Cancer Prevention in the Fire Service

Captain John Gulotta
Tucson Fire Department
Safety & Wellness
Jeff Burgess, MD, MS, MPH, University of Arizona
FDIC
April 10, 2019

Introduction

- TFD Demographics
- Cancer LODD: Our Why
- Goals in Cancer Prevention
  - Collaboration
  - Collection
  - Changing Culture
  - Cancer Legislation
  - Cancer & Data-The Science
- Discussion and Questions?

Tucson Fire Department

Tucson Fire Department
All hazards department

TFD Demographics

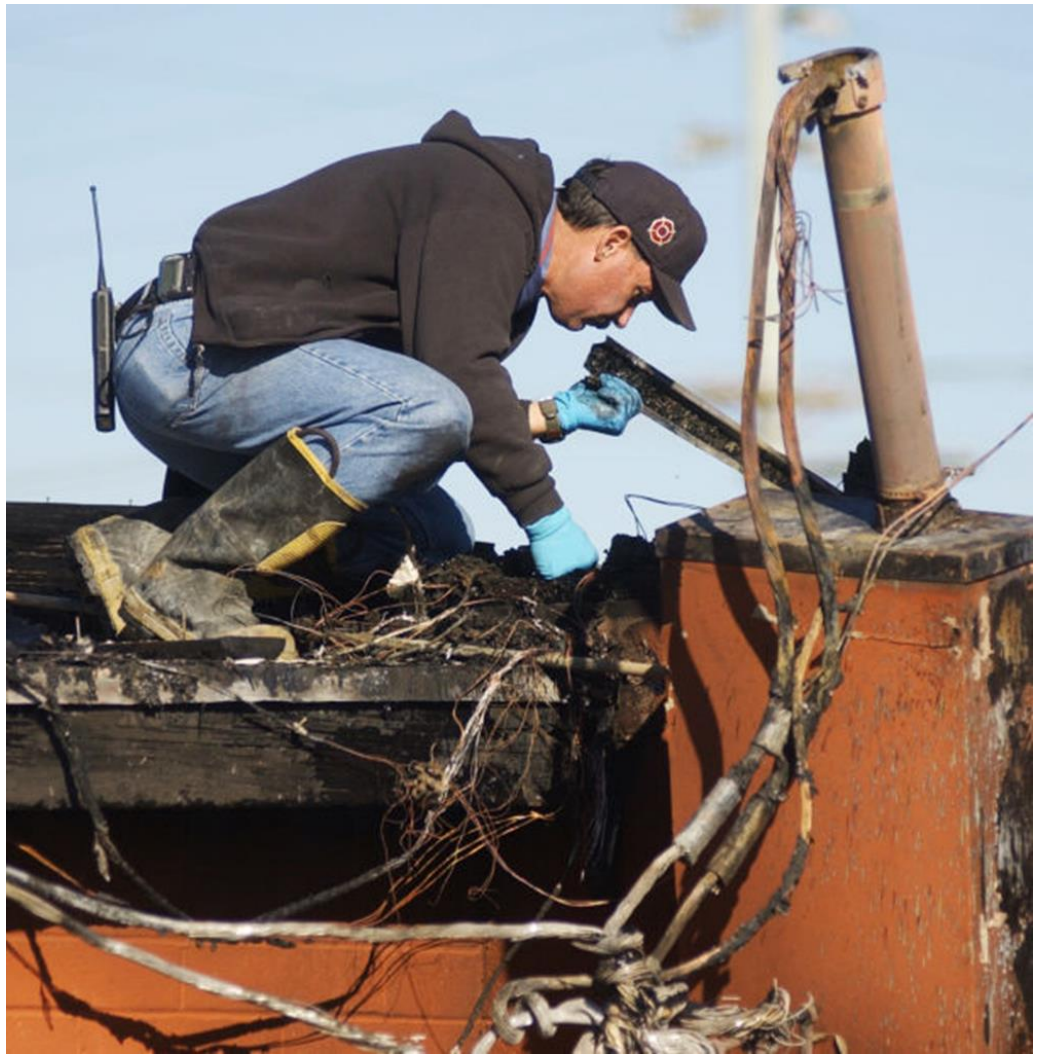
- Established in 1881
- 2nd largest FD in Arizona
- Serving a population of 635,000
- Service area of 237 square miles
- 22 Fire Stations
- 650 Commissioned Personnel
- 95,000 Emergency Responses (2018)
- 9,217 Fire Responses (2018)
- Class 1 ISO Rating

Cancer LODD: Our Why

- On March 14, 2014, TFD Fire Cause Investigator **Tom Quesnel** died after a battle with leukemia. “Presumptive in AZ”
- Tom spent 20 years investigating nearly 3,000 fires throughout the southwest United States.
- Over the course of Tom’s career, he investigated fires with two accelerant detecting dogs, both of which died of cancer.

Cancer LODD: “Presumptive”

Cancer LODD: Our Why



TFD Goals of the FEMA 2014 study

1. Help with the worker comp definition of- Presumptive
   “ PROVE TO US YOU ARE BEING EXPOSED ON THE JOB”
   “Which Fire Did you get Cancer?”
2. POST structure fire data (non-training fires)
   a) Prove carcinogen exposure
3. Link between Dr. Daniels (NIOSH) study and “Toxic Soup”
4. Test Interventions- “Best practices”
   a) **Design prevention strategies** (SOP)

Unified Mission:

- TFFA and TFD Administration working together

Collaboration

- University of Arizona and Tucson Fire Department partnership resulted in the FEMA 2014 Fire Service Cancer Study and now the ongoing FEMA 2015 or Firefighter Cancer Cohort Study.

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Specific Aims 2014 Study

1) Evaluate carcinogen exposures throughout the:
   - work shift
   - fire scene
   - station life
2) Measure biomarkers of carcinogenic (epigenetic) effect in relation to workplace exposures
3) Reduce fire service carcinogen exposure and effects through interventions.

Recruiting

1. Administrative support
2. Union support -Local 479
3. The Body*(U of A needs 250 Min.)

Funding

-During original pilot study

Cancer Prevention in the Fire Service: Exposure Assessment, Toxic Effects and Risk Management

EMW-2014-FP-00200


BN

Cancer Prevention in the Fire Service: Exposure Assessment, Toxic Effects and Risk Management

EMW-2014-FP-00200

and

The Firefighter Multicenter Cancer Cohort Study: Framework Development and Testing

aka the "Fire Fighter Cancer Cohort Study"

AFG EMW-2015-FP-00213

Captain John Gulotta, Deputy Chief Darin Wallentine,
Deputy Chief Paul Moore, Tucson Fire Department
Jeff Burgess, MD, MS, MPH, University of Arizona

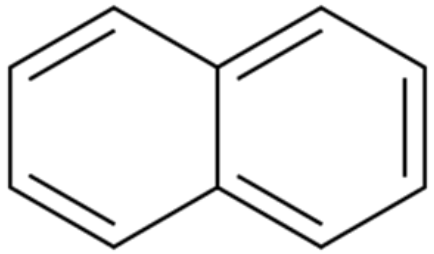
The Body

2015-2018 106 Recruits

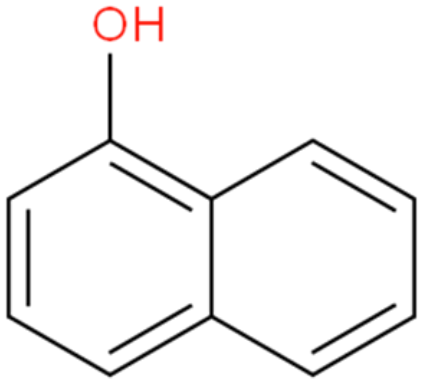
- From 2015 to 2018, 106 firefighter recruits consented and biologicals (blood, urine, and buccal cells) collected.
- 98% of recruits had no prior fire experience.
- Consented 525 of 650 incumbent TFD personnel.

