

significantly decreased in response to ATR treatment but included STAT1 and several GBP genes. To evaluate whether several small transcriptomic changes could reveal the involvement of biological processes or transcription factors, we used gene set enrichment. Using SCENIC, we found decreased STAT1 activity and increased JUNB activity. Similarly using GSEA, we found increases in STAT1, IRF9, and FOXM1 after activation, all of which were reciprocally decreased in the presence of ATR. Overall, we demonstrate the utility of scRNA-Seq in discovering multiple novel transcriptional mechanisms in response to a pleiotropic toxicant such as ATR in a model of T cell activation.

W 1113 Into the Fire: Exploring Firefighter Exposures and Health

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At the sound of an alarm, firefighters prepare themselves to rush into situations of extreme peril to protect citizens from potentially catastrophic circumstances. While committing these acts of bravery, firefighters encounter significant exposures to several hazards, including known carcinogens. In light of the recent determination by the International Agency for Research on Cancer (IARC) that the firefighter occupation is considered a group 1 carcinogen, this session will explore the unique exposure experiences of firefighters, the associated long-term health implications, and efforts to discover biomarkers useful in indicating exposures and early health effects. The first speaker will give a firsthand hand account of the hazards endured in this occupation and the fight to have policies created to better protect firefighter health. The second speaker will detail federal efforts to better track the exposures and health outcomes of firefighters across the country. There are numerous ongoing efforts to monitor and evaluate civilian and military firefighter health and examine correlations between measured exposures and markers of biological effect. We will hear updates from three distinct cohort studies: Women Firefighters Biomonitoring Collaborative, based in San Francisco; the nationally representative Fire Fighter Cancer Cohort Study; and firefighters within the longitudinal military Millennium Cohort Study. Each of these studies may involve firefighters with varied exposures due to the types of fires to which they respond, and the agents used to extinguish the fires. Finally, the last speaker will give an overview of comparative toxicological assessments of fluorine-containing and fluorine-free aqueous film-forming foams used to extinguish fires in certain situations. These presentations will be followed by a panel discussion of future needs and ways that government and academic toxicologists, advocates, and policymakers can work together to ensure that firefighters are healthier for the long term.

W 1114 Firefighter Health Impacts and Protective Policy Needs

E. Kelley. International Association of Firefighters, Washington, DC. Sponsor: S. Fenton

Cancer is the biggest health threat fire fighters face long-term. The International Association of Fire Fighters (IAFF) represents over 344,000 full-time professional fire fighters and emergency medical workers across the United States and Canada. IAFF has developed relationships with researchers, environmentalists, politicians, and academics to tackle the fight with cancer head-on. In the legislative stage, the IAFF is pursuing a number of initiatives, including: legislation to fund research and development of next-generation and PFAS-free gear, efforts to ban AFFF from being used in testing and training scenarios, creation of grant funds to help replace AFFF with fluorine-free foams, legislation to mandate that bunker gear sales include a written notification of the presence of PFAS, and legislation to pre-emptively ban new purchases of PFAS-laden gear once an acceptable PFAS-free alternative is available. Although there has been much success with much legislation being passed in several states that restricts the use of AFFF and implements gear labeling requirements, this fight is far from over. One of the IAFF's top federal priorities is securing passage of the PFAS Alternatives Act (HR 4769), which would create a grant program within the US Fire Administration to fund development of next-generation, PFAS-free gear, with fire fighters engaged in the research. Contemporary available data are clear – cancer is the biggest health issue of firefighters, followed by cardiovascular disease. More research in all areas of fire fighter health and safety is needed, so industries and medical insurance companies are convinced that being a fire fighter is an independent risk factor for diseases like cancers and cardiovascular disease. This is critical to enable fire fighters to access cancer and cardiac screenings earlier, which will lead to better long-term health outcomes and, ultimately, to greater monetary savings by the insurance companies, as it is much more economical to address diseases in their early stages, rather than at later ones. Fire fighters are unnecessarily exposed to chemicals and carcinogens, and need the assistance of esteemed organizations, like the Society of Toxicology, to continue to research the toxins that are killing fire fighters – like PFAS – and to provide the critical data needed to eliminate them.

