U.S. Fire Administrator's Summit on Fire Prevention and Control

National Emergency Training Center
October 11, 2022

U.S. Fire Administration

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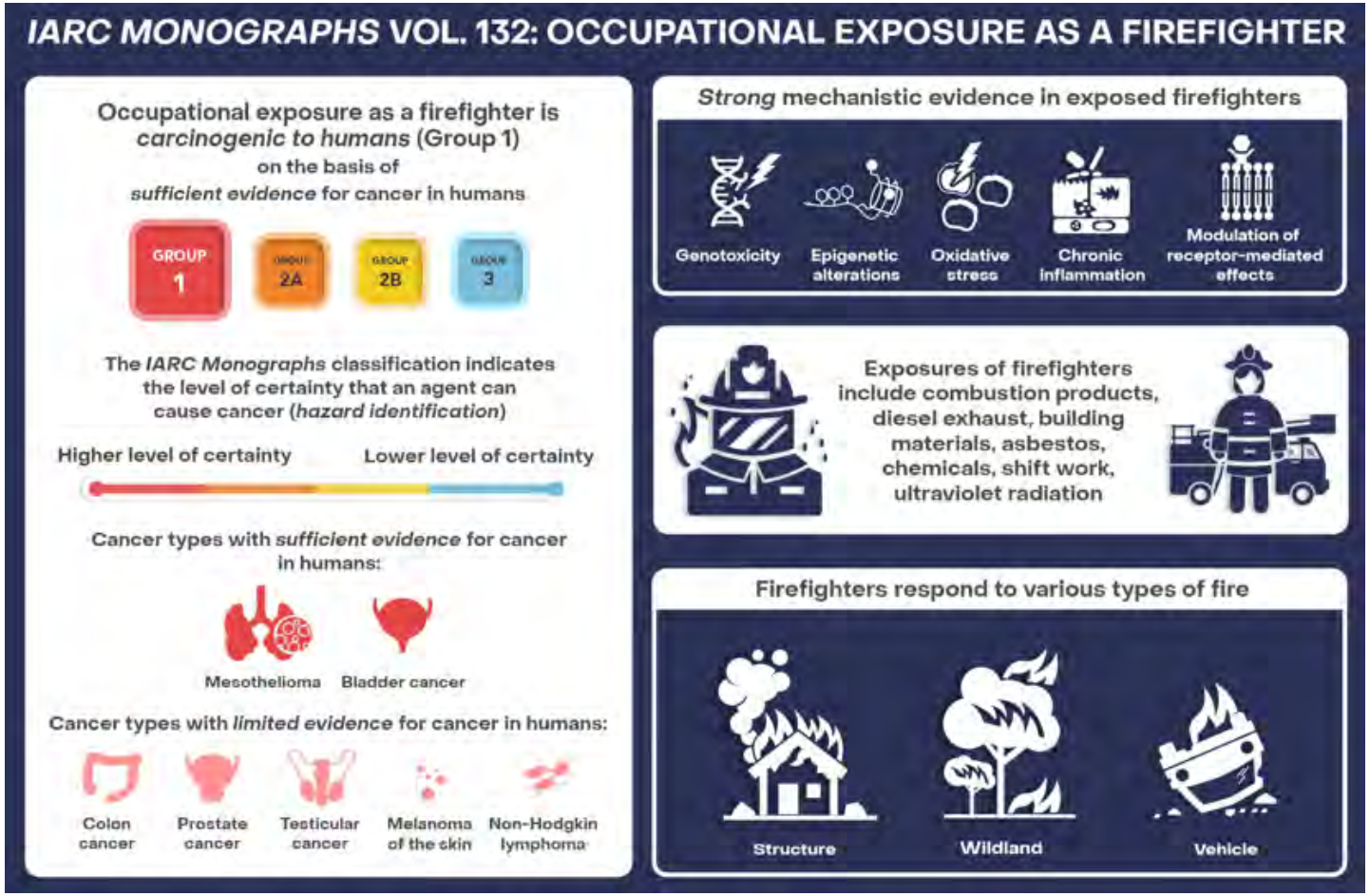
National Firefighter Registry: The Missing Piece

Kenny Fent, PhD, CIH

U.S. Fire Administrator's Summit on Fire Prevention and Control

WHAT DO WE KNOW?



https://www.iarc.who.int/infographics/iarc-monographs-evaluate-the-carcinogenicity-of-occupational-exposure-as-a-firefighter/

WHAT DON'T WE KNOW?

- What is the cancer risk for volunteer firefighters?
- What is the cancer risk for the sub-specialties of the fire service?
- How does the cancer risk vary for demographic groups?
- How does the cancer risk vary regionally across the U.S. fire service?
- How prevalent are rare forms of cancer among firefighters?
- How does the cancer risk change with increasing exposures, including major events?
- What other occupational and non-occupational risk factors contribute to cancer risk among firefighters?
- To what extent do different control interventions and workplace practices reduce the risk of cancer?
- Are there other chronic illnesses that are elevated in firefighters?

NATIONAL FIREFIGHTER REGISTRY (NFR)

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

Goal: Enroll 200,000 firefighters

Specific aims:

1. Collect self-reported information on workplace & personal characteristics through web portal
2. Obtain records from fire departments or agencies to track trends and patterns of exposure
3. Link with health information databases including population-based cancer registries and the National Death Index to detect cancers and deaths

THE MISSING PIECE

- Cancer is reportable in all 50 states
- Most states do not collect detailed information about occupation
- NFR allows you to register yourself as a firefighter
- NFR makes it possible to study the relationship between “firefighting” and “cancer”

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ENROLLING IN THE NFR

- Visit web portal NFR.cdc.gov
- Confirm eligibility and click Login.gov
- Create account
- Read and sign consent form
- Fill out user profile
- Complete the questionnaire
  - Demographics, work history, health history, lifestyle

30 – 45 minutes

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DATA SECURITY

Logging into web portal requires multi-factor authentication

Email, password, and another form of authentication (e.g., text message passcode)

Data uploaded to an encrypted database each time the firefighter clicks “save and continue” or logs out

Logging out saves progress

Privacy protected by an Assurance of Confidentiality

Identifiable information will not be shared outside of NIOSH

WHO'S ELIGIBLE?

- **ALL firefighters!**
  - Active and retired
  - Career and volunteer
  - Structural, wildland, or other specialties
  - Those with or without cancer

- NIOSH will reach out to <u>select</u> fire departments to solicit participation and request incident records
- <u>Most</u> will enroll through the open enrollment route (NFR.cdc.gov)

WHAT HAPPENS AFTER ENROLLMENT?

200,000 or more!
Over next few years

Starting line

Enroll firefighters in NFR

NATIONAL FIREFIGHTER REGISTRY
Understanding & Reducing Cancer

Data collection (including incident records and follow-up surveys)

- Personal and demographic information
- Work history and use of controls
- Other occupational and non-occupational factors

Matching to state cancer registries and data analyses

- Demographic and regional differences in cancer risk
- Exposure-response relationships and impact of controls
- Cancer risk by job category
- Quantification of cancer risk modifiers and confounders

Over next 10+ years

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THANK YOU

WHO CAN REGISTER FOR THE NFR?

All U.S. firefighters, with or without cancer, no matter their length of service. This includes:

- Active and retired firefighters
- Career, paid-on-call, and volunteer firefighters
- Structural firefighters
- Wildland firefighters
- Instructors
- Fire investigators
- Other fire service members

Having all types of firefighters join the NFR is vital to examining the relationship between firefighting and cancer. Participation is voluntary.

The findings and conclusions in this presentation are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

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NFR™ NATIONAL FIREFIGHTER REGISTRY
Understanding & Reducing Cancer