Collection

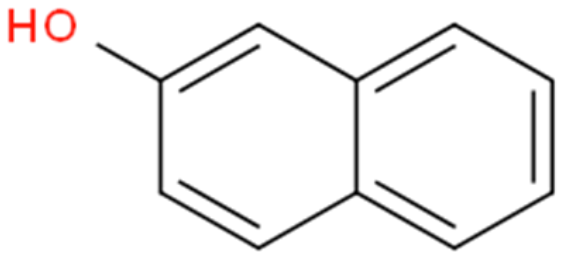
- Annual physicals included cancer study surveys and biological collections.



Naphthalene



1-Naphthol



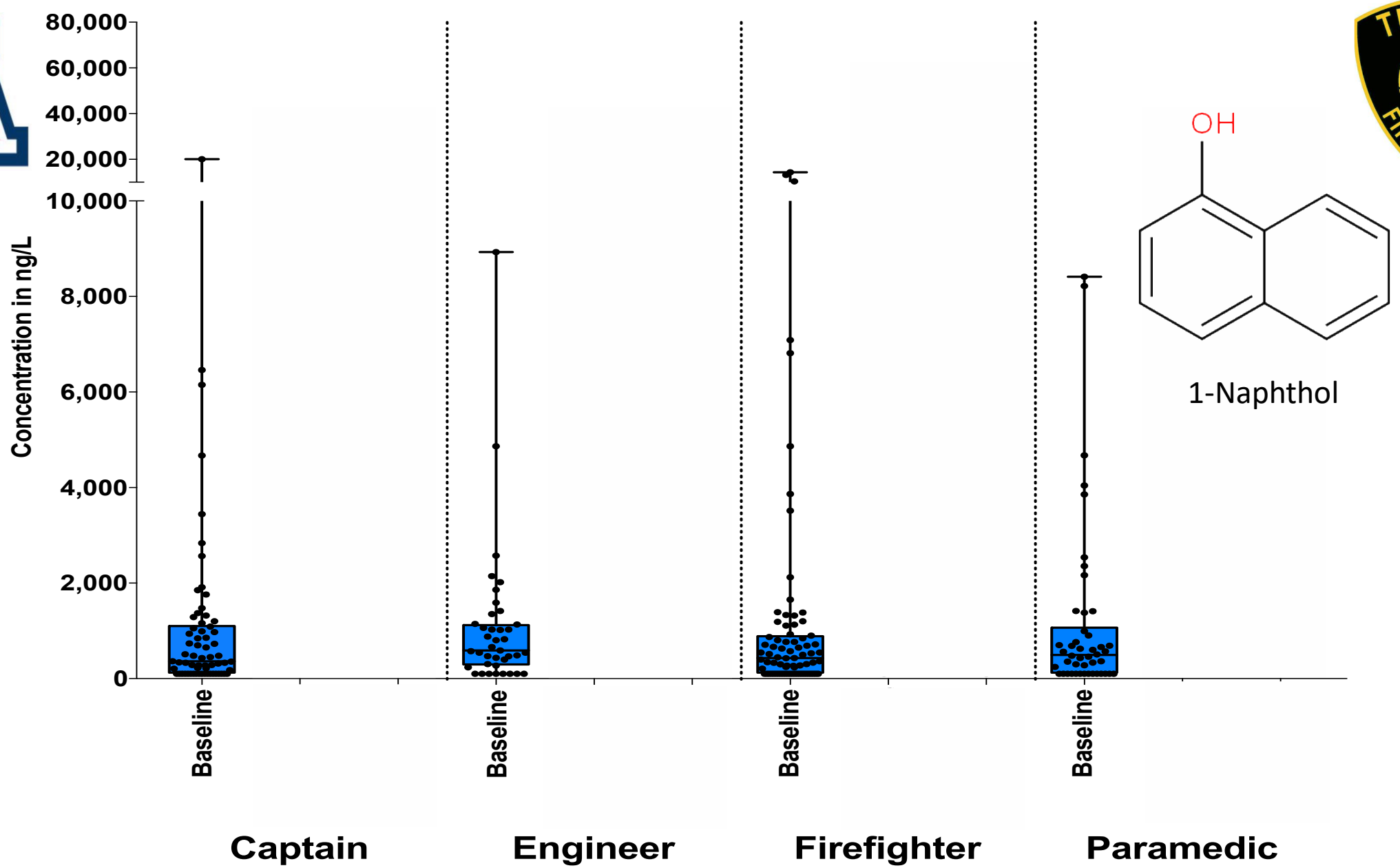
2-Naphthol

-**Pre study- 6 test fires**
-**27 Structure fires**
-**2500 Urines**
-**600 Blood**
-**550 Buccal cell**
-**5000 surveys**
-**Recruit class(s) 15-2**
15-3
15-4
16-1
17-1
18-1

Naphthalene is an organic compound with formula $C_{10}H_8$. It is the simplest polycyclic aromatic hydrocarbon, and is a white crystalline solid with a characteristic odor that is detectable at concentrations as low as 0.08 ppm by mass.[13] As an aromatic hydrocarbon, naphthalene's structure consis

Post Fire Collection

- Response to working fires to conduct surveys and collect urine 2 – 4 hours post-fire.
- Collected 2500 biologicals and 6000 surveys.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60,000
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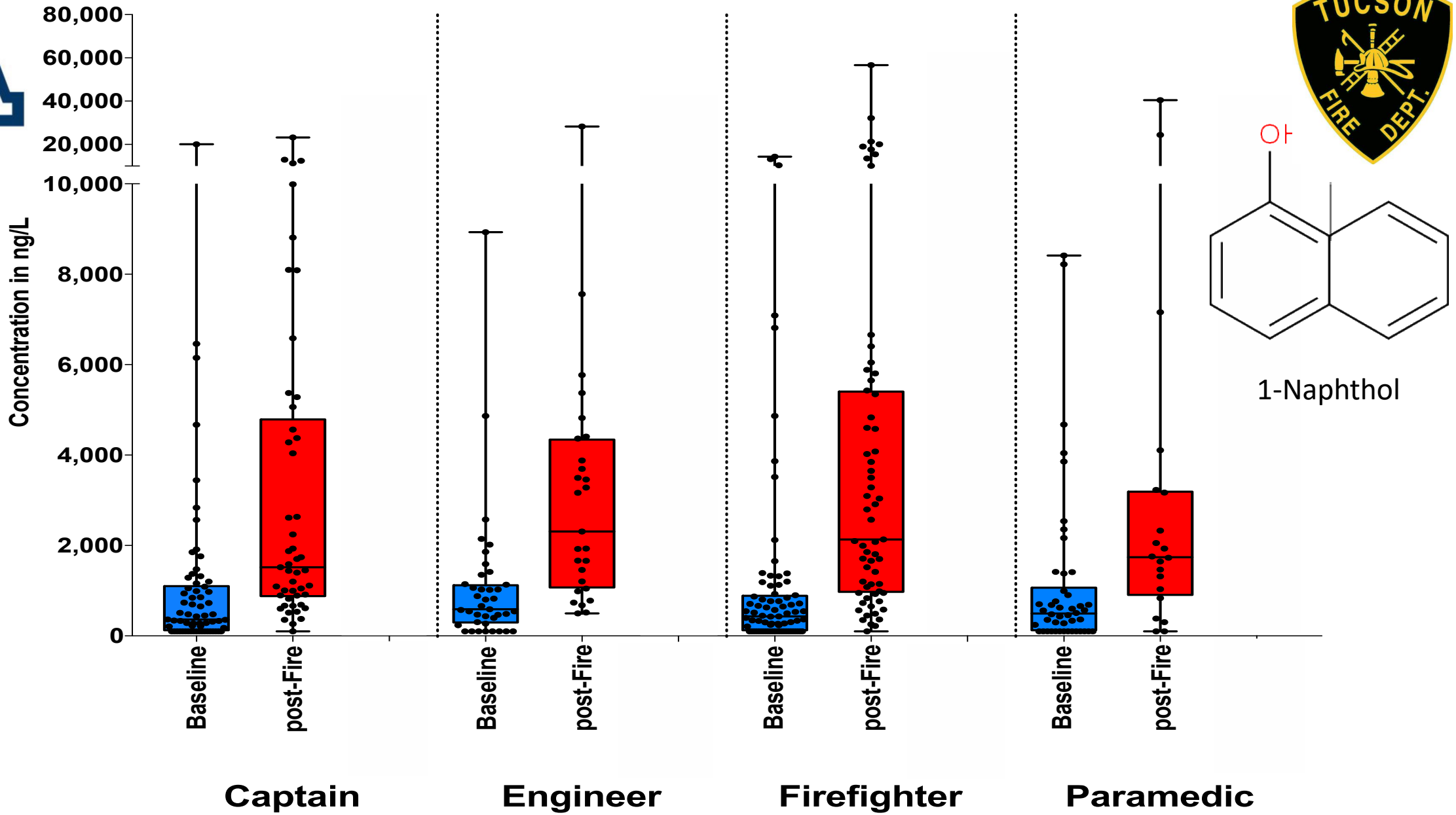
10,000
8,000
6,000
4,000
2,000
0
Concentration in ng/L
Baseline
Baseline
Baseline
Baseline
Captain
Engineer
Firefighter
Paramedic
OH
1-Naphthol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Concentration in ng/L
Baseline
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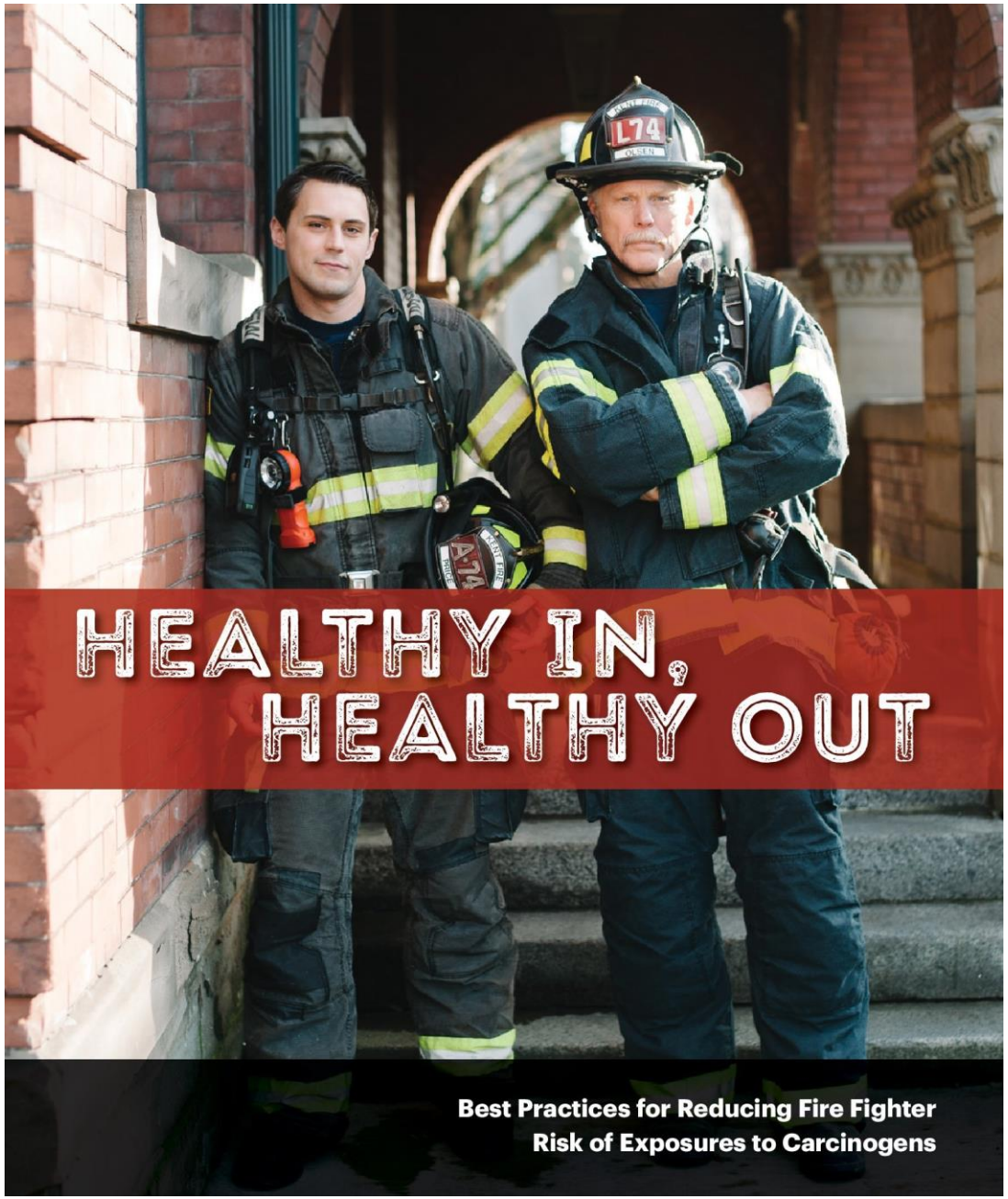
Best

Practices



Interventions

1

Engineers on air

2

Emergency Scene Wash Down

3

Bagging gear/equipment

Changing Culture-Interventions

- Interventions --> Best Practices
  - Emergency scene “wash down”
  - Engineers on air
  - Bagging soiled gear/clean cab
  - Fire Cause Investigator PPE and SOG’s

NIOSH/CDC Firefighter- Contamination of Firefighters Personal protective equipment and skin and the effectiveness of decontamination procedures-Kenneth W. Fent, PHD,CIH

Changing Culture

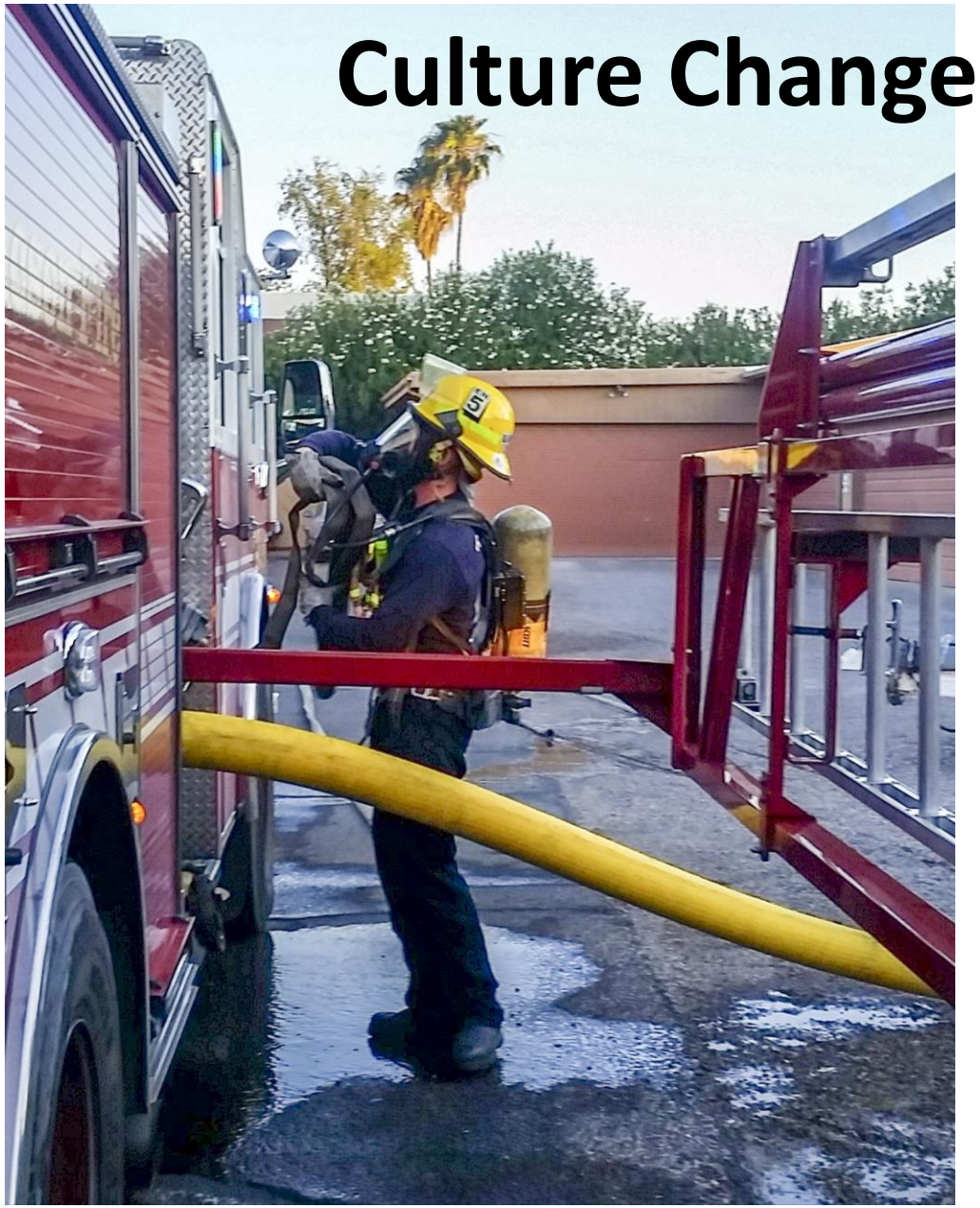
- Dirty gear vs. clean gear
- PPE technology and standards
- Cross-contamination
- Rehab and shower within an hour

Changing Culture- WASH DOWN


20
TUCSON
FIRE DEPT
8793
DUPONT


TUCSON
FIRE DEPT.
Pierce
701

Culture Change- Engineers on Air




TUCSON FIRE


TUCSON FIRE
BREATHING AIR

Changing Culture

Changing Culture

- Rehab operations and Wet wipes

Are the interventions working?

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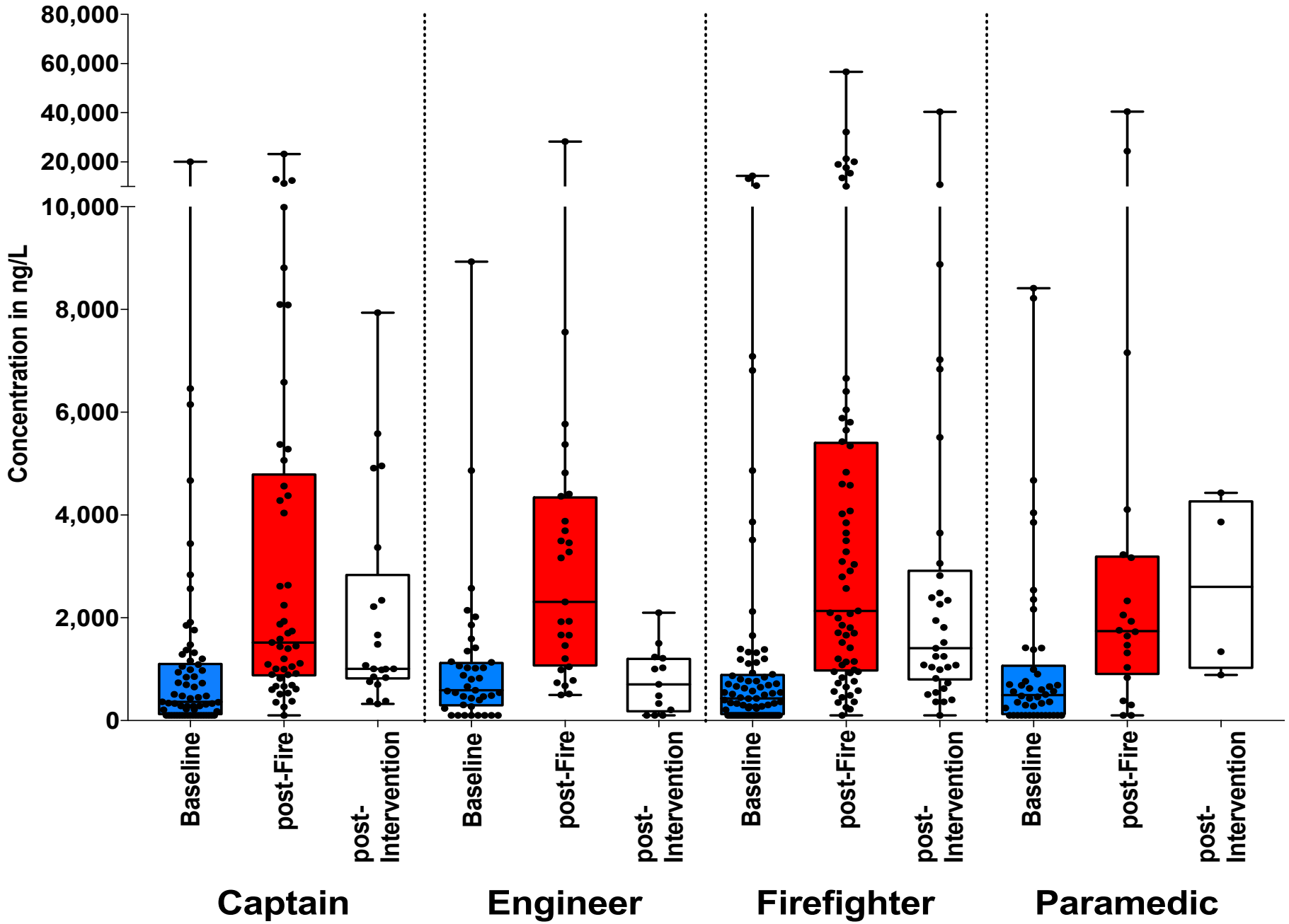
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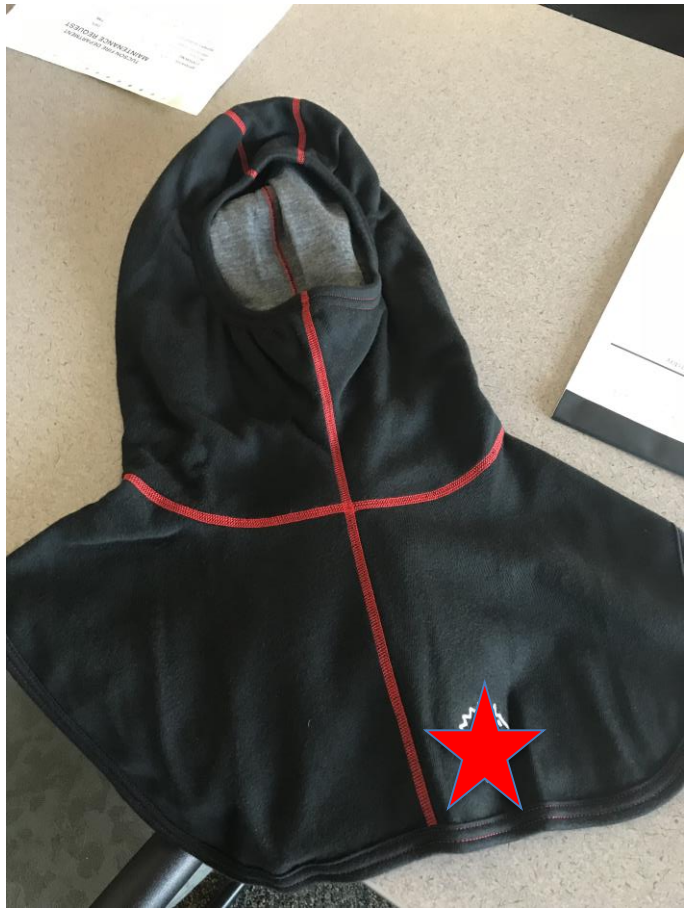
Concentration in ng/L
Baseline
post-Fire
post-Intervention
Captain
Engineer
Firefighter
Paramedic

Tom Q's promise-
make sure the FC Investigators wear their SCBA's.

National Trends: Changing Culture

PPE

- Hood exchange while in Rehab and influencing hood and PPE technology
- Two sets of turnouts, including gloves



Cancer Legislation

- Arizona Presumptive Legislation
  - ❖ Arizona Revised Statute 23-1043.01

B. Notwithstanding subsection A of this section and § 23-1043.01 :

1. Any disease, infirmity or impairment of a firefighter's or peace officer's health that is caused by brain, bladder, rectal or colon cancer, lymphoma, leukemia or adenocarcinoma or mesothelioma of the respiratory tract and that results in disability or death is presumed to be an occupational disease as defined in § 23-901 , paragraph 13, subdivision (c) and is deemed to arise out of employment.

Cancer Legislation

- Arizona Presumptive Legislation cont.

B. Notwithstanding subsection A of this section and § 23-1043.01 :

2. Any disease, infirmity or impairment of a firefighter's health that is caused by buccal cavity and pharynx, esophagus, large intestine, lung, kidney, prostate, skin, stomach or testicular cancer or Non-Hodgkin's lymphoma, multiple myeloma or malignant melanoma and that results in disability or death is presumed to be an occupational disease as defined in § 23-901 , paragraph 13, subdivision (c) and is deemed to arise out of employment.

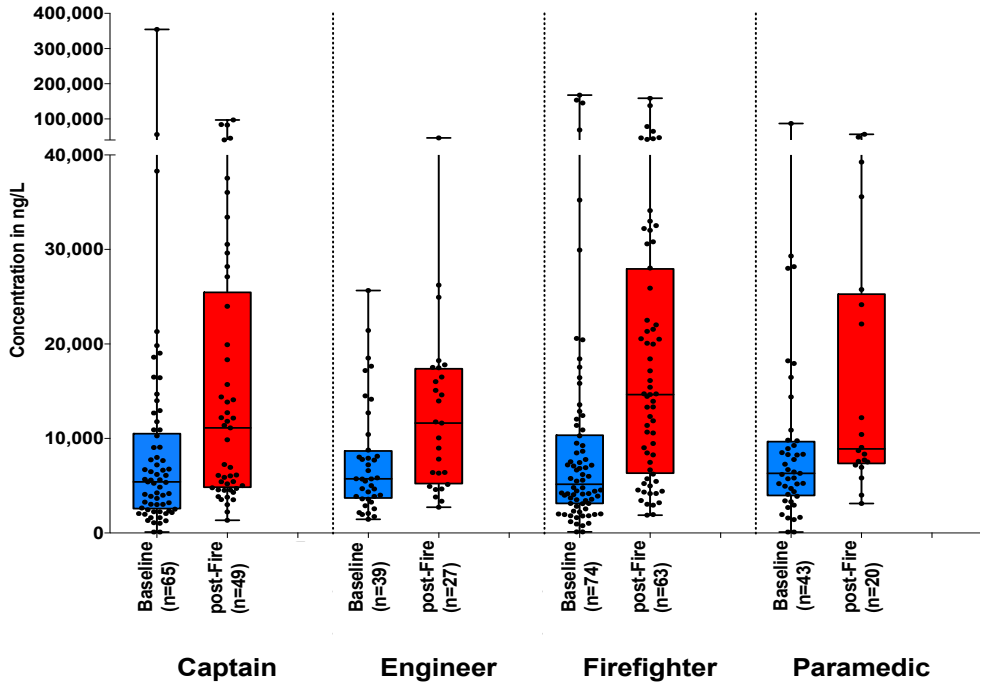
Cancer Legislation

- Arizona Presumptive Legislation cont.

D. Subsection B of this section applies to former firefighters or peace officers who are sixty-five years of age or younger and who are diagnosed with a cancer that is listed in subsection B of this section not more than fifteen years after the firefighter's or peace officer's last date of employment as a firefighter or peace officer.

National Trends: Cancer & Data

- Importance of data to support claims in support of firefighters diagnosed with cancer.
- FireRMS & TeleStaff link for fire response data



Incident Summary

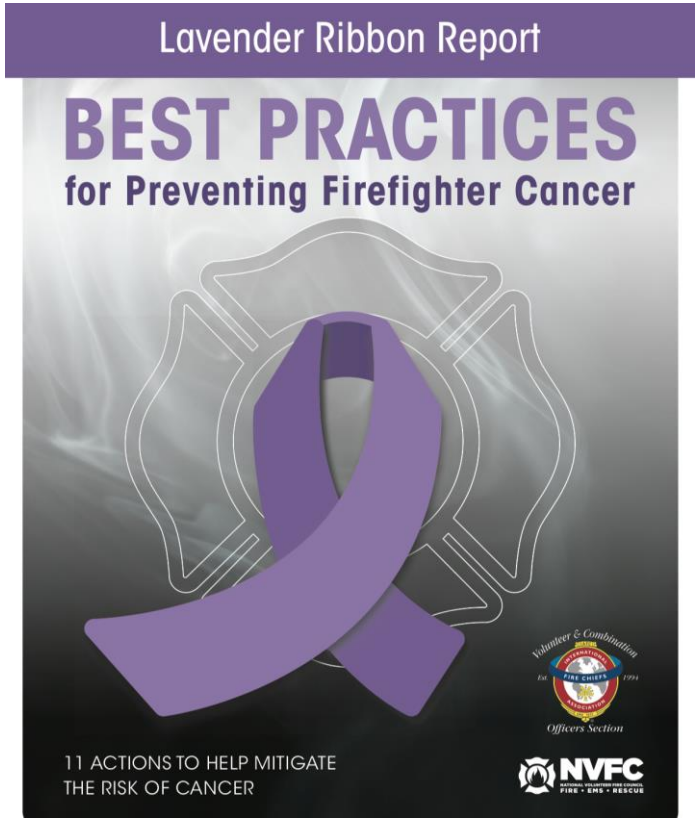
Metric	Value
Total Incidents	245 ▲ 12%
EMS Incidents	184 ▲ 13%
Fire Incidents	61 ▲ 11%
Total Responses	463 ▲ 14%
Six Minute Response Percentage	54 ▲ 2%
90% EMS Turnout Duration (sec)	102 ▼ -6%
90% Fire Turnout Duration (sec)	97 ▼ -22%
90% Event Duration (min)	62 ▲ 12%

National Trends: Cancer & Data

- NFORS and NFORS Exposure Module
  - A way for individual firefighters to track and document their fire ground and traumatic event exposures.
  - The app populates the response data from CAD and is capable of adding events manually.

National Trends: Changing Culture

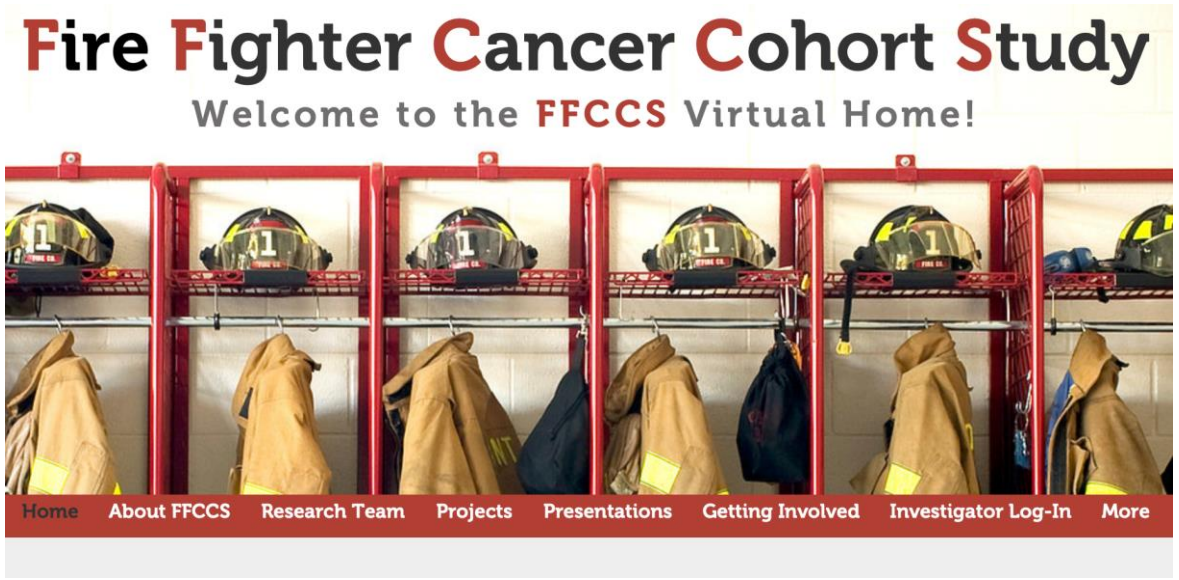
- The Lavender Ribbon Report
  - 11 Actions to Help Mitigate the Risk of Cancer.
  - Joint effort between the IAFC Volunteer & Combination Officers Section and National Volunteer Fire Council.



Link: https://www.iafc.org/press-releases/press-release/lavender-ribbon-report-best-practices-for-preventing-firefighter-cancer-released

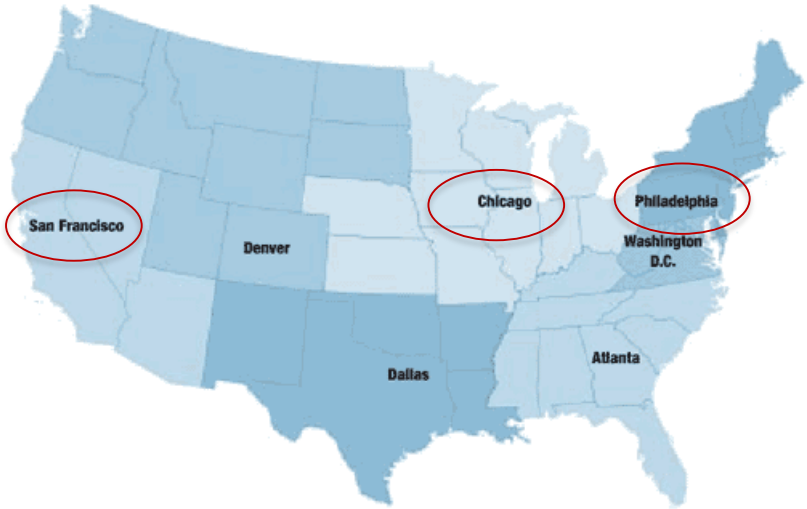
National Trends: Collaboration

- FEMA 2015 or Firefighter Cancer Cohort Study
- Exposure assessment, surveys, and biomarkers
- Link: www.FFCCS.org



US Firefighter Cancer Studies

- NIOSH (Daniels et al., 2014) demonstrated excesses in US firefighter cancer mortality:
  - lung (10%)
  - gastrointestinal (30-45%)
  - kidney (29%)
  - mesothelioma (100%)
  - similar increases in cancer incidence.
- Further analyses (Daniels et al., 2015) demonstrated significant associations:
  - fire hours and lung cancer incidence and mortality
  - fire runs and leukemia mortality



Daniels et al. *Occup Environ Med* 2014;71:388-397.
Daniels et al. *Occup Environ Med* 2015 Epub ahead of print.

California Cancer Study

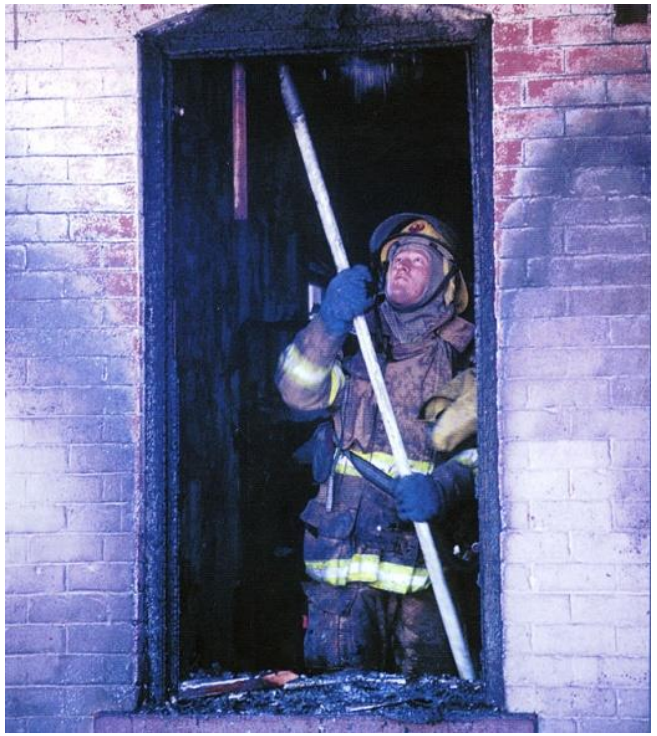
- NIOSH (Tsai et al., 2015) study of California firefighters with cancer 1988-2007
- Cancer excess (all firefighters combined):
  - melanoma (80%)
  - multiple myeloma (40%)
  - acute myeloid leukemia (40%)
  - adenocarcinoma of the esophagus (60%)
  - prostate (50%)
  - brain (50%)
  - kidney (30%)

- Cancer excess (minority firefighters only):
  - Tongue cancer, testicular cancer, bladder cancer, non-Hodgkin lymphoma, chronic lymphocytic leukemia, and chronic myeloid leukemia

Tsai et al. *Am J Ind Med*. 2015;58:715-729

Overhaul Study

- TFD wore no respiratory protection and PFD wore APRs
  - CC16 and SP-A are serum pneumoproteins which spill into the blood with lung inflammation
  - FEV_1: forced expiratory volume in one second
  - FVC: forced vital capacity
- PFD had poorer respiratory outcomes despite APR use



Group	n	CC16	SP-A	n	FVC (L)	FEV_1 (L)
TFD	25	8.9±3.5	287±144	19	5.42±0.72	4.10±0.62
TFD-OH	25	**12.3±3.6**	306±157	19	5.36±0.73	3.94±0.65
PFD	26	9.6±3.5	250±117	26	5.44±0.68	4.22±0.51
PFD-OH	26	**14.6±5.2**	**334±141**	26	**5.29±0.74**	**4.09±0.56**

Burgess JL et al. *J Occup Environ Med.* 2001;43:467-473.

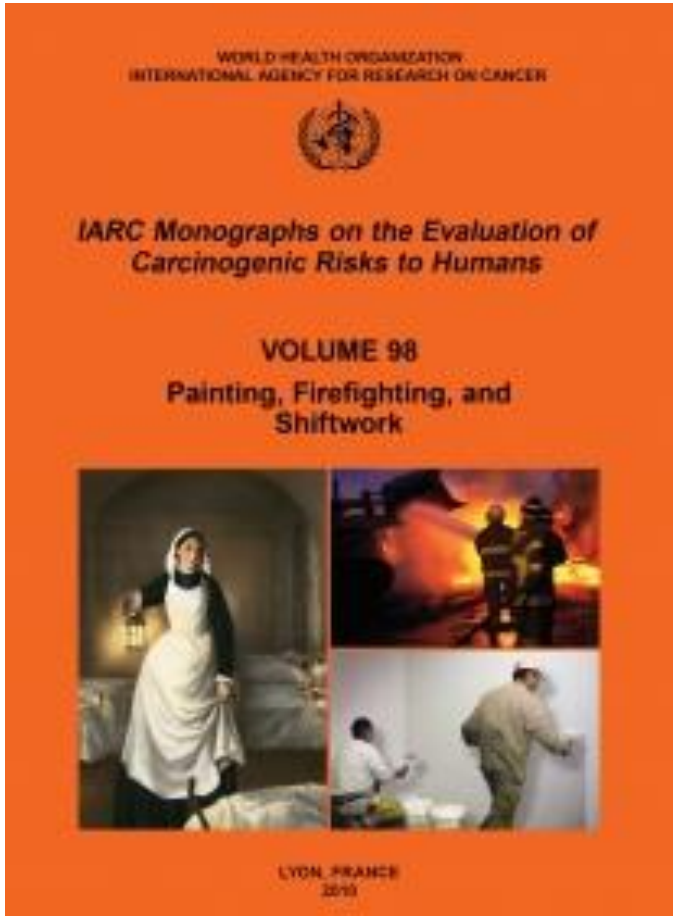
Health Effects

Latency period 3 - 30+ years

Exposure → Cellular Changes → Cancer

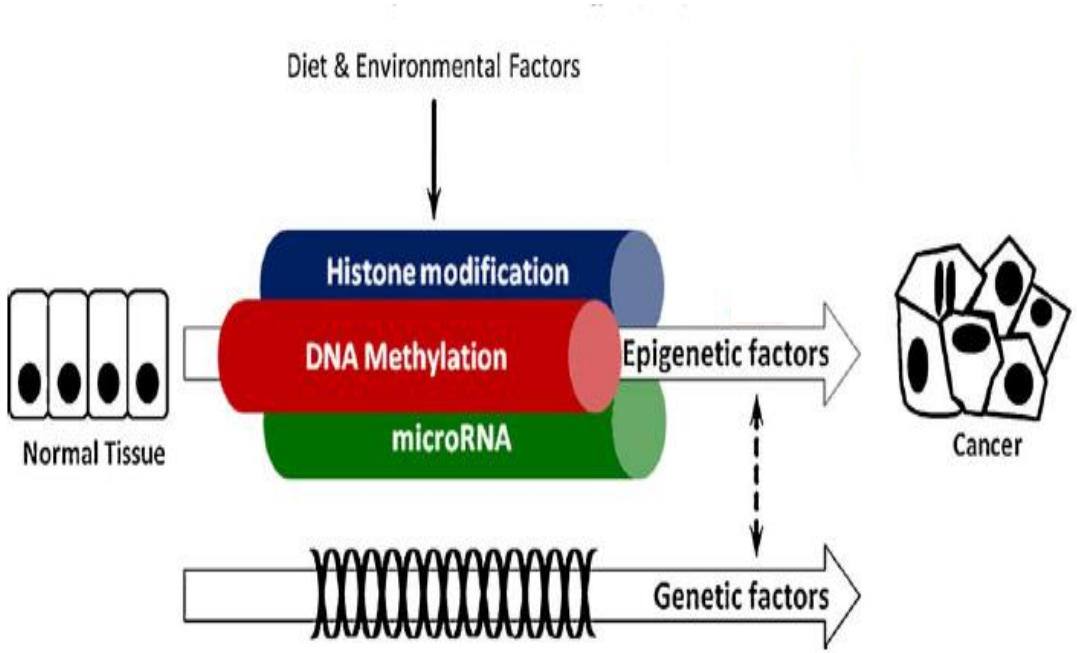
Presumptive Legislation

- Identification of cellular mechanisms will support presumptive legislation
- Need to provide scientific support for moving from *possibly carcinogenic to humans (2B)*
  to *probably carcinogenic to humans (2A)*
  or *carcinogenic to humans (1)*



Epigenetic Changes

- Change in gene expression without changes in DNA sequence
- Profound roles in carcinogenesis
- DNA hypermethylation silences tumor suppressor genes
- microRNA: small molecules that control gene expression
  - Can act as oncogenes or tumor suppressor genes



Link et al. Biochem Pharmacol 2010;80:1771-92.

DNA Methylation Pathway Analysis

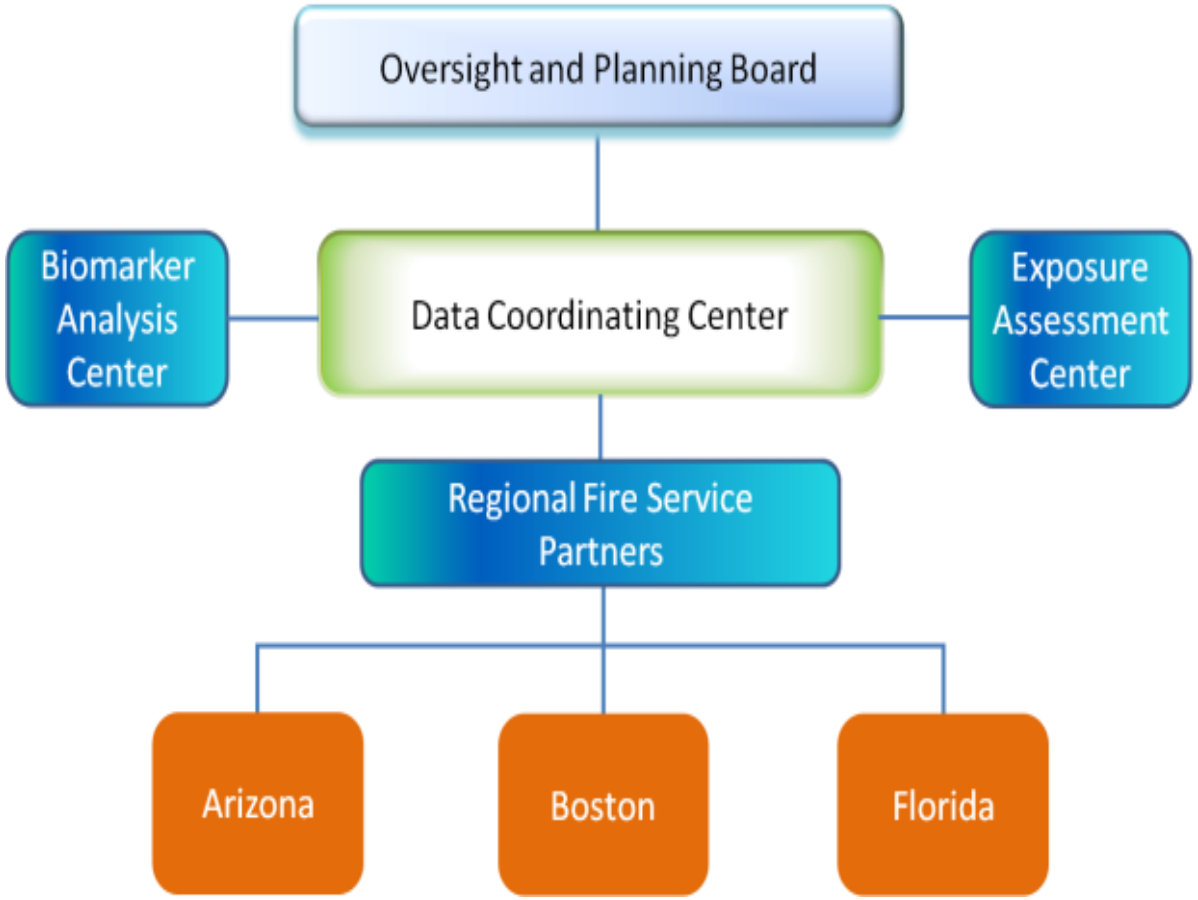
Disease annotation	p-value	# genes	Hub genes
Abdominal cancer	5.1e-18	88	STAT3, TP63, TP73, FOXO1, PML, DAXX, RUNX2, INSR, PCNA
Colon tumor	5.9e-09	44	STAT3, TP63, TP73, FOXO1, DAXX, RUNX2, INSR, PCNA
Skin cancer	2.9e-07	51	STAT3, TP63, PML, DAXX, RUNX2, INSR
Lung tumor	6.6e-07	49	INSR, PCNA, STAT3, TP63, TP73

MicroRNA Results

	Incumbents vs. new recruits*			New recruits at 2 yrs vs. baseline**				
miRNA Name	FC	95% CI		FC	95% CI		Role in cancer	Select cancer associations
miR-1260a***	**0.55**	0.43	0.71	**0.66**	0.47	0.91	Tumor suppressor	Brain (glioblastoma)
miR-548h-5p	**0.59**	0.51	0.69	0.83	0.50	1.16	Tumor suppressor	Cervical and lung
miR-145-5p***	**0.44**	0.32	0.61	**0.61**	0.45	0.82	Tumor suppressor	Prostate
miR-4516	**0.56**	0.48	0.65	0.81	0.56	1.16	Tumor suppressor	Apoptosis of keratinocytes
miR-331-3p	**0.60**	0.52	0.70	1.05	0.77	1.44	Tumor suppressor	Prostate & colorectal
miR-181a-5p	**0.62**	0.53	0.72	1.03	0.83	1.27	Tumor suppressor	Lung (Non-small cell)
miR-5010-3p***	**1.59**	1.41	1.81	**1.79**	1.32	2.42	Unknown	
miR-374a-5p	**1.72**	1.40	2.13	1.31	0.94	1.83	Oncogene	Esophageal & gastric
miR-486-3p***	**3.35**	2.59	4.33	**4.95**	3.14	7.81	Oncogene	Colorectal

*Fold changes of incumbents (n=52) compared to new recruits (n=45), adjusted for age, obesity and ethnicity, male non-smokers only (Jeong et al., *J Occup Environ Med*. 2018;60(5):469-474); **Also adjusted for batch effects; ***Markers also significant in longitudinal analysis of new recruits after adjustment.

FFCCS Framework (Initial)



Initial Partners

University of Arizona
University of Miami
NIOSH
FPRF
Dongguk University (Korea)
IFSI
NDRI
Boston Fire Department /Local 718
Elephant Head Volunteer Fire Dept.
Firefighter Cancer Support Network
Helmet Peak Volunteer Fire Department
IAFC/NFPA Metro Chiefs
International Association of Fire Fighters
National Fallen Firefighters Foundation
National Volunteer Fire Council
Palm Beach County Fire Rescue
Tucson Fire Department/Local 479
WellAmerica

Persistent Chemical Contaminants

- Per- and polyfluoroalkyl substances (PFAS) are found in smoke from fires, turnout gear, and many Class B firefighter foams
- Legacy PFAS exposure in the general population has been associated with testicular, kidney, prostate, and ovarian cancers and non-Hodgkin lymphoma, as well as respiratory disease and reproductive toxicity
- We previously found ⬆ PFOS and PFHxS levels in firefighter's blood in Arizona
- Opportunity: use the FFCCS to measure PFAS exposures and toxic effects in firefighters

http://sanfrancisco.cbslocal.com/video/3580561-crews-clean-up-firefighting-foam-that-spilled-from-airport-hangar-in-santa-clara/

Additional Grants and Proposals

Funded

- FFCCS Expansion proposal (FEMA)
  - WUI, fire investigators, trainers and volunteers
- Serum per- and polyfluoroalkyl substances (PFAS) (IAFF)
- Serum PFAS and epigenetic analysis (NIEHS)

Submitted (or proposed)

- Firefighter colorectal cancer (CRC) proposal to NCI (to be resubmitted)
- Longitudinal analysis of epigenetic changes to NIOSH
- Social media messaging for CRC screening to NCI (planned 12/2018)
- PFAS exposure and toxicity evaluation to FEMA (planned 12/2018)
- Reproductive outcomes in male firefighters to FEMA (planned 12/2018)

Discussion and Questions?

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Thank you

John Gulotta
Tucson Fire Department
Captain
Safety & Wellness
John.Gulotta@tucsonaz.gov
520-837-7096

Jeff Burgess, MD, MS, MPH, University of Arizona

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