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HEALTH AND SAFETY SYMPOSIUM

Cancer Awareness & Prevention

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Cancer in the Fire Service: Recent Research & Prevention

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Occupational Exposures of Fire Fighters

- Combustion products
  - Complex mixture of cancer causing chemicals
- Diesel exhaust
- Flame retardants
- Chronic exposures
- Uncontrolled

Personal Protective Equipment (PPE)

- Lowest on hierarchy of controls
- Increasingly protective models but still limited
  - SCBA traditionally not used in overhaul to better detect re-ignition potential
  - Not 100% effective
  - Dermal absorption
    - Neck, seams

Which Chemicals Cause Cancer?

- The International Agency for Research on Cancer (IARC)
  - Part of the World Health Organization (WHO)
  - Authoritative agency on cancer causation

IARC Carcinogens in the Fire Fighting Environment

Group 1 agents (known to cause cancer in humans)

- Arsenic
- Asbestos
- Benzene
- Benzo[a]pyrene
- 1,3-butadiene
- Formaldehyde
- Dioxin
- Soot
- Diesel engine exhaust

Group 2A agents (probable human carcinogens)

- Creosote
- Wood combustion products

http://monographs.iarc.fr/ENG/Classification/index.php

Cancer Facts & Risk Factors

- Cancer is the second leading cause of death in the United States (after heart disease)
- Develops over years (latency)
- Multiple factors that affect a person's risk for developing cancer
  - Smoking, diet, genetics/family history, environmental exposures, etc.
- Which cancers are work-related in fire fighters?
  - Human epidemiology studies
    - Compare rates of cancers in fire fighters to non-fire fighter comparison groups or less exposed fire fighters
    - Similar exposures or fire fighter occupation in patients with specific types of cancer

Recent Epidemiologic Studies

- Meta-analysis - research technique combining multiple studies
  - Increased power to detect risk with more participants
  - Quality, consistency of data
- LeMasters, JOEM, 2006
  - Combined data in 32 studies of fire fighters for 20 different cancer types
    - Risks for 10 types of cancer (50%) were significantly increased in fire fighters
    - Risks for the other 10 were increased but did not reach statistical significance

NIOSH Fire Fighter Cancer Study

- US National Institute for Occupational Safety and Health (NIOSH)
- One of the largest studies of US fire fighters
- Multi-year pooled historical cohort study started in 2010
- ~30,000 career fire fighters
  - Chicago, Philadelphia, and San Francisco Fire Departments, employed between 1950 and 2009
  - Non-white and female fire fighters included
- Phase I compared fire fighters cancer deaths and diagnoses to the general population (Daniels, OEM, 2013)
  - Increased risks for gastrointestinal, genitourinary and lung cancers

NIOSH Study Phase 2

- Daniels, OEM, 2015
- Detailed work histories of position(s) each fire fighter held and the length of time in the position
  - Cumulative number of fire runs, exposed days, fire run-hours
    - Use of personal protective equipment
    - Use of diesel exhaust controls
  - Very challenging
- Compare cancer risk in higher exposed FF compared to lower exposed
  - Lung cancer and leukemia risk increased with exposure
  - Colon and prostate cancer risk decreased

Nordic Study

- Pukkala, OEM, 2014
- Cohort study of cancer incidence in 16,422 fire fighters from 5 Nordic countries
  - National cancer registries linked to census data on occupation from 1961-2005
- Increased risk for all cancers combined
- Statistically significant increases in specific cancers: melanoma and non-melanoma skin cancer, lung and prostate cancer
  - In specific ages: mesothelioma and multiple myeloma in 70+ year olds
  - Did not observe increase in prostate cancer risk after screening started

Which Cancers Are Work-related in Fire Fighters?

- No updated meta-analysis
  - Study quality
- Consider consistency across studies

Challenges in Epidemiologic Studies in Fire Fighters

- Exposure misclassification
- Healthy worker effect
- Small study sizes
- Other cancer risk factors
- NIOSH Phase II study focused on exposure misclassification and healthy worker effect
- Three of these limitations result in underestimation of risk

Presumptive Legislation

- Presumptive legislation does:
  - Remove the burden for proof of causation from the affected fire fighter
  - Allow for individual case evaluation
- Present in > 30 US states, Canadian provinces, Australia
- Presumption legislation does NOT:
  - Guarantee a fire fighter who develops cancer will be covered by workers' compensation
- IAFF assistance