U.S. Fire Administrator's Summit on Fire Prevention and Control

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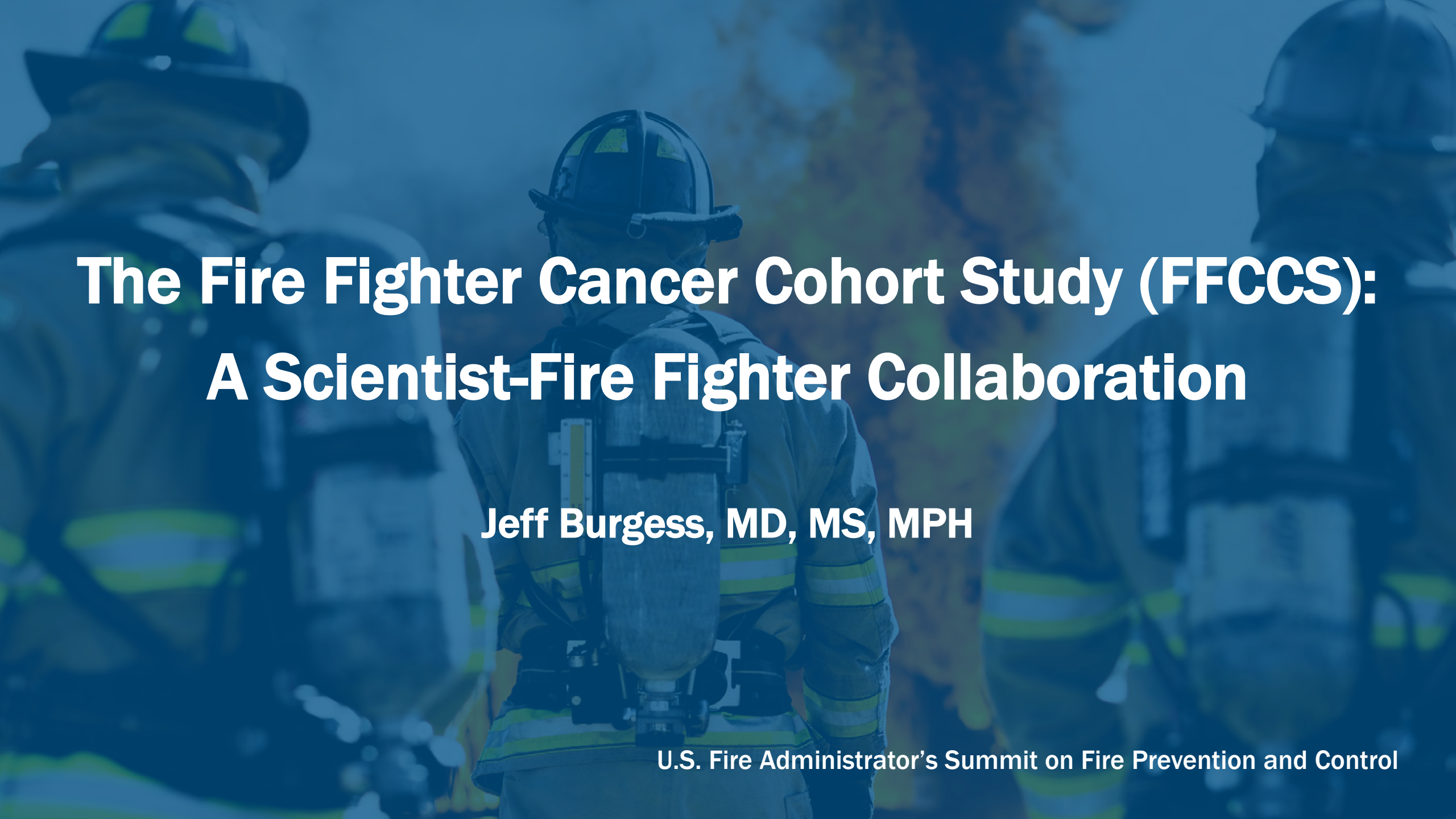


The Fire Fighter Cancer Cohort Study (FFCCS): A Scientist-Fire Fighter Collaboration

Jeff Burgess, MD, MS, MPH

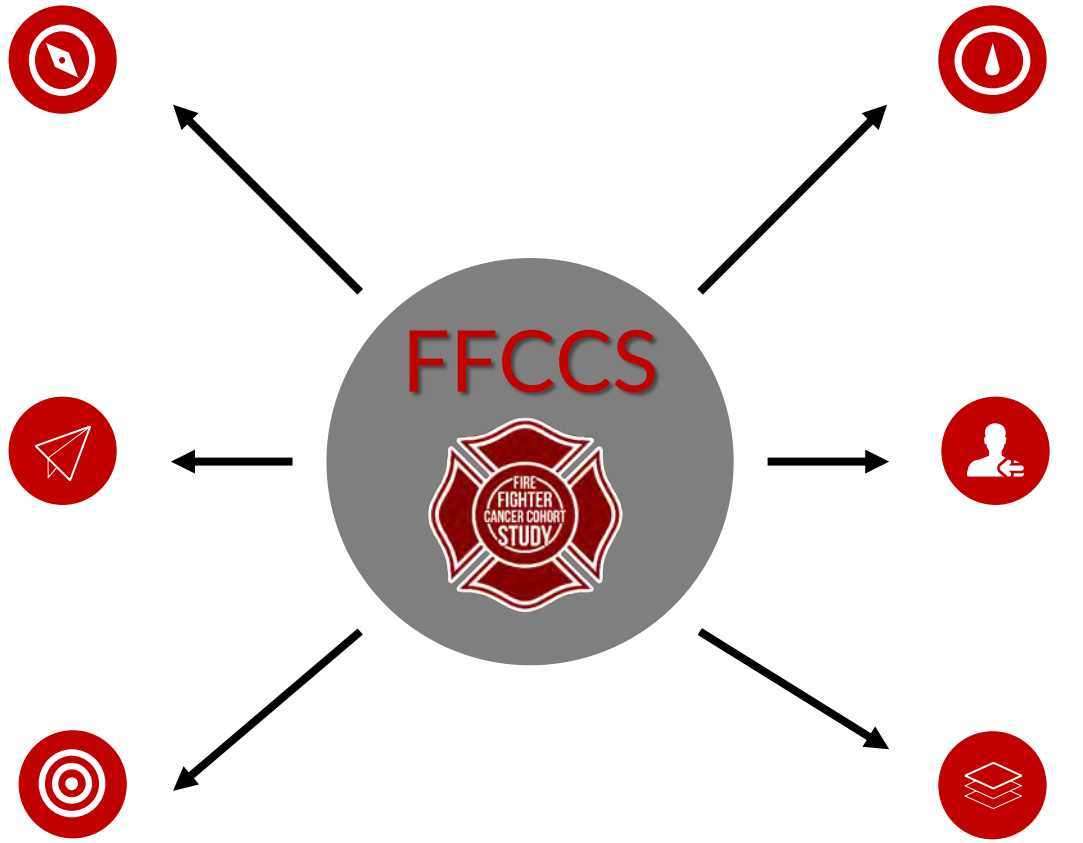
U.S. Fire Administrator's Summit on Fire Prevention and Control

FIRE FIGHTER CANCER COHORT STUDY (FFCCS)

MISSION STATEMENT
Conduct basic and applied research through a community-engaged approach with the fire service to advance firefighter cancer control and prevention.

TARGET GOAL
10,000 firefighters enrolled and followed over 30 years.

FIRE SERVICE PARTNERSHIP
Fire Service Oversight and Planning Board and firefighter research champions in each research project.



BIOLOGICAL SAMPLES
Collect blood, urine, and other biological samples at enrollment, every two years, and as needed after exposures. Report back results to firefighters.

COLLECT EXPOSURE DATA
Collect exposure data from firefighters at the fireground, during training activities, and at other locations.

INTEGRATE DATA
Integrate exposure, biological and health survey data through a centralized data center. Data protected by a Certificate of Confidentiality.

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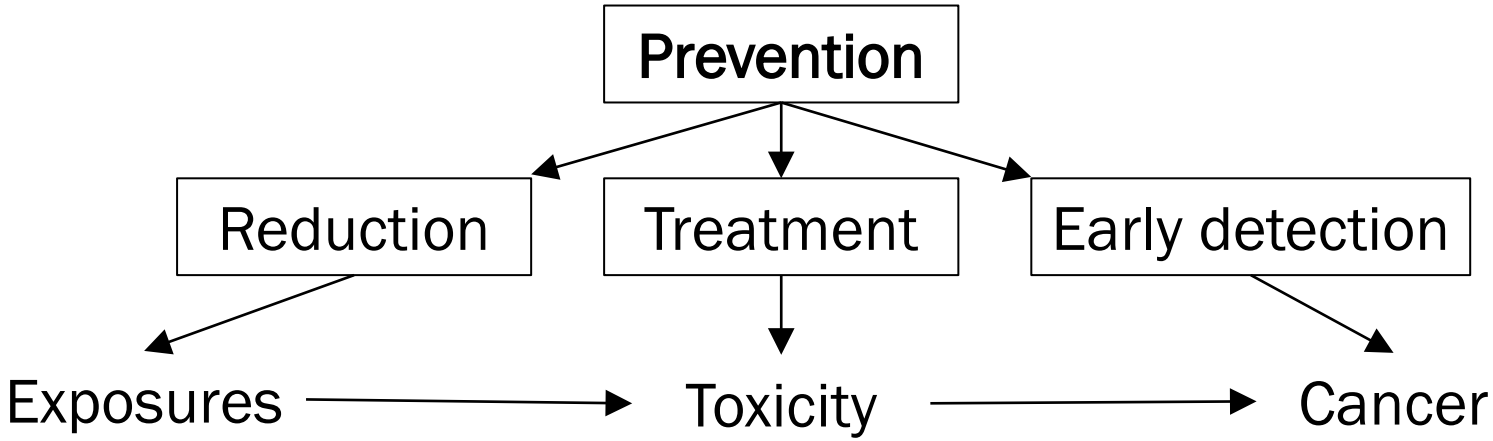
FFCCS INCLUDES ALL TYPES OF FIREFIGHTERS

