



# RESEARCH FOUNDATION

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## Fireground Exposure of Firefighters: A Literature Review

There is growing concern in the fire and life safety community that repeated exposures to contamination at the fire scene, combined with the subsequent post fire scene exposures to contaminated clothing, tools, apparatus, and stations are likely causing increased rates of cancer in firefighters. Moreover, contamination has broader negative effects on health than just cancer. A number of other chronic health disorders could be related to broad chemical exposures. While there have been studies on firefighter exposure, there is not yet a complete understanding of what firefighters are exposed to during firefighting and training as each of the existing studies focuses on a limited number of contaminants/toxicants and/or exposure scenarios. A comprehensive compilation and review of global literature is needed to provide a focus on this topic in support of ongoing efforts to address firefighter health and safety.

The objective of the project was to assimilate the existing peer reviewed literature into a framework to understand the matrix of carcinogen exposure risks firefighters face in the course of their job tasks on the fireground. This examination focused specifically on carcinogenic exposure on the fire ground.

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### Summary Observations:

The project undertook the task of developing a systematic review of existing literature to outline the current state of the science, summarize the findings, and identify gaps in the literature. A total of 75 articles were included in the analysis with most (68%) being conducted in the last decade.

Biomonitoring studies have been conducted that identified the presence of known human carcinogens (Group 1: benzene, PAHs, PCBs, dioxins, furans, and dioxin-like PCBs), probable carcinogens (Group 2A: guaiacol, organochlorines), and possible carcinogens (Group 2B: 1,4 dichlorobenzene, organochlorines, phthalates, phenolic compounds, PFAAs, heavy metals) on the fireground. Similarly, environmental monitoring studies have found known carcinogens (Group 1: 1,3 butadiene, 2,3,4,7,8 pentachlorodibenzofuran, 2,3,7,8-tetrachlorodibenzo-P-dioxin, asbestos, benzene, benzo[a]pyrene, formaldehyde, pentachlorophenol, trichloroethylene), probable carcinogens (Group 2A: acrolein, cyclopenta[cd]pyrene, dibenz[a,h]anthracene, styrene, perchloroethylene), and possible carcinogens (Group 2B: acetaldehyde, benz[a]anthracene, benzo[b]fluoranthene, benzo[c]phenanthrene, benzo[j]fluoranthene, benzo[k]fluoranthene, chrysene, di(2-ethylhexyl)phthalate, crotonaldehyde, dichloromethane, indeno[1,2,3-cd]pyrene, isoprene, methyl isobutyl ketones, naphthalene, trichlorophenol) on the fireground.

For biomonitoring studies, significant gaps were identified for fire instructors, fire investigators, aircraft rescue and firefighting (ARFF) firefighters, industrial firefighters, and recruits. It was also noted that future research should focus on examining the impact of the changing fire environment as the products of combustion in fires have evolved over the years.

The gap analysis identified several areas of needed research within environmental monitoring including studies of carcinogens through wildland fires, exposures through electrical/transformer fires, ARFF exposures, and training fires. Additional research by type of data collection such as through gear samples and passive sampling devices also were identified. Finally, additional research on major events is needed through real-time environmental monitoring.

Clearly, the fireground – by its very nature – is a high-risk environment with a number of carcinogenic exposures for any responder on the scene. Understanding these risks is an important foundation for understanding health and environmental impacts and for identifying and promoting mitigation and prevention efforts.