Cancer Prevention: Screening

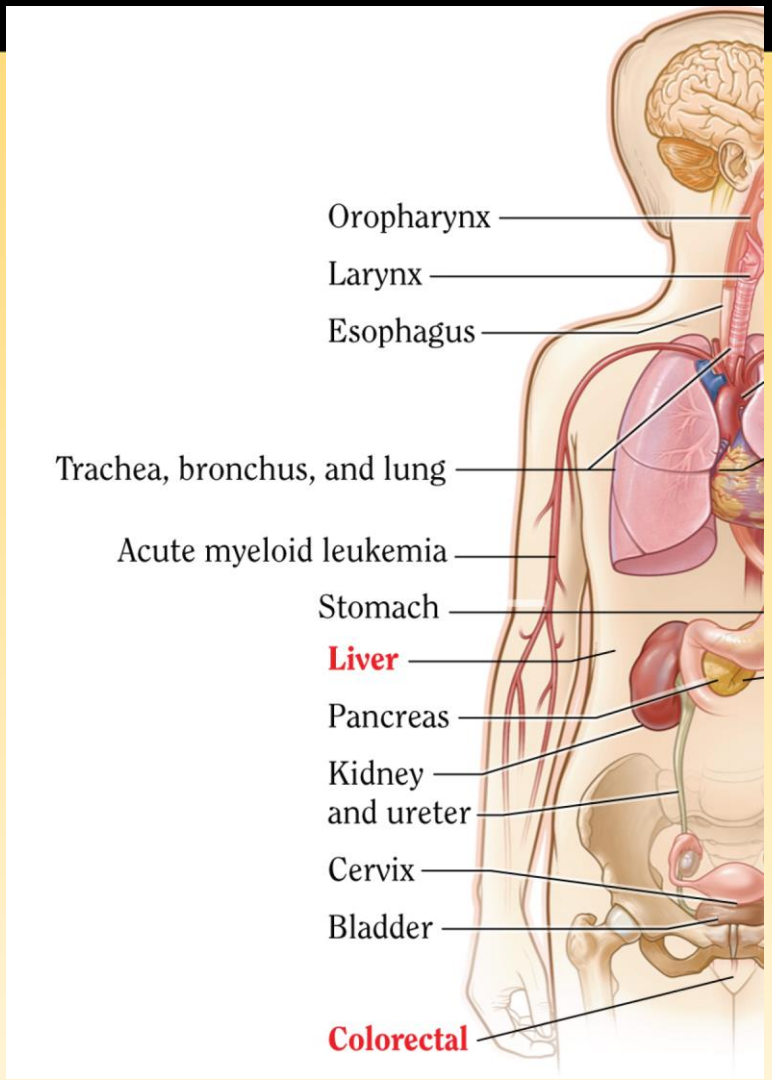
- General population recommendations for cancer screening
- Wellness – Fitness Initiative screening modified to reflect increased risk in fire fighters
  - Colon cancer screening example
    - Discussion at age 40 and if screening chosen, fecal occult blood testing until age 50 as lowest risk screening procedure
- American Cancer Society
  - http://www.cancer.org/Healthy/FindCancerEarly/CancerScreeningGuidelines/american-cancer-society-guidelines-for-the-early-detection-of-cancer
  - Cytology (Pap smear) and human papillomavirus testing
  - Mammography
  - Colonscopy/sigmoidoscopy or fecal occult blood test

Cancer Screening

- Lung
  - Low-dose computed tomography in those ages 55 to 80 years who have a 30 pack-year smoking history and currently smoke or have quit within the past 15 years
  - Chest X-ray and sputum cytology not helpful
- Depending on a person's age and gender, physical exams for various cancers
  - Thyroid, oral cavity, skin, lymph nodes, testes
- Certain cancer types do not have an adequate screening test
  - Prostate - "informed decision with their doctor about whether to be tested"
  - Leukemia

Cancer Prevention is Best

- An ounce of prevention really does equal a pound of cure
- Occupational exposure prevention
- Tobacco
  - Cigarette smoking – personal or secondhand
  - Chewing tobacco
  - Range of smoking cessation options



The Health Consequences of Smoking —50 Years of Progress.
A Report of the Surgeon General; 2014
http://www.surgeongeneral.gov/library/reports/50-years-of-progress/exec-summary.pdf;
latest cancers causally linked in red

Cancer Prevention

- Diet
  - Food pyramid
    - More fruits, vegetables, and whole grains
    - Less red meat, fried and fatty foods
    - Avoid calorie dense, nutrient poor foods
  - Portion control
- Exercise regularly
  - Lifestyle exercise
- Weight control
- Alcohol in moderation
  - Moderation is key to most prevention
- Sunscreen

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Legacy and Emerging Flame Retardants in Fire Station Dust

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IAFF – Fire Station Dust Study

Study team:

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[3]*Commonweal, Bolinas, CA*

IAFF – Fire Station Dust Study

The Fire Station Dust Study:

1. Analyzed dust from 25 US fire stations to determine levels of PBDEs and OPFRs;

2. Compared FS levels to levels found in other CA fire stations and in other locations

Fire Station Selection Criteria

- Station uses vacuum for cleaning
- Station uses one vacuum
- Urban/suburban response areas (does not respond to wildland fires)
- Apparatus bay adjoins living quarters
- Fire station is a permanent structure (not a temporary structure, such as a trailer)
- Has incident data through end of 2013
- Busy fire station (responds to relatively high number of structural, car, residential fires)
- Majority of those residing in station are firefighters
- Firefighters live and work at fire station when on duty
-

Study Protocol

Study team collected dust samples from the vacuum cleaner bags used in the living quarters of the 25 firehouses (five fire stations in each of 5 states).