FFCCS RESEARCH CONCEPTS

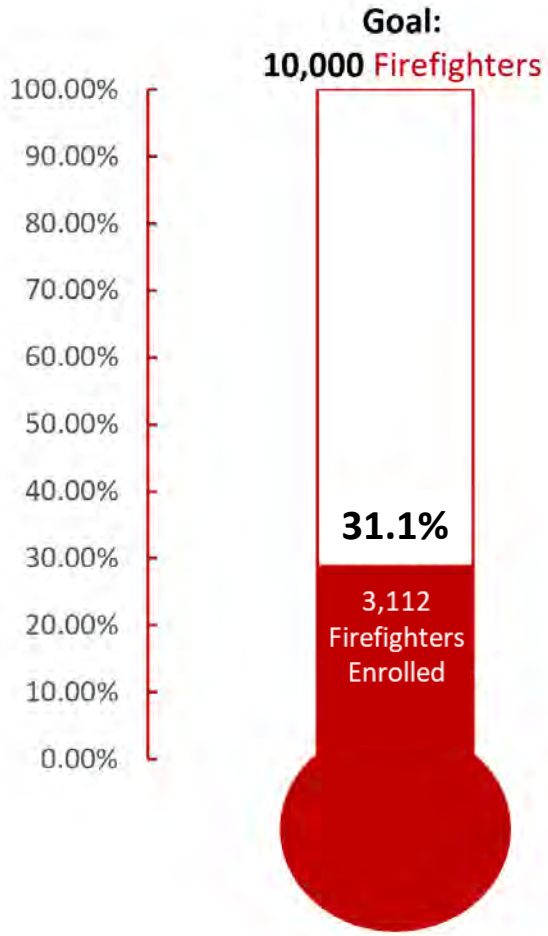


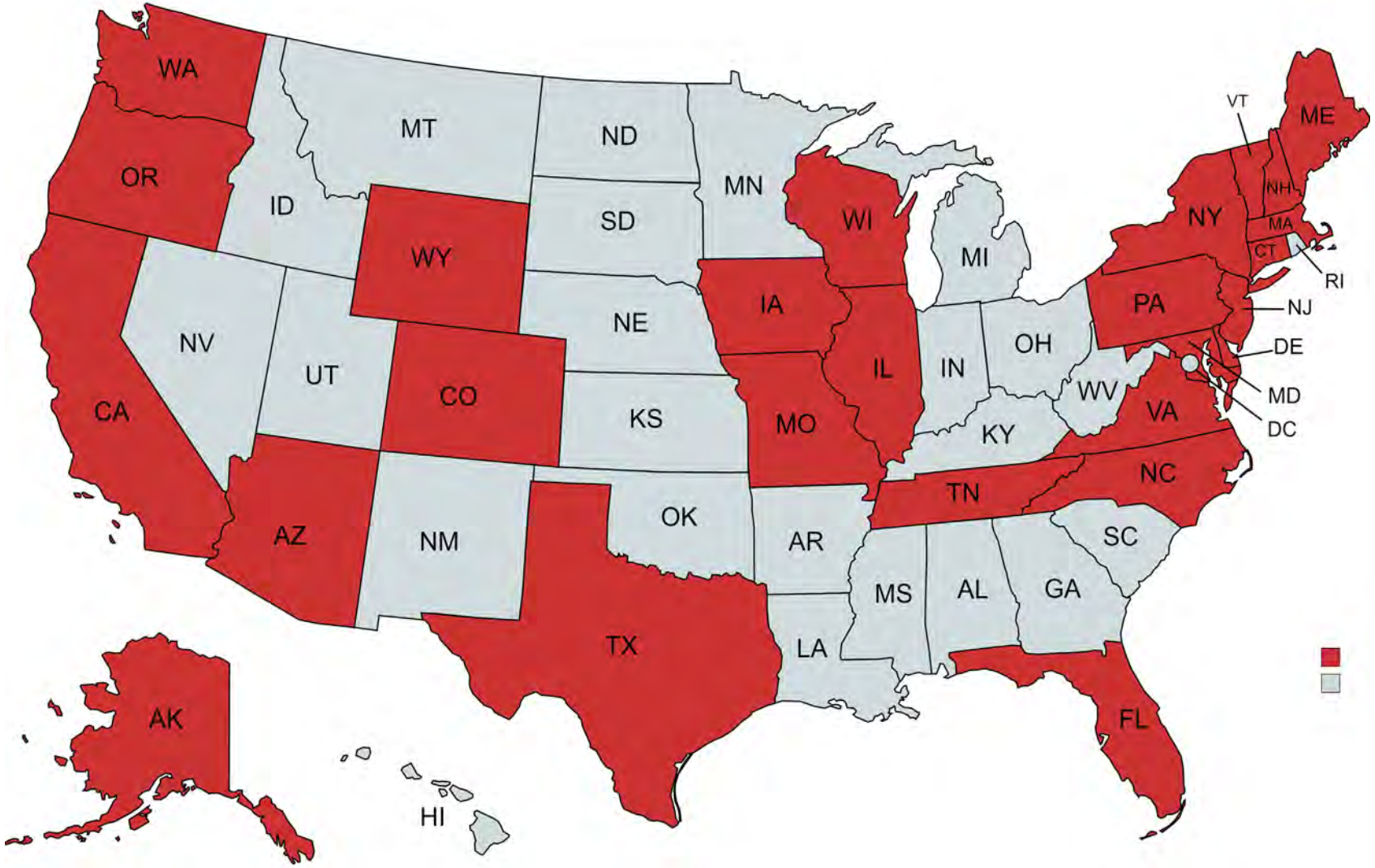
Examples:
Polycyclic aromatic hydrocarbons (PAHs), PFAS (forever chemicals)
Flame retardants

Examples:
DNA damage
Epigenetic changes
Anti-müllerian hormone (AMH)

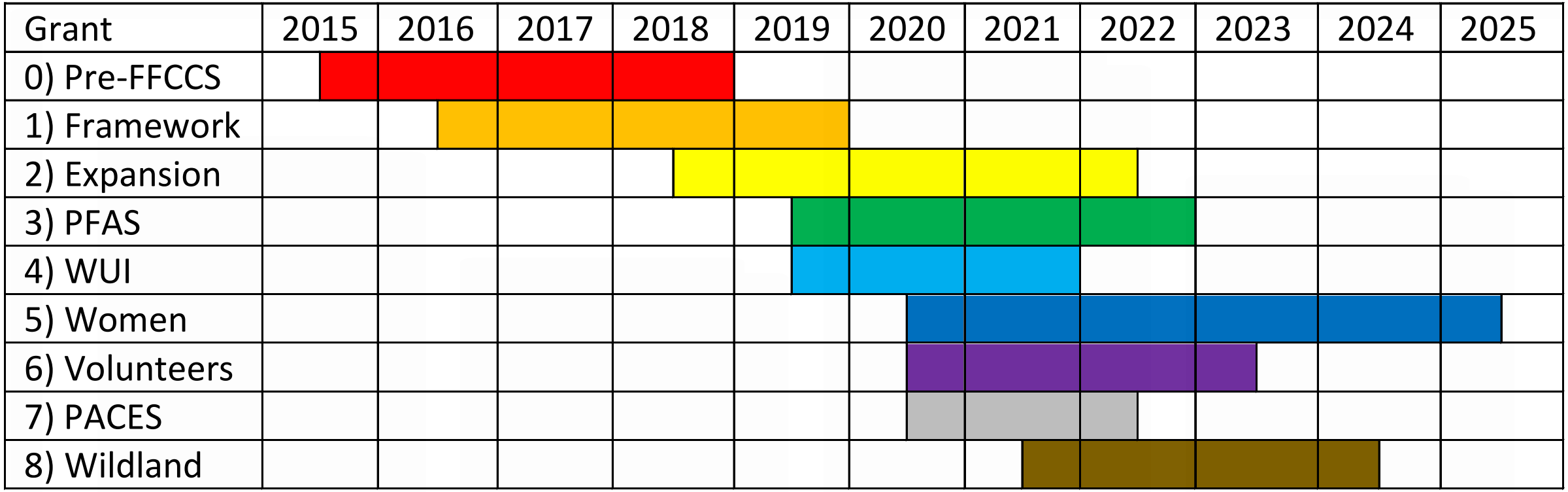
Examples:
Identification of firefighters at high risk for cancer, for advanced screening

FFCCS ENROLLMENT TO DATE





FFCCS PROJECTS AND FUNDING



Funding: Federal Emergency Management Agency (FEMA) EMW-2014-FP-00200, EMW-2015-FP-00213, EMW-2017-FP-00860, EMW-2018-FP-00086, EMW-2019-FP-00526, EMW-2019-FP-00517, EMW-2020-FP-00430, National Institute of Environmental Health Sciences (NIEHS) P30 ES006694, P30 ES017885, National Institute for Occupational Safety and Health (NIOSH), University of Arizona Cancer Center, International Association of Fire Fighters (IAFF), some individual fire departments, and the National Cancer Institute (NCI).

FFCCS: CONTRIBUTIONS TO DATE AND COMING SOON

Exposures and Toxic Mechanisms Causing Cancer in Fire Fighters

Everyone on the fireground is exposed, including firefighters, captains, engineers and paramedics[1]

Firefighter exposures cause epigenetic changes associated with increased cancer risk[2-5]

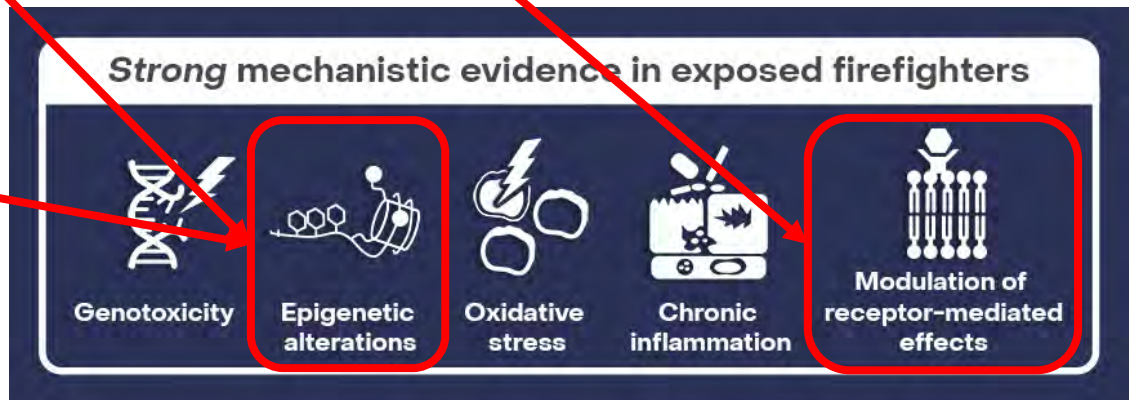
Serum PFAS are elevated in volunteer and career firefighters and are associated with epigenetic changes[6-8]

Prevention & Intervention

Engineers on air (SCBA) and entry team wash-down both significantly reduce exposure[9]