W 1115 The National Firefighter Registry for Cancer

A. Mayer, and K. Fent. NIOSH, Cincinnati, OH. Sponsor: S. Fenton

The National Firefighter Registry (NFR) for Cancer is a groundbreaking initiative led by the National Institute for Occupational Safety and Health (NIOSH). The NFR is a voluntary registry that aims to monitor and evaluate cancer and cancer risk factors among US firefighters. The NFR collects firefighters' self-reported personal, demographic, work history, and lifestyle information through an online portal, which will be linked to cancer registries and other health information databases to track health outcomes among enrolled firefighters. This presentation will provide a status update on the NFR. We will also share other firefighter exposure and health research initiatives led by NIOSH, including our work characterizing potential exposures to combustion byproducts during electric vehicle (EVs) fires, and other NIOSH-led firefighter exposure and health research initiatives.

W 1116 Exposures and Breast Cancer in the Fire Service: Discovery and Translation to Reduce Risks

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Studies of firefighters have shown increased exposures to carcinogenic compounds and elevated rates of certain cancers compared to the general population, yet this research has focused almost exclusively on men. To address this gap, the Women Firefighters Biomonitoring Collaborative created a biological sample archive and analyzed levels of perfluoroalkyl substances (PFAS) and flame retardants among women firefighters (N = 86) and office workers (N = 84) in San Francisco. Previously published work in this cohort documented elevated exposures to PFAS and to several halogenated flame retardants in the firefighters, and ongoing work is using non-targeted analyses (LC-HRMS) to identify novel exposures by comparing serum samples collected longitudinally following fire events. Firefighters, like our co-author, Heather Buren, are co-investigators in this community-based participatory research project, and translation of the research to reduce risks has been a priority. Translational activities have included developing new training materials that support individual behavioral changes to reduce exposures as well as policy advocacy to support systemic changes such as replacing PFAS with less toxic alternatives. We have also compiled evidence documenting that firefighting involves elevated exposures to chemicals likely to increase risk of breast cancer, to target exposure reduction efforts and inform presumptive disease policies. Some exposures documented for firefighters and that also are linked to breast cancer include polycyclic aromatic hydrocarbons; volatile aromatics, such as benzene and styrene; PFAS; persistent organohalogenes, such as polychlorinated biphenyls; and halogenated organophosphate flame retardants. Common sources of exposure included combustion byproducts, diesel fuel and exhaust, firefighting foams, and flame retardants.

W 1117 Exposures and Epigenetics in the Fire Fighter Cancer Cohort Study

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Firefighters face exposures and stressors including combustion byproducts, per- and polyfluoroalkyl substances (PFAS), heat, and more. Firefighters have increased risks for cancers and other diseases. Epigenetic modifications including DNA methylation and microRNA (miRNA) expression are responsive to toxicant exposures, including those that firefighters may encounter. Widespread changes to DNA methylation and miRNA expression are part of the development of diseases including cancers. Epigenetics may serve as an early indicator of the effects from exposures. The Fire Fighter Cancer Cohort Study (FFCCS) is a national framework to collect and integrate survey, exposure, and health biomarker data from fire service members with a focus on understanding risks for cancers and other diseases. The ultimate goals are to enroll and follow-up 10,000 US firefighters and to inform prevention and intervention strategies to protect health. Epigenetic biomarkers are employed in the FFCCS to understand biological impacts from exposures that occur before diseases develop. We quantify blood leukocyte DNA methylation at ~750,000 loci throughout the genome via the Infinium EPIC array. We also quantify relative abundance of 800 miRNAs in blood samples. We assess whether DNA methylation and miRNA change in new firefighters after several years in the fire service. We also examine associations between epigenetic biomarkers and specific exposures (i.e. PFAS) or exposure events (i.e. response to a wildland urban interface fire). In this presentation, we will discuss these results and their implications for firefighter health.



SOT 64TH ANNUAL MEETING
& ToxExpo • March 16–20, 2025
ORLANDO, FLORIDA

The Toxicologist

Supplement to *Toxicological Sciences*

SOT | Society of
Toxicology

Toxicological Sciences

The Official Journal of the
Society of Toxicology

 OXFORD
UNIVERSITY PRESS

ISSN 1096-6080 Volume 204,
Issue S1 (March 2025)
www.academic.oup.com/toxsci

Publication Date: March 5, 2025