Each station completed a survey indicating age of fie house, cleaning practices for the stations, fire engine, turn out gear.

Turn Out Gear

Survey re	Yes	No
• Designated area for TG	92%	8%
• TG stored in enclosed area	65%	35%
• TG area is ventilated	45%	55%
• TG allowed in living quarters	8%	92%
• Vacuum cleaners used for areas other than floor	26%	70%

- TG storage Apparatus bay 85% Living quarters 5%.

Flame Retardants Tested For in FS Dust

Legacy FRs:

18 PBDEs (polybrominated diphenyl ethers) including:

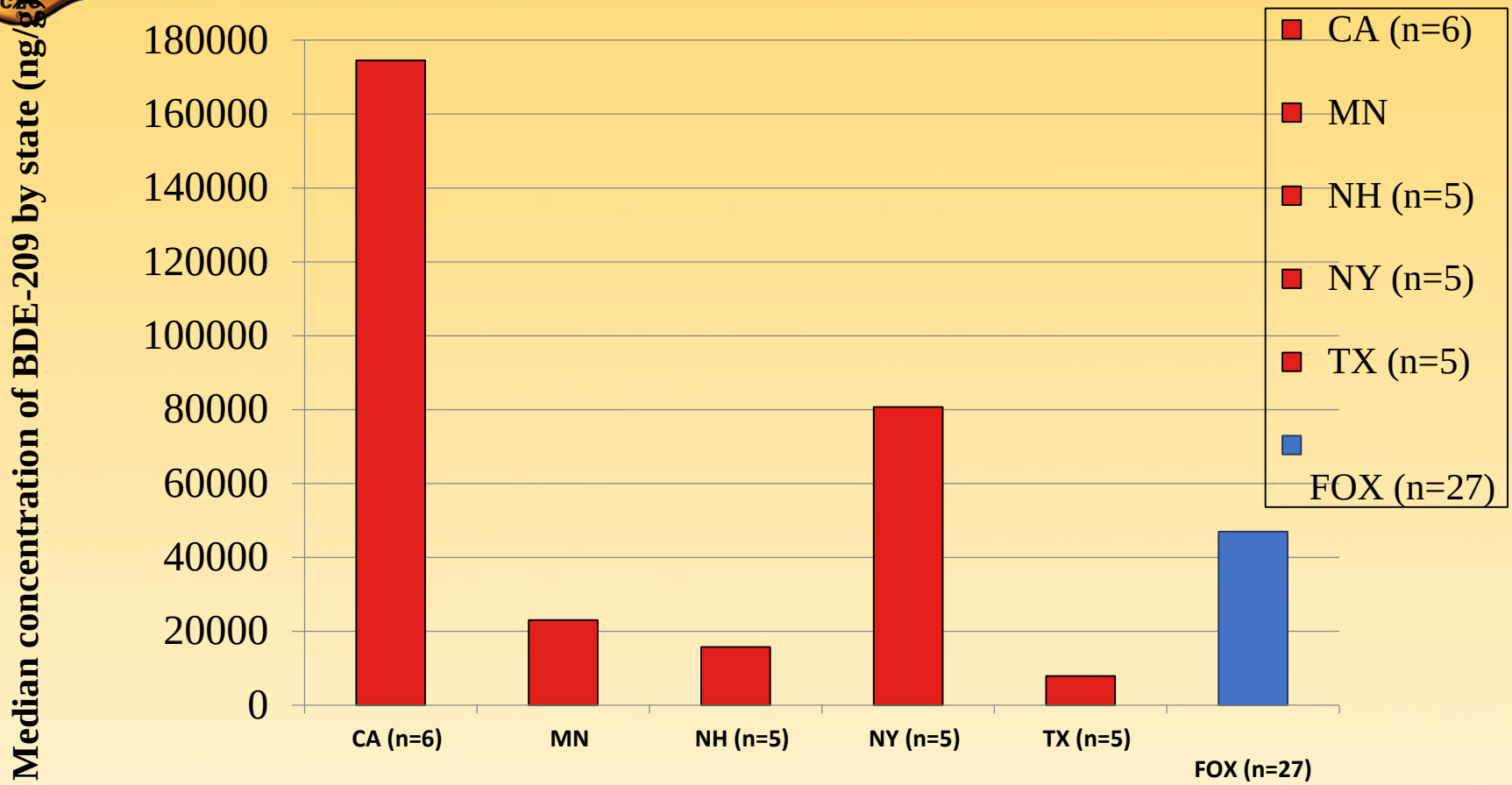
- BDE-47
- BDE-99
- BDE- 209

- **Emerging FRs**

5 OPFRs:

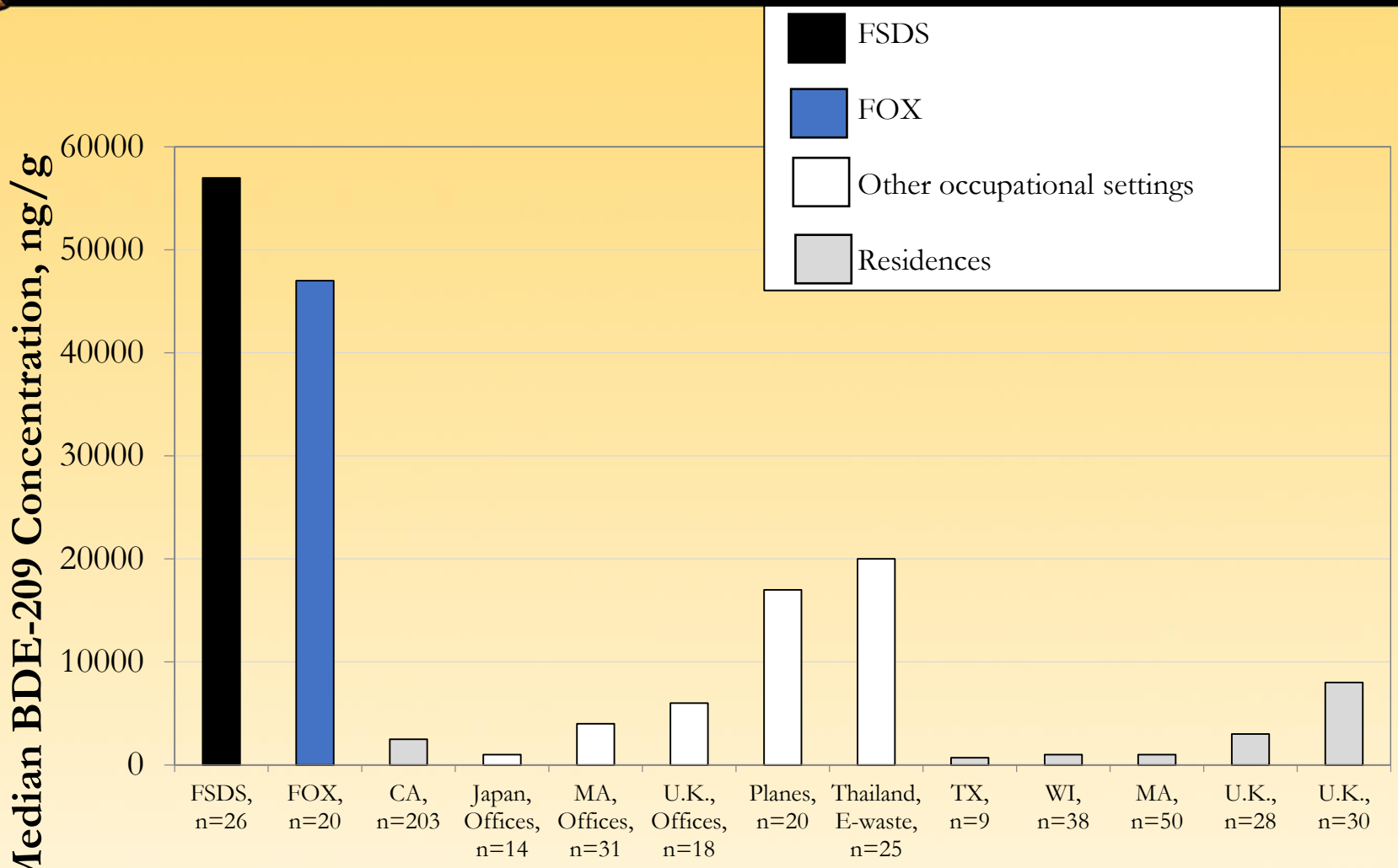
- Tri-n-butyl phosphate (TnBP)
- Tris(2-chloroethyl) phosphate (TCEP) (carcinogen- CA Prop 65)
- Tris(1-chloro-2-propyl) phosphate (TCiPP)
- Tris(1,3-dichloro-2-propyl) phosphate (TDCiPP)(carcinogen – CA Prop 65)
- Triphenyl phosphate (TPHP)

Median Concentration BDE-209

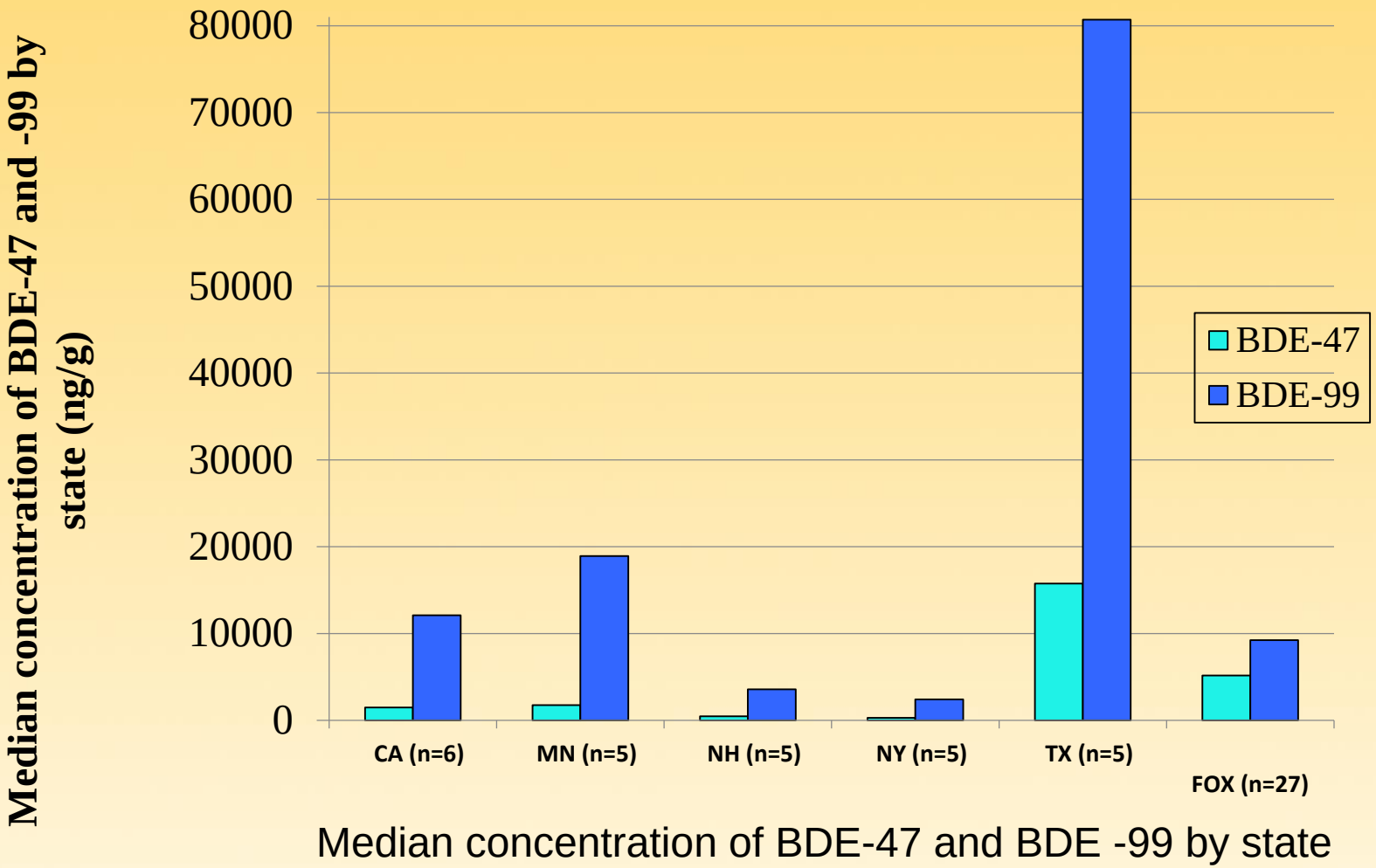


Median concentrations (ng/g) of major congener of commercial Deca-BDE by state and compared to FOX.

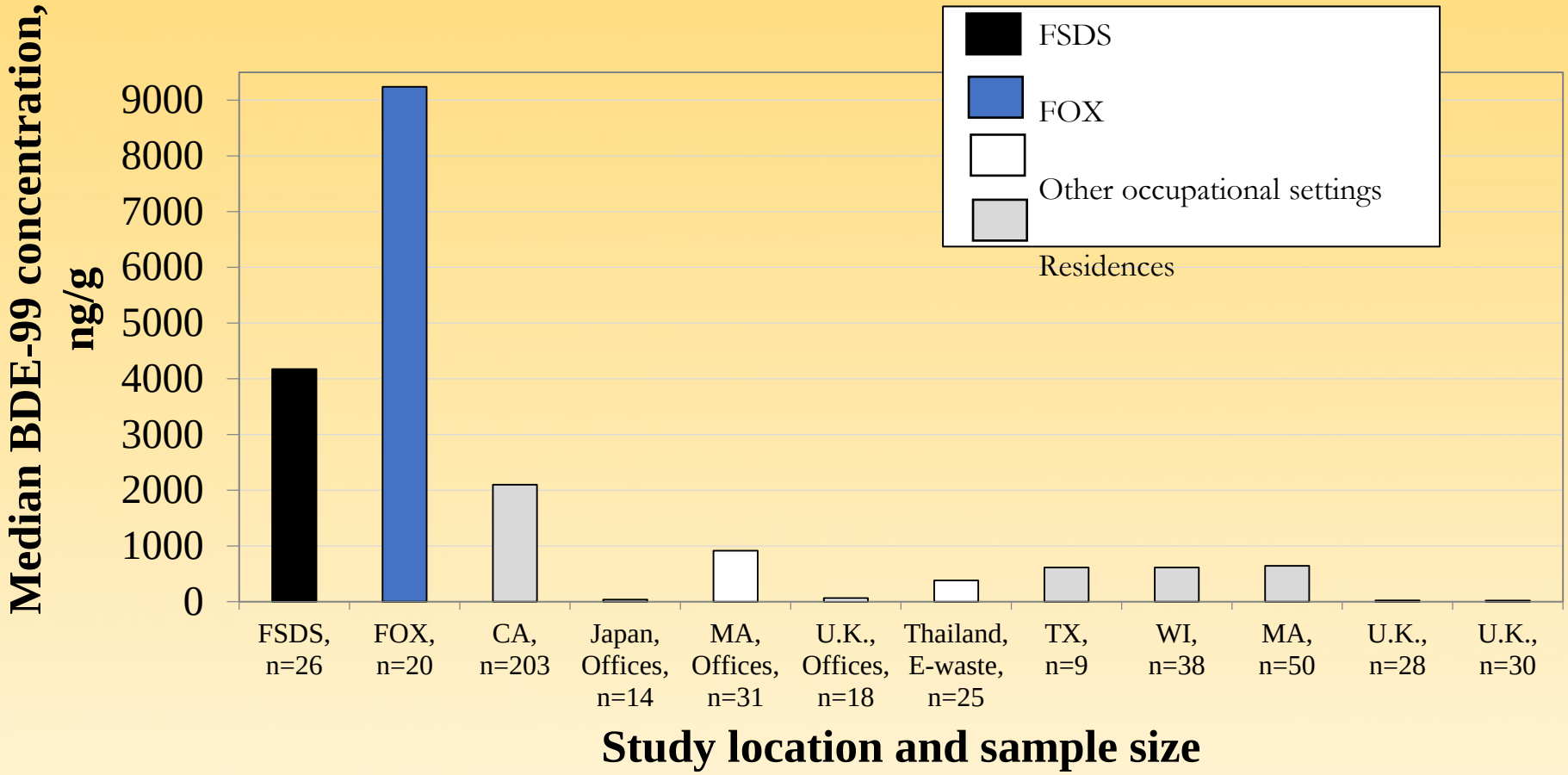
Study Location and Sample Size BDE-209



BDE-47, BDE-99 Median



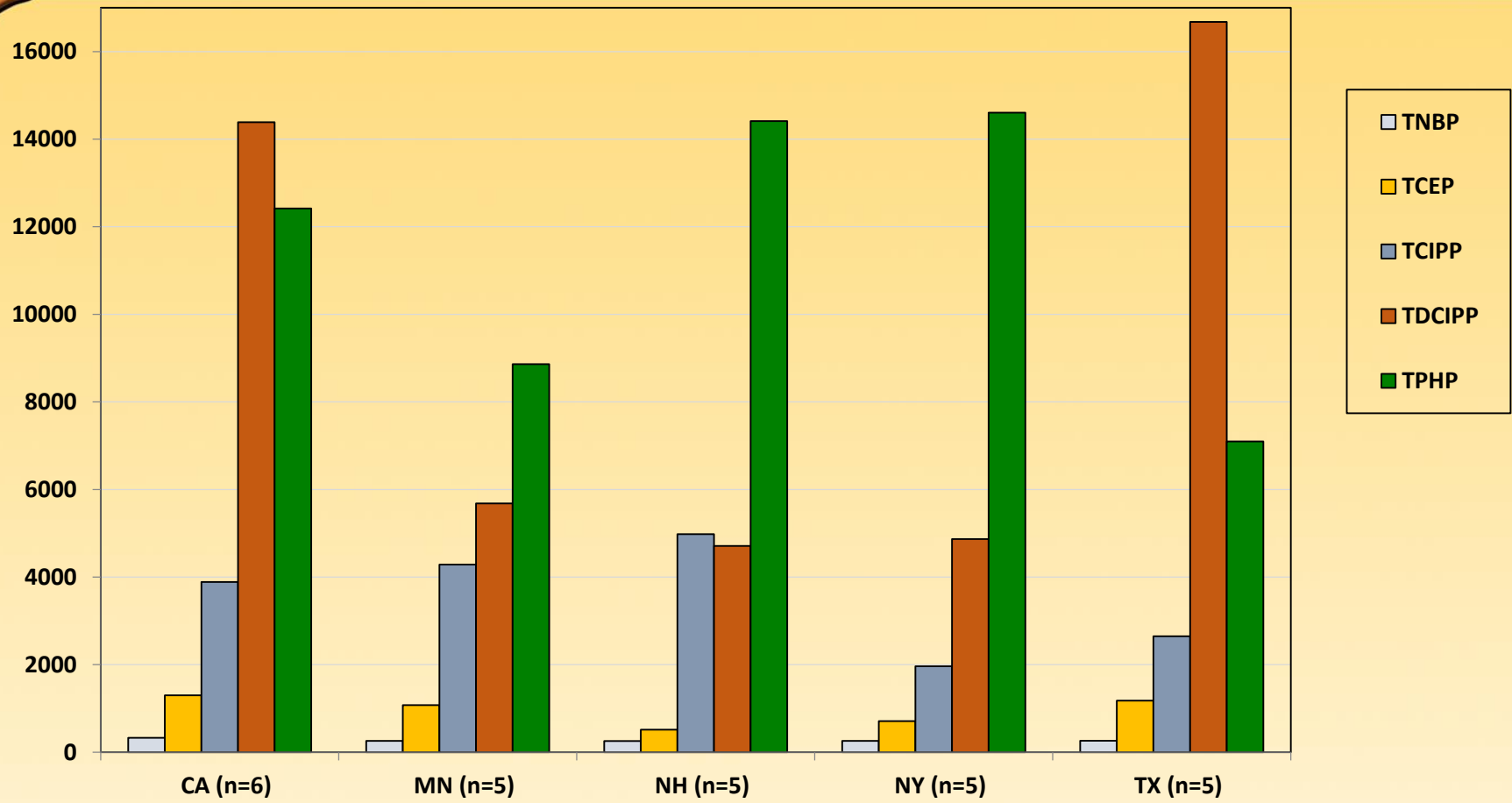
Median BDE-99, Location, Sample Size



Organophosphate Flame Retardants (OPFRs)

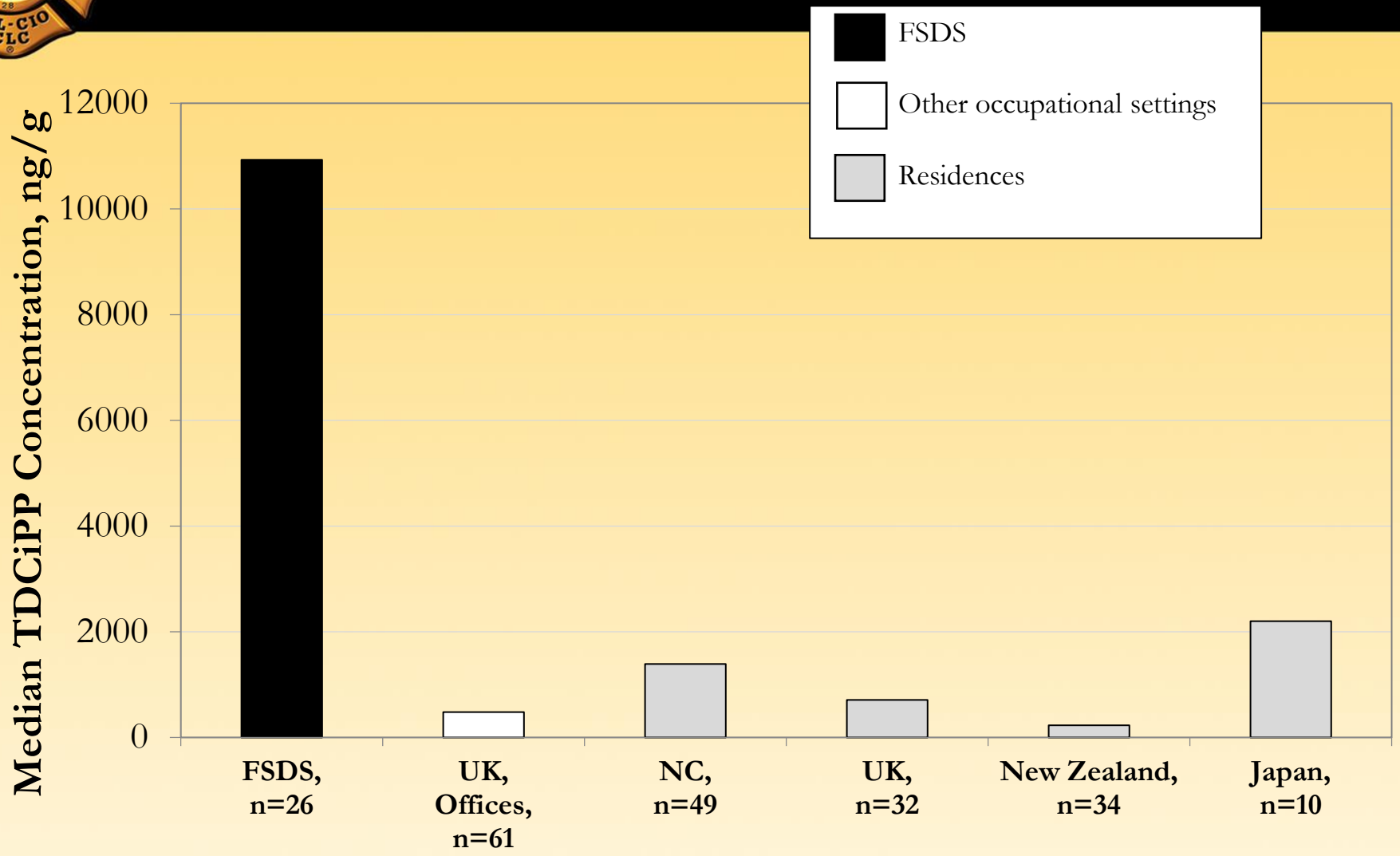
- Tri-N-butyl phosphate TNBP
- Tris(2-chloroethyl) phosphate TCEP
- Tris(1-chloro-2-propyl)phosphate TCIPP
- Tris(1,3-dichloro-2-propyl) phosphate TDCIPP
- Triphenyl phosphate TPHP

Median Concentration – Emerging FRs



Median concentrations (ng/g) of the OPFR compounds by state.

Study Location, Sample Size - TDCIPP



Study Conclusions

PBDE and OPFR levels in fire station dust appear higher than other occupational and residential settings. Further studies need to be performed to determine the reasons behind the high levels of chemicals found in fire station dust.

PBDE levels were slightly higher than OPFR levels with PBDE levels measured across five orders of magnitude (1.22 ng/g – 351,000 ng/g) and OPFR levels measured across three orders of magnitude (177 ng/g – 218,000 ng/g).

When PBDE levels were compared to other occupational and residential settings, the fire stations had higher median levels of BDE-99 and BDE-209. OPFR levels did not significantly vary between states.

When OPFR levels were compared to other occupational and residential settings, the fire stations had higher levels of TDCiPP.

PBDEs Toxicity

Neurological:

- Exposure to PBDEs during critical windows of brain development results in decreased memory and learning that worsens with age and is irreversible. (Viberg, 2003) Higher brominated BDEs – impairs spontaneous behaviour and learning and memory functions of adult mice.

- Reproductive System:
- Penta-BDE exposure at levels similar to those found in humans was associated with decreased sperm counts in rodents. Deca-BDE exposure is associated with abnormal sperm function. ((Kuriyama, et al. 2005; Lilienthal, et al. 2005; Tseng, et al. 2006; Ema, 2008)

- Cancer
- Deca-BDE has been associated with an increase in liver tumors and thyroid tumors in rodent studies. US EPA considers decaBDE a possible human carcinogen (http://cfpub.epa.gov/iris/quickview.cfm?substance_nmbr=0035)

FR	Toxicity	Uses
• TCEP	carcinogen (CA prop. 65)	polyurethane foam, plastics, polyester textiles , resins
• TNBP	carcinogen	plasticizer, anti-foam agent, lacquers
• TCIPP	little data on toxicity structurally similar to TCEP	polyurethane foam
• TDCIPP	carcinogen (CA Prop. 65)	polyurethane foam, plastics, textiles
• TPHP	neurotoxicity	plasticizer, FF foam, Firemaster 550, linked to prostate cancer, infertility

Possible Exposure Pathways

- On fire ground
- In fire truck/engine
- At fire station
  - Tracking dust in from fire ground
  - Turnout gear storage
  - Live/work environment

“PPE Contamination”

A firefighter training video by the
San Francisco United Fire Service Women

Producer/Director – Sharyle Patton

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Firefighters' Chemical Exposures

May 19, 2016

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The findings and conclusions in this presentation are those of the author(s) and do not necessarily represent the views of the National Institute for Occupational Safety and Health

Complex Exposure Pathways

- **Source**: where the chemicals originate
- **Composition**: makeup and physical state of the chemicals
- **Transport / contact**: how the chemicals come into contact with the firefighter
- **Intensity**: exposure concentration
- **Duration**: length of the exposure time
- **Absorption route**: how the chemicals enter the firefighter's body (inhalation, dermal absorption, or ingestion)
- **Dose**: amount of chemical deposited in the firefighter's body

Potential Sources of Exposure

Residential fire (photo by IAFF.org)

Dumpster fire (public domain)

Vegetation fire (photo by Physics.org)

Industrial fire (photo by Eastern Daily Express)

Car fire (photo by NIOSH)

Training fire (photo by NIOSH)