Skin wipes reduce firefighter exposures and toxic effects[10]

Coming Soon-Evaluation of:



FFCCS RESEARCH CONCEPTS

Exposures and Toxic Mechanisms Causing Cancer in Fire Fighters

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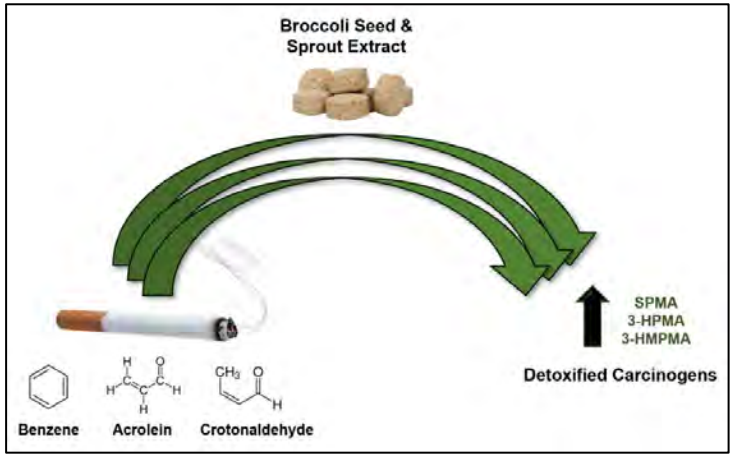

Coming Soon-Evaluation of:

PFAS exposure (from AFFF, fires, turnout gear) and toxicity

Cancer risk, stress and reproductive toxicity in women firefighters[11]

Exposures and toxicity in WUI & wildland firefighters

Toxicity reduction intervention studies

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NEXT STEPS

- Seek funding to expand participation to 10,000 firefighters and provide for long-term follow-up
- Evaluate additional outcomes as requested by fire service
- Further define toxic exposures and mechanisms
- Establish linkages to the NFR
- Expand cancer prevention activities
  - Exposure reduction
  - Toxicity mitigation

CONTACT INFORMATION

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Women Firefighters & Cancer

Dr. Sara A. Jahnke

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In the United States, women account for:

- 13% of Police
- 14% of Military
- 6% of Marine Corps
- 3.5 % – 5% of Fire & Emergency Services

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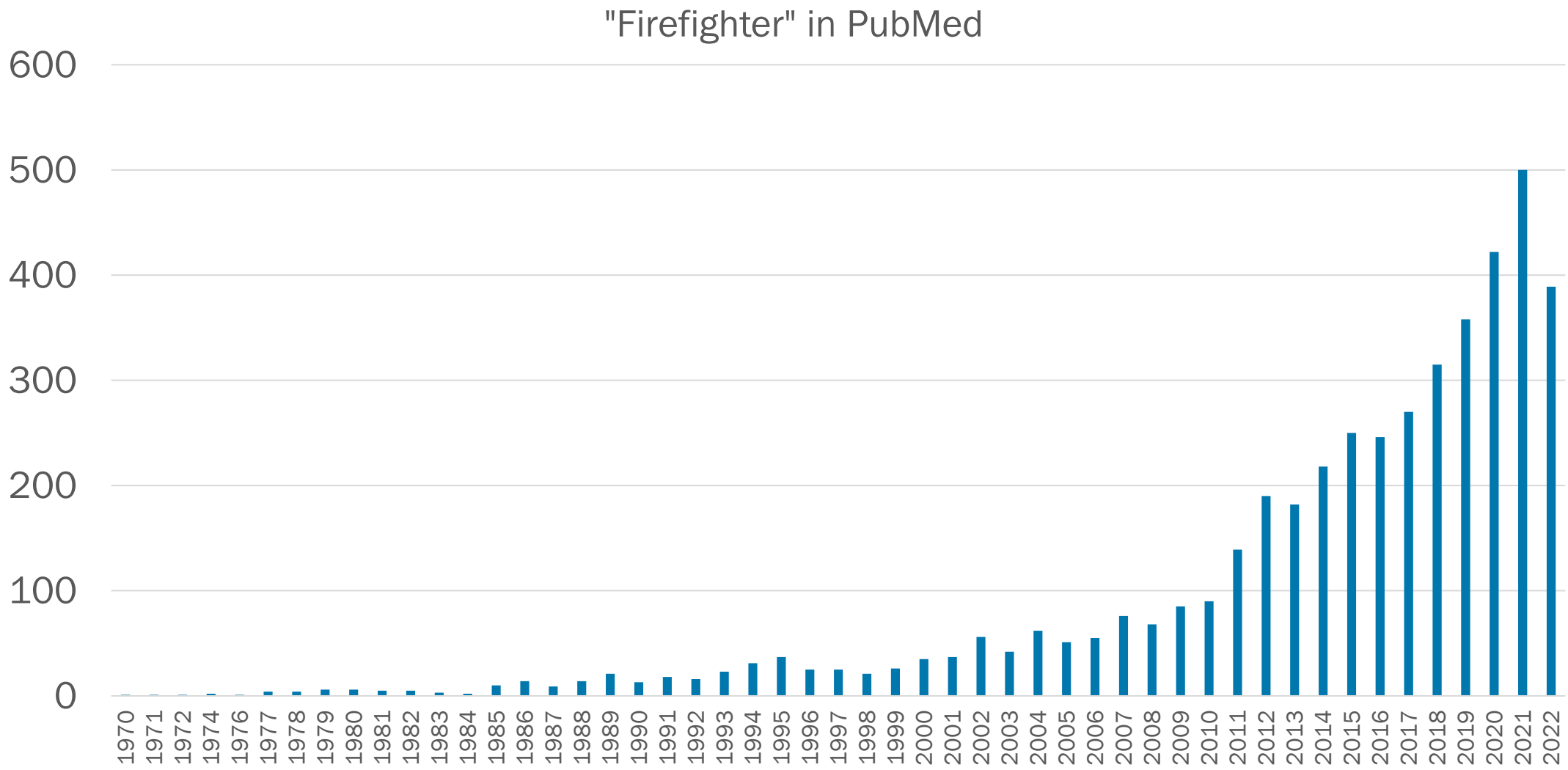
"Firefighter" in PubMed
600
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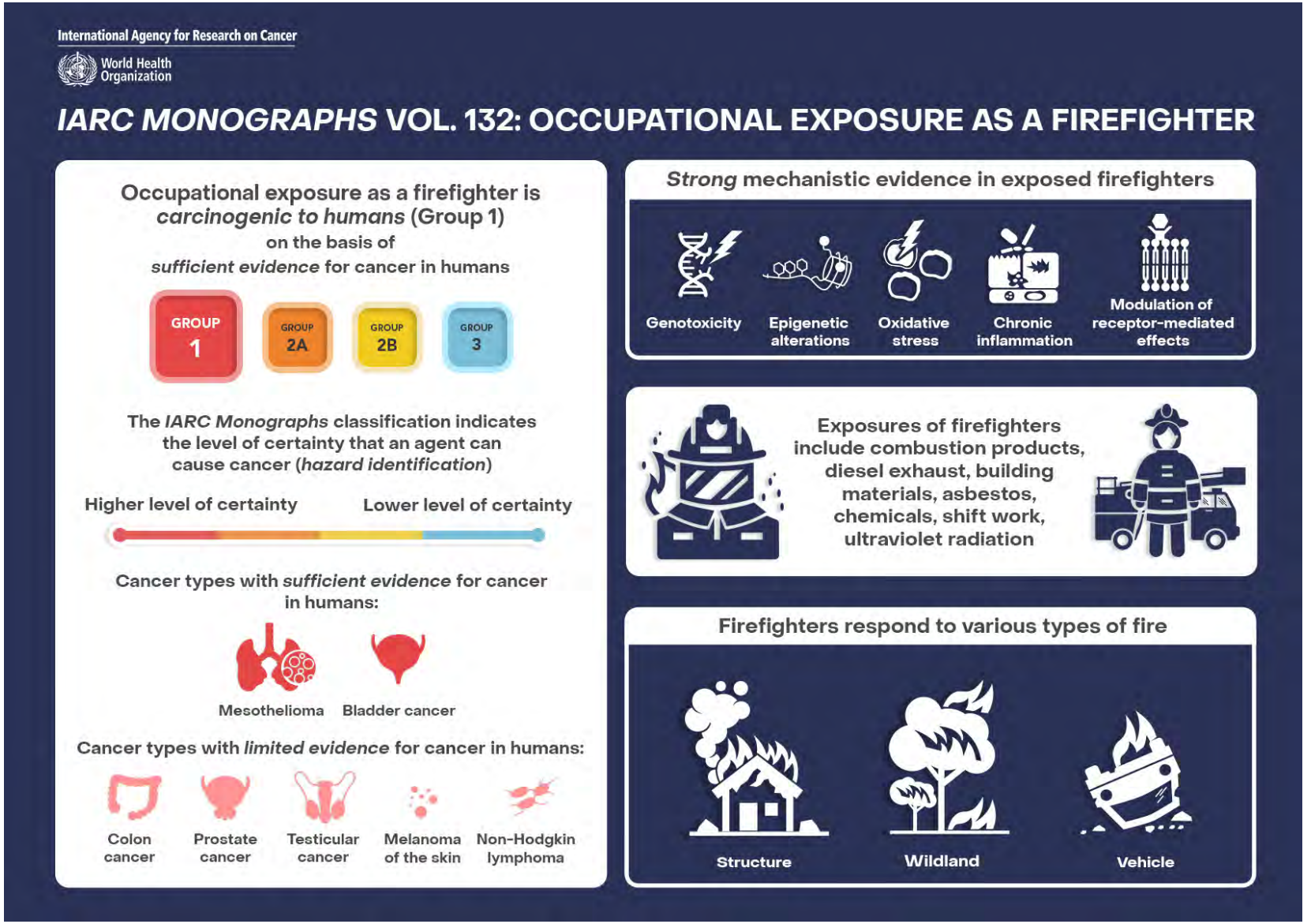
International Agency for Research on Cancer
World Health Organization
IARC MONOGRAPHS VOL. 132: OCCUPATIONAL EXPOSURE AS A FIREFIGHTER
Occupational exposure as a firefighter is carcinogenic to humans (Group 1)
on the basis of
sufficient evidence for cancer in humans
GROUP 1
GROUP 2A
GROUP 2B
GROUP 3
The IARC Monographs classification indicates the level of certainty that an agent can cause cancer (hazard identification)
Higher level of certainty
Lower level of certainty
Cancer types with sufficient evidence for cancer in humans:
Mesothelioma
Bladder cancer
Cancer types with limited evidence for cancer in humans:
Colon cancer
Prostate cancer
Testicular cancer
Melanoma of the skin
Non-Hodgkin lymphoma
Strong mechanistic evidence in exposed firefighters
Genotoxicity
Epigenetic alterations
Oxidative stress
Chronic inflammation
Modulation of receptor-mediated effects
Exposures of firefighters include combustion products, diesel exhaust, building materials, asbestos, chemicals, shift work, ultraviolet radiation
Firefighters respond to various types of fire
Structure
Wildland
Vehicle

CANCERS IN WOMEN FIREFIGHTERS

Findings: While there was little evidence of excess overall cancer mortality among women (SMR=0.74, 95% CI 0.27 to 1.61, n=6), most cancer deaths were from breast cancer (SMR=1.46, 95% CI 0.30 to 4.26, n<5). Bladder cancer mortality was statistically significant (SMR=33.51, 95% CI 4.06 to 121.05, n<5) based on few cases.

Table 1 Demographic characteristics of the cohort by fire department and combined (1950–2009)

Description	All fire departments	San Francisco	Chicago	Philadelphia
Study cohort:				
Eligible for mortality analysis	29 993	5313	15 185	9495
PYAR	858 938	154 317	419 414	285 207
Years of follow-up; avg. (SD)	29 (16)	29 (16)	28 (16)	30 (16)
Race (%):				
White	24 244 (80.8)	4254 (80.1)	11 736 (77.3)	8254 (86.9)
Other	5008 (16.7)	986 (18.6)	2808 (18.5)	1214 (12.8)
Unknown	741 (2.5)	73 (1.4)	641 (4.2)	27 (<1.0)
Gender (%):				
Male	29 002 (96.7)	5009 (94.3)	14 694 (96.8)	9299 (97.9)
Female	991 (3.3)	304 (5.7)	491 (3.2)	196 (2.1)
Vital status:				
Alive (%)	17 965 (59.9)	3239 (61.0)	9241 (60.9)	5485 (57.8)
Deceased (%)	12 028 (40.1)	2074 (39.0)	5944 (39.1)	4010 (42.2)
Unknown cause of death	144	9	91	44
Attained age*; avg. (SD)	60 (16)	62 (16)	59 (16)	61 (16)
LTFU	175	1	32	142
PYAR potentially LTFU (%)	8809 (1.0)	59 (<1.0)	1483 (<1.0)	7267 (2.5)
Employment:				
Avg. hire year	1968	1967	1970	1965
Age at hire; avg. (SD)	29 (5)	29 (5)	29 (5)	27 (5)
Employment years; avg. (SD)	21 (11)	22 (11)	21 (11)	21 (11)
Hired before 1950 (%)	8085 (27)	1682 (32)	3294 (22)	3109 (33)
Employed <1 year (%)	1328 (4.4)	194 (3.7)	891 (5.9)	243 (2.6)

*Age attained at earliest of the date of death, date LTFU or 31 December 2009.
Avg., average; LTFU, lost to follow-up; PYAR, person-years at risk.

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DOI: 10.1002/ajim.23086

RESEARCH ARTICLE

AMERICAN JOURNAL OF INDUSTRIAL MEDICINE | WILEY

Cancer risk among career male and female Florida firefighters: Evidence from the Florida Firefighter Cancer Registry (1981-2014)

David J. Lee PhD[1,2,3] | Tulay Koru-Sengul PhD, MHS[1,2] | Monique N. Hernandez PhD[3] | Alberto J. Caban-Martinez DO, PhD, MPH[1,2] | Laura A. McClure MSPH[1,2] | Jill A. Mackinnon PhD[3] | Erin N. Kobetz PhD, MPH[1,2,4]

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[2]Department of Public Health Sciences, University of Miami Miller School of Medicine, Miami, Florida
[3]Florida Cancer Data System, Sylvester Comprehensive Cancer Center, University of Miami Miller School of Medicine, Miami, Florida
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Email: Dlee@miami.edu

Funding information
State of Florida, Grant/Award Number: Appropriation #2382A

Abstract

Background: Firefighters are at increased risk for select cancers. However, many studies are limited by relatively small samples, with virtually no data on the cancer experience of female firefighters. This study examines cancer risk in over 100,000 career Florida firefighters including 5000 + females assessed over a 34-year period.

Methods: Florida firefighter employment records (n = 109 009) were linked with Florida Cancer Data System registry data (1981-2014; ~3.3 million records), identifying 3760 male and 168 female-linked primary cancers. Gender-specific age and calendar year-adjusted odds ratios (aOR) and 95% confidence intervals for firefighters vs non-firefighters were calculated.

Results: Male firefighters were at increased risk of melanoma (aOR = 1.56; 1.39-1.76), prostate (1.36; 1.27-1.46), testicular (1.66; 1.34-2.06), thyroid (2.17; 1.78-2.66) and late-stage colon cancer (1.19;1.00-1.41). Female firefighters showed significantly elevated risk of brain (2.54; 1.19-5.42) and thyroid (2.42; 1.56-3.74) cancers and an elevated risk of melanoma that approached statistical significance (1.68; 0.97-2.90). Among male firefighters there was additional evidence of increased cancer risk younger than the age of 50 vs 50 years and older for thyroid (2.55; 1.96-3.31 vs 1.69; 1.22-2.34), prostate (1.88; 1.49-2.36 vs 1.36; 1.26-1.47), testicular (1.60; 1.28-2.01 vs 1.47; 0.73-2.94), and melanoma (1.87; 1.55-2.26 vs 1.42; 1.22-1.66) cancers.

Conclusion: Male career firefighters in Florida are at increased risk for five cancers with typically stronger associations in those diagnosed younger than the age of 50, while there was evidence for increased thyroid and brain cancer, and possibly melanoma risk in female firefighters. Larger cohorts with adequate female representation, along with the collection of well-characterized exposure histories, are needed to more precisely examine cancer risk in this occupational group.

KEYWORDS
cancer registry, cancer risk, firefighters, Florida, occupation

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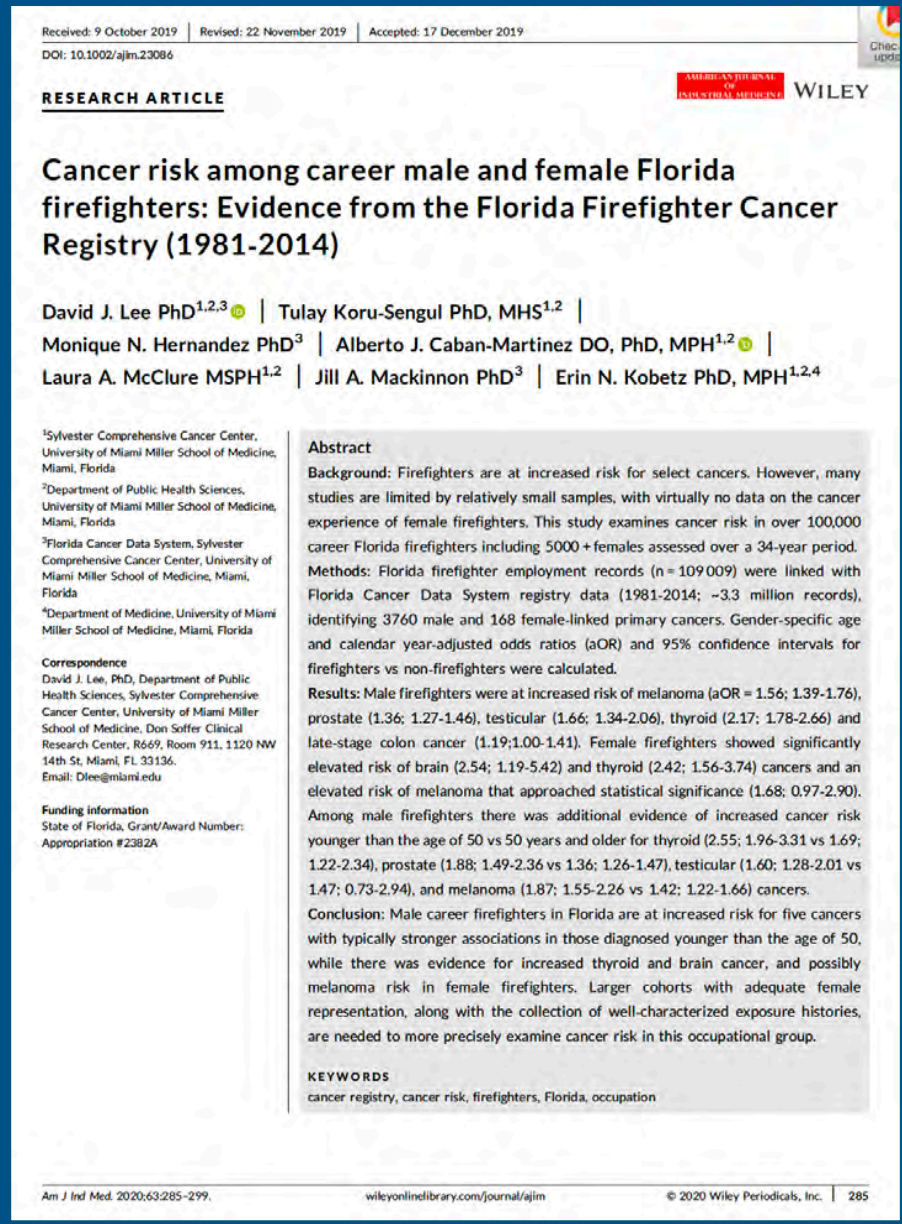
CANCERS IN WOMEN FIREFIGHTERS

- Brain Cancer: aOR=2.54 (95% CI=1.19-5.42)
- Thyroid: aOR=2.42 (95% CI=1.56-3.74)
- Melanoma: aOR=1.68 (95% CI=0.97-2.90)



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BREAST CANCER RISKS

RESEARCH TEAM

Firefighter Organizations:

- United Fire Service Women
- San Francisco Firefighters Cancer Prevention Foundation

Science Team:

- UC Berkeley
- UC San Francisco
- Silent Spring Institute

Environmental Health Advocates:

- Breast Cancer Prevention Partners
- Commonwealth

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REPRODUCTIVE HEALTH

- **Concerns:**
  - Chemical, biological, radiologic exposures
  - Shift schedule
  - Extreme physiological strain of emergency response
  - High ambient temperature and noise
- **Under-studied**
- **Little known about:**
  - Child health impact
  - Occupational exposures for mothers

REPRODUCTIVE HEALTH

Environmental Health

Jung et al. Environ Health (2021) 20:116
https://doi.org/10.1186/s12940-021-00800-4

Open Access

RESEARCH

Occupational factors and miscarriages in the US fire service: a cross-sectional analysis of women firefighters

Alesia M. Jung[1*], Sara A. Jahnke[2], Leslie K. Dennis[1,3], Melanie L. Bell[1], Jefferey L. Burgess[3], Nattinee Jitnarin[2], Christopher M. Kaipust[2] and Leslie V. Farland[1,4]

Abstract

Background: Evidence from previous studies suggests that women firefighters have greater risk of some adverse reproductive outcomes. The purpose of this study was to investigate whether women firefighters had greater risk of miscarriage compared to non-firefighters and whether there were occupational factors associated with risk of miscarriage among firefighters.

Methods: We studied pregnancies in the United States fire service using data from the Health and Wellness of Women Firefighters Study (n = 3181). We compared the prevalence of miscarriage among firefighters to published rates among non-firefighters using age-standardized prevalence ratios. We used generalized estimating equations to estimate relative risks (RRs) and 95% confidence intervals (CIs) between occupational factors (employment (career/volunteer), wildland firefighter status (wildland or wildland-urban-interface/structurall), shift schedule, fire/rescue calls at pregnancy start) and risk of miscarriage, adjusted for age at pregnancy, education, gravidity, BMI, and smoking. We evaluated if associations varied by age at pregnancy or employment.

Results: Among 1074 firefighters and 1864 total pregnancies, 404 pregnancies resulted in miscarriages (22%). Among most recent pregnancies, 138 resulted in miscarriage (13%). Compared to a study of US nurses, firefighters had 2.33 times greater age-standardized prevalence of miscarriage which varied by wildland status (interaction p-value<0.01). volunteer firefighters had an increased risk of miscarriage (95% CI 1.96–2.75). Overall, we observed that Among structural firefighters, volunteer firefighters had 1.42 times the risk of miscarriage (95% CI 1.11–1.80) compared to career firefighters. Among wildland/wildland-urban-interface firefighters, volunteer firefighters had 2.53 times the risk of miscarriage (95% CI 1.35–4.78) compared to career firefighters.

Conclusions: Age-standardized miscarriage prevalence among firefighters may be greater than non-firefighters and there may be variation in risk of miscarriage by fire service role. Further research is needed to clarify these associations to inform policy and decision-making.

Keywords: Firefighters, Occupational health, Women's health, Reproductive health, Epidemiology, Miscarriage, Spontaneous abortion

Background

In 2018 there were over 1.1 million estimated firefighters in the United States (US), 8% of whom were women [1]. Firefighters face specific occupational exposures (toxic substances and physical hazards) that may influence risk

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- **Recent research:** Miscarriage rates among female firefighters were at least **2.3 times higher** compared to the U.S. National average of 10% (Jung, 2021)

- Volunteer firefighters had a **42% higher rate of miscarriage** than career

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FUTURE OF RESEARCH: WOMEN FIREFIGHTERS AND CANCER

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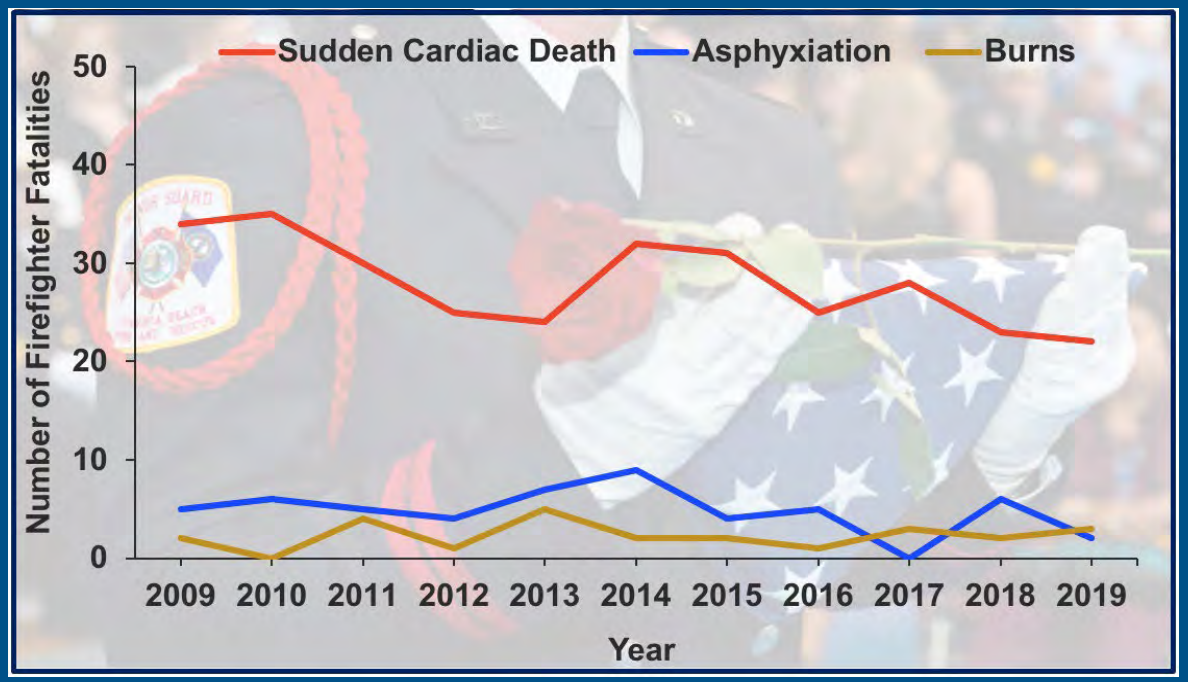
Firefighter Cardiovascular Health

Denise L. Smith, Ph.D.

U.S. Fire Administrator's Summit on Fire Prevention and Control

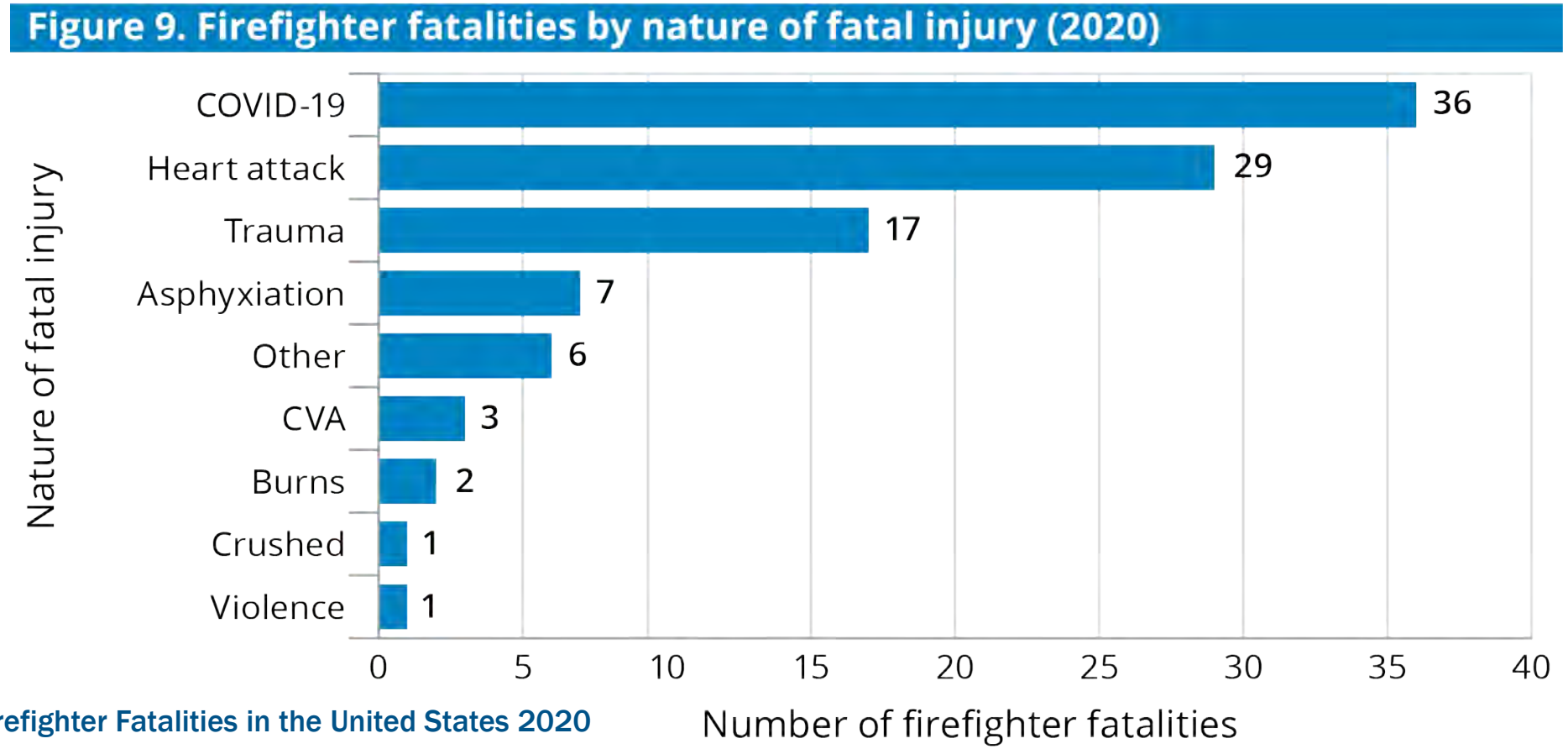
SUDDEN CARDIAC EVENTS (SCE)

- SCE are the leading cause of acute duty-related death
- 800-1,000 non-fatal events per year
- SCE are not random throughout day
- 32% of their fatalities occur during firefighting but only 1% of time spent
- Statistically, 86 times more likely to have SCE after FF



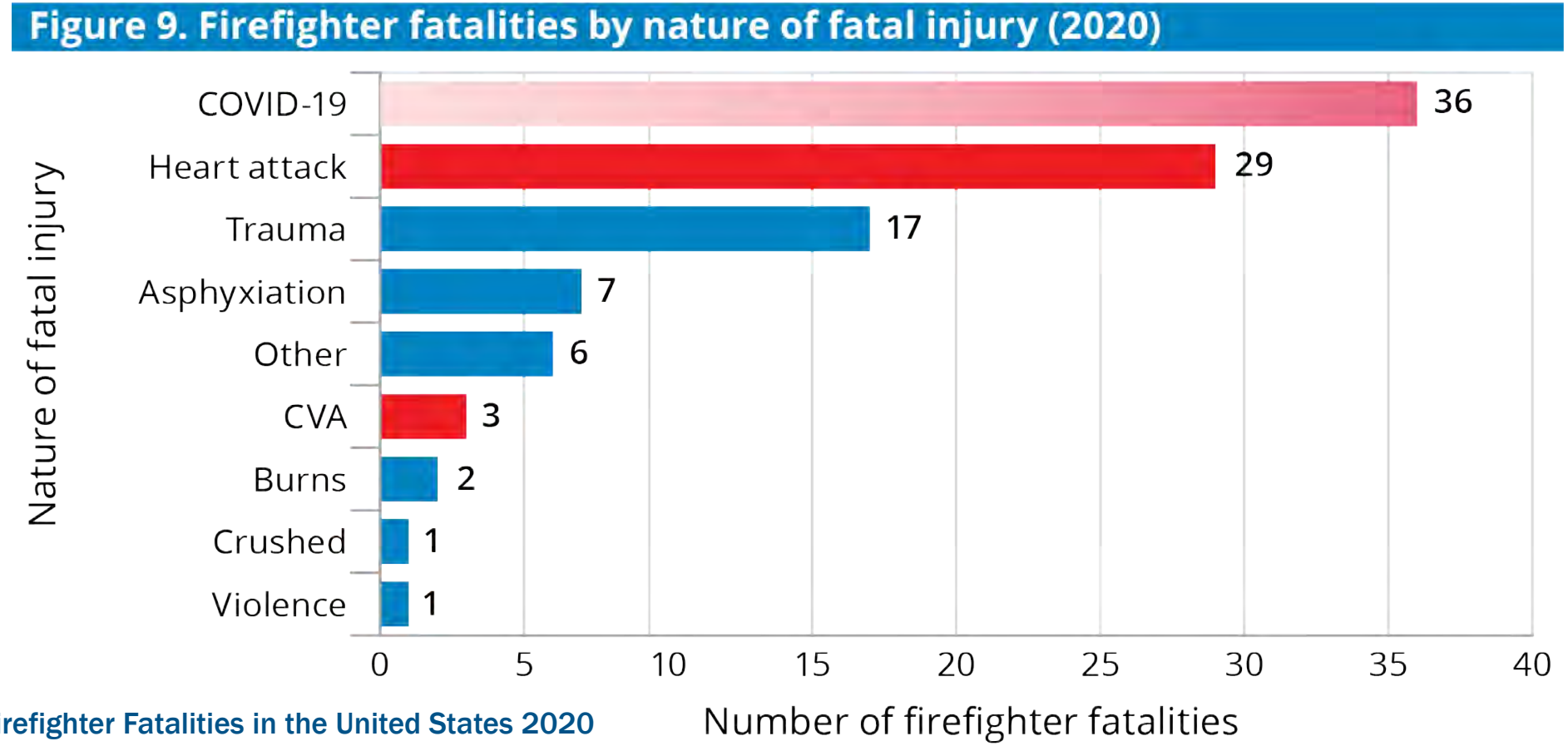
	Time Spent	Fatalities
Fire Suppression	1%	32%
Response to Alarm	4%	11%
Return from Alarm	7%	4%
Physical Training	8%	20%
Nonfire emergencies	15%	9%
Nonemergency duties	65%	25%

CURRENT USFA DATA 2020



Source: USFA-Firefighter Fatalities in the United States 2020

CURRENT USFA DATA 2020



Source: USFA-Firefighter Fatalities in the United States 2020

PHYSICAL DEMANDS OF THE JOB

Strenuous work

Heavy PPE

Hot and Dangerous Environment

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PHYSIOLOGICAL STRAIN

→ Cardiovascular

→ Hematological

→ Thermoregulatory

→ Respiratory

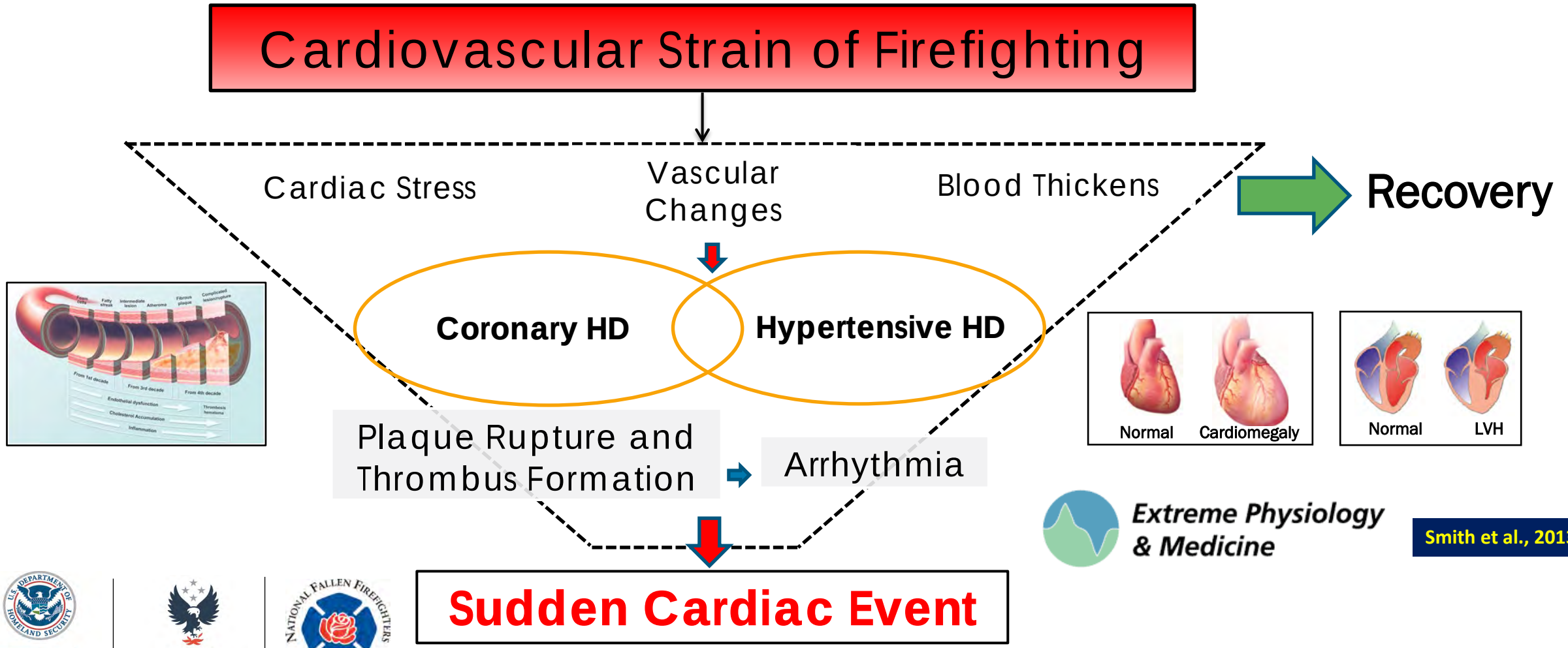
→ Metabolic

→ Immune/Endocrine

→ Nervous

→ Muscular

RESEARCH FRAMEWORK



Extreme Physiology & Medicine

Smith et al., 2013

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RESEARCH FINDINGS

Autopsy Findings of Cardiac Death Cases and Controls:		
Underlying disease	Cardiac Case	Non-Cardiac Control
Coronary artery ≥50% stenosis	73.2%	18.5%
Heart weight >450g	77.2%	32.5%

KEY FINDING – 80% of cardiac deaths had *both* CHD and HHD

CVD Risk Factor Prevalence Among Firefighters:	(%)
Hypertension (n=5063)	69%*
High Cholesterol (n=4513)	20%#
Low HDL (n=4513)	25%#
High Blood Glucose (n=4513)	4%#
Obesity (n=4513)	36%#

KEY FINDINGS – greater hypertension than general population, others similar. FF is NOT similar to other jobs

FIREFIGHTER CARDIOVASCULAR HEALTH

- Firefighting causes significant CV strain and physiological disruption
- Firefighting can Trigger a cardiac event in people with underlying disease - especially if FF has CHD and hypertensive heart disease
- Firefighters should be screened for underlying CVD
- Firefighters NEED robust fitness and wellness programs
  - Address cardiovascular disease risk factors
  - Prevent cardiovascular disease

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Firefighter Behavioral Health

Pat Morrison

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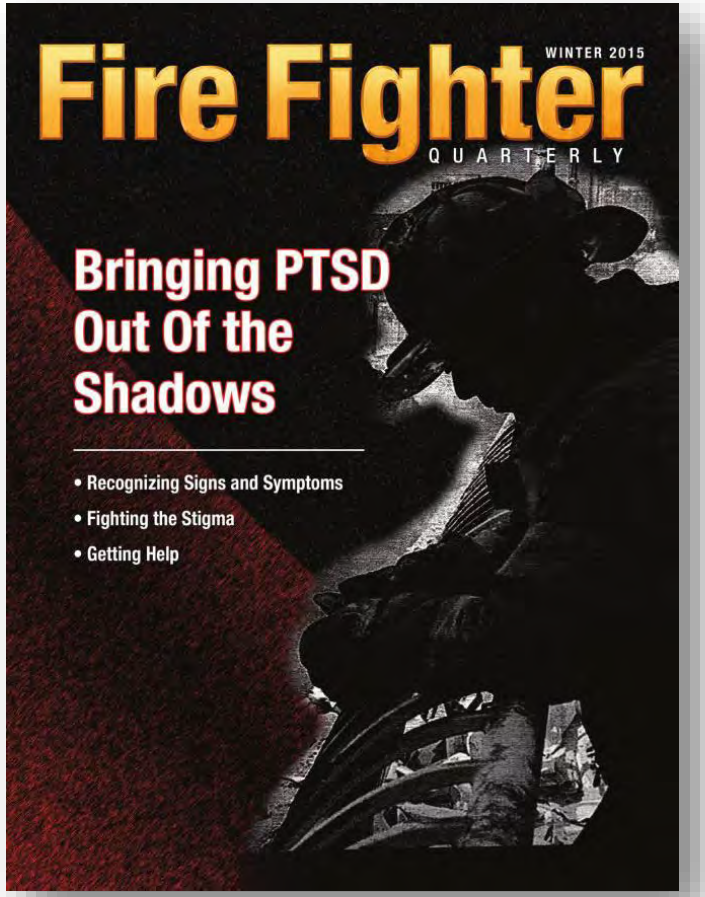
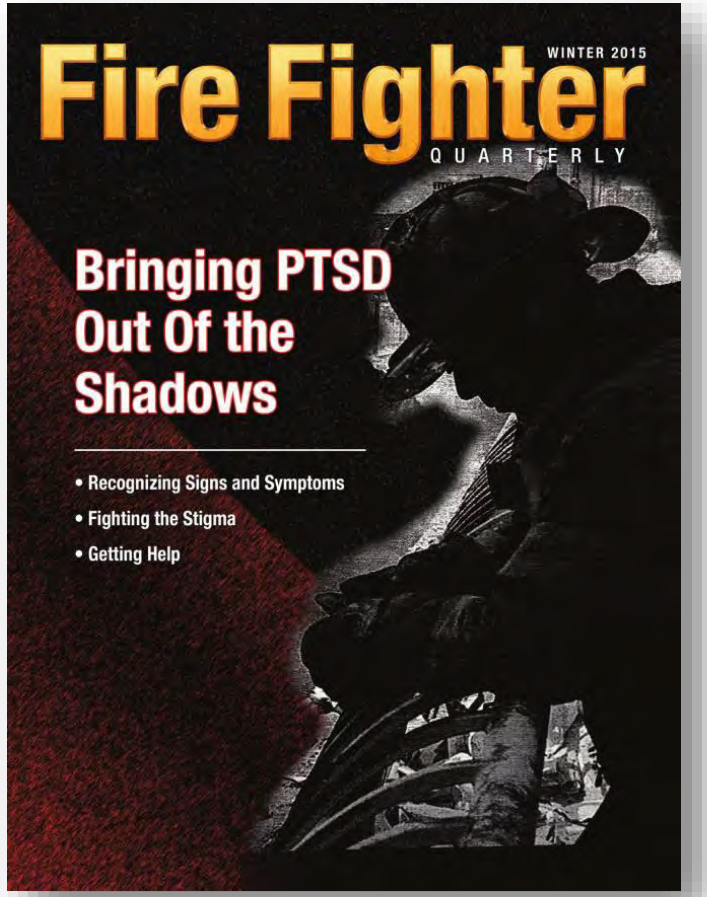
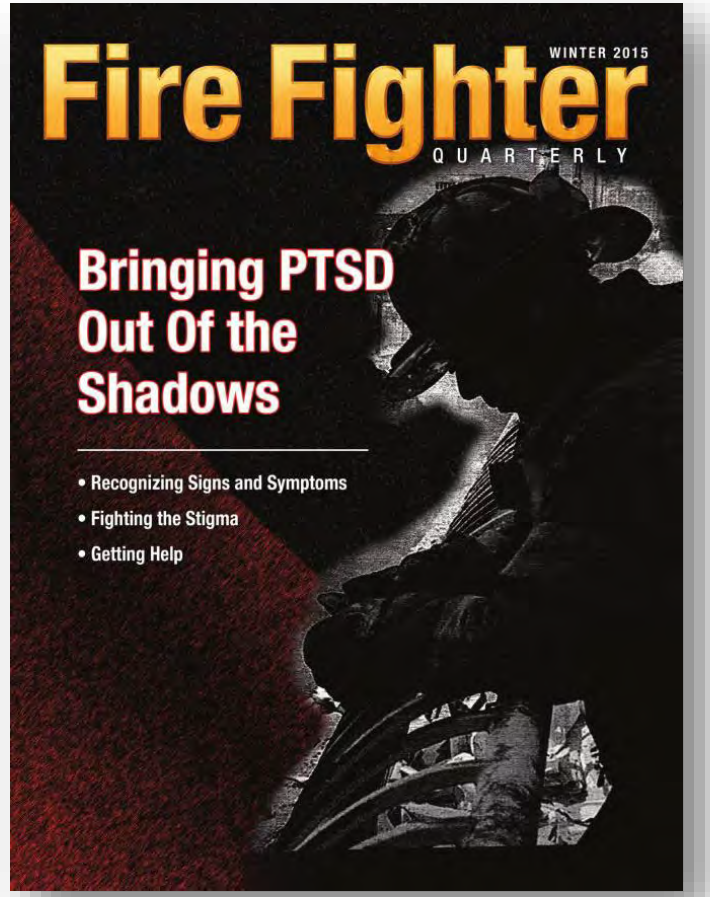
WHERE WE STARTED







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WHAT WE KNOW

- Fire service members experience higher rates of behavioral health disorders, when compared to the general population
- Suicide, burnout, and recruitment are major challenges of today
- The connection between behavioral health, sleep, and all other health outcomes is indisputable
- Many barriers still exist that prevent fire fighters from seeking help
- Peer support can effectively bridge the gap to help
- Fire fighters need culturally informed, evidenced based treatment
- Fire fighters remain highly resilient due to protective factors inherit to the occupation

WHAT WE DON'T KNOW

- The rate (or cause) of fire fighters that die by suicide
- How to tackle the eroding physiological and cognitive impacts of sleep deprivation/shiftwork
- How to translate education/awareness into concrete behavioral change that saves lives
- How to expedite critical behavioral change in a legacy of tradition
- How to attract and retain millennials and Gen Z to the fire service

ORGANIZATIONAL RESILIENCE

- Behavioral Health Education
- Department-wide Resiliency Training
- Peer Support Programming
- Behavioral Health Screening
- Comprehensive Health Insurance Coverage
- Post- PTE Response
- Chaplaincy Program
- Vetted Mental Health Providers
- Physical Fitness Program
- Retiree Inclusion
- Family Inclusion

CREATING A RESILIENT WORKFORCE FOR TOMORROW

Emerging Trends

- Comprehensive fire department behavioral health programming
- Mandatory behavioral health education for all levels of rank
- Targeted outreach/inclusion of department leaders and recruits
- Annual behavioral health screening and evaluation
- Increased treatment access through telehealth
- Improved treatment outcomes through culturally informed care
- The role of science in cutting edge behavioral health treatments


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