of work settings where fire equipment mechanics are employed in California;
- b) Develop a risk profile of job tasks and activities that could lead to exposure to carcinogens or other toxic substances;
- c) Measure levels of exposure in a sample of job tasks and activities; and
- d) Identify health outcomes potentially associated with exposure.

A secondary aim will be to develop recommendations for fire equipment mechanics and their employers to prevent occupational exposures that may be contributing to illnesses and other adverse health outcomes.

The project will be led by the UCLA Labor Occupational Safety and Health (LOSH) Program in collaboration with the UCLA Center for Environmental and Occupational Health (COEH) Program and with several unions representing skilled automotive/helicopter mechanics and equipment maintenance workers across the state. We are also working to establish relationships with professional and training organizations for fire equipment mechanics in California to further extend the reach of our activities to nonunion workers.

¹ NIOSH’s multi-year Firefighter Cancer Study, for example, found that rates of digestive, oral, respiratory, and urinary cancers were particularly elevated among career firefighters, and that incidence of some cancers (i.e., bladder and prostate cancer) was higher than expected among firefighters under age 65. In 2023, the International Agency for Research on Cancer (IARC) concluded there is sufficient evidence to classify occupational exposures of firefighters as carcinogenic.

Methods

The project will use a mixed-methods approach that incorporates collection of qualitative and quantitative data from workers in multiple worksites across the state.

Worksite mapping. Fire equipment mechanics work in a variety of settings, including fire stations, fire apparatus and emergency vehicle repair facilities, and wildfire basecamps, where they are employed by a mix of state, county, and local government agencies and private companies. There is currently no database providing information on the overall number or work location of fire equipment mechanics. Therefore, our first step will be to examine publicly available data and to arrange discussions with union and employer representatives, professional organizations, and others with knowledge about this workforce to **map the range of fire equipment mechanic worksites and work settings across the state.**² Understanding how fire equipment mechanics are currently distributed across employers and work settings, in both Los Angeles and other municipalities—and under what conditions mechanics may find themselves onsite during active wildland and structure fires—will be critical for informing the subsequent plans for worksite visits and other research tasks.

Worksite visits and key informant interviews. Based on the results of the worksite mapping, the project team will develop a plan for visiting **up to twelve (12) worksites in Los Angeles County** to develop a qualitative risk profile for this workforce. Worksites will be selected to represent the widest variety of work settings where fire equipment mechanics are employed. The project team will work with union representatives and with amenable fire station managers and/or private company owners in Los Angeles to secure worksite access. During these site visits, members of the research team will conduct qualitative assessments to document hazards and potential exposures linked to specific tasks and procedures (e.g., metal grinding, use of solvents to clean equipment, contact with post-burn residue on vehicles and equipment, contact with fire suppressing foams or liquid “wash” at fire scenes, etc.); availability and use of PPE; and decontamination procedures.

In addition to worksite visits in Los Angeles County, members of the research team will conduct **semi-structured interviews with ten (10) key informants outside of Los Angeles County** to assess how our direct worksite observations compare to mechanics’ job tasks and activities in other locations.³ Respondents will include frontline workers and supervisors from fire departments in the Bay Area and in rural communities in the northern and eastern parts of the state. Participants will be recruited using a purposive sampling strategy. To be eligible, participants must be at least 18 years of age and have worked as a fire equipment mechanic for at least one year. Participants will be asked about job tasks, availability and use of personal protective equipment, decontamination protocols at worksites, and perceptions of occupational cancer risk.

The worksite visits and key informant interviews will result in the creation of a risk matrix that can be used to set priorities for subsequent sampling activities and control recommendations.

² For example, there are an estimated 396 municipal fire stations in Los Angeles County and three County-run equipment repair facilities (<https://locator.lacounty.gov/fire>), but it remains unclear how mechanics and cleaners are distributed across these various sites. There are also several private companies offering contract fire equipment repair and cleaning services.

³ Research has shown that a minimum of nine interviews is needed in studies with key informants to reach “data saturation,” i.e., the point at which no new information is learned from subsequent interviews. See, for example, Hennink & Kaiser (2022).

Environmental sampling. From the worksite visits and key informant interviews, we will develop an environmental sampling plan to characterize the presence of several known carcinogens in the work environment and to measure levels of exposure. Sampling will be conducted with **25-30 workers engaged in select job tasks across at least five (5) worksites in Los Angeles County**. (The goal of this sampling is *not* to develop a “representative” portrait of exposures for all California fire equipment mechanics in the state, but rather to determine potential exposure levels associated with specific work areas, tasks, and procedures identified as highest risk in the risk profile; the subsequent worker survey will then aim to establish the prevalence of these tasks and procedures in a larger sample of workers across the state.)

We anticipate collection of air and dermal samples to assess presence of and worker exposures to polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), formaldehyde, and volatile organic compounds at both fixed facilities and (if possible) at active fire scenes. Samples will be analyzed at an AIHA or EPA-accredited laboratory. A combination of NIOSH, OSHA and EPA sampling methods will be employed, depending on the analyte. Sampling results will be subjected to validated statistical treatment using tools such as Expstats and will be compared against health-based values.

Worker survey. The project team will conduct a survey of current and former fire equipment mechanics across California to assess the prevalence of tasks and activities of potential concern identified during worksite visits and environmental sampling. The survey will also aim to capture information about health outcomes potentially associated with occupational exposures.

We will develop a survey tool that includes questions regarding common work tasks and activities; types of PPE provided and frequency of use; typical decontamination and hygiene procedures; and health outcomes, including cancer diagnoses. The tool will also include items to capture demographic and work information such as age, length of time on the job, and family history of cancer. Survey questions will be adapted from several prior studies of cancer risks among firefighters, including the UK Firefighter Contamination Survey (Wolffe et al. 2023). The survey will be pilot tested with 3-5 fire equipment mechanics to ensure validity of the instrument for this study population.

We will coordinate with labor and industry partners to disseminate the online survey. Our goal will be to secure responses from **up to 100 current and former workers across the state** representing a broad range of roles (e.g., vehicle mechanics, aerial and flight operations, equipment maintenance workers, etc.).⁴ The team will generate descriptive statistics based on survey results to indicate the proportion of respondents engaged in select tasks and activities associated with potential exposures; availability and frequency of PPE use; frequency of adequate decontamination and hygiene procedures; and potential variations in exposures based on work setting, union/nonunion worksites, and/or length of time on the job.

⁴ We understand from discussions with AFSCME Local 119 that the union currently represents about 140 fire equipment mechanics across Southern California, and that the local maintains extensive contacts with former mechanics as well. The number of fire equipment mechanics affiliated with other union locals across the state, as well as those who are nonunion and/or contracted employees, is currently unknown. Figures from the U.S. Census indicate that approximately 5,000 individuals in California work as Mobile Heavy Equipment Mechanics, Bus and Truck Mechanics, or Aircraft Mechanics and Service Technicians within the Public Administration industry (U.S. Census Bureau, American Community Survey, 2006-2010 data tabulations), but only a subset of those individuals are presumed to work specifically for local fire departments.

Technical Advisory Committee

The project team will convene a technical advisory committee to inform research activities and help interpret findings. The committee will comprise representatives from the California Occupational Health Branch, Cal/OSHA Research and Standards Division, and at least one external researcher with experience investigating firefighter health matters. (A number of these individuals have been involved in helping to shape the proposed research efforts.)

We will convene a meeting of the advisory committee at the start of the project period to review proposed research activities and timeline; subsequent meetings will be held quarterly throughout the project period. Members of the research team will also be in touch with individual committee members between meetings as needed to solicit additional support and guidance. Advisory committee members will be asked to provide feedback on overall project plans, review drafts of interview guides and the worker survey tool, assist the project team with interpreting data results, and review a draft of the final project report.

Deliverables

The project team will develop brief summary reports of the worksite visits and key informant interviews, environmental sampling, and worker survey each quarter to inform the technical advisory committee and CHSWC of milestones and accomplishments over the project period. Members of the project team will be available to provide updates on project activities at each CHSWC public meeting during 2026.

The final study report will include summary of all research activities and results, along with recommended control measures to prevent exposures to hazards identified through this project. A draft final study report will be submitted to CHSWC by January 31, 2027, providing the agency with an opportunity to review the document and offer any feedback. The final study report will be submitted to CHSWC by March 31, 2027. Members of the project team will be available for several months following submission of the final study report to present the findings and recommendations to various stakeholders.

Budget and Timeline

The current budget of \$250,000 will provide support for portions of two (2) LOSH staff members and one (1) graduate student researcher at UCLA, along with costs for analysis of environmental samples, travel, supplies and equipment over a 15-month period; see summary budget figures below. A more detailed budget can be provided upon request.

Jan 1, 2026 – Mar, 31, 2027	
LOSH staff (2)	\$134,000
Graduate student researcher (1)	\$42,000
Analysis of environmental samples	\$18,000
Misc. supplies and equipment	\$6,000
University F&A (25%)	\$50,000
TOTAL	\$250,000

An additional \$100,000 would enable us to expand our proposed research activities in several valuable ways – including hiring a second graduate student researcher to support with an increased number of worksite

visits, key informant interviews, and/or surveys; covering travel costs to enable project team members to conduct in-person site visits and/or environmental sampling outside of Los Angeles County; creating a detailed inventory of common chemical products used in the work environments of fire equipment mechanics; and investing more time and effort with our project partners to expand the reach of the worker survey. More details can be provided upon request.

Bibliography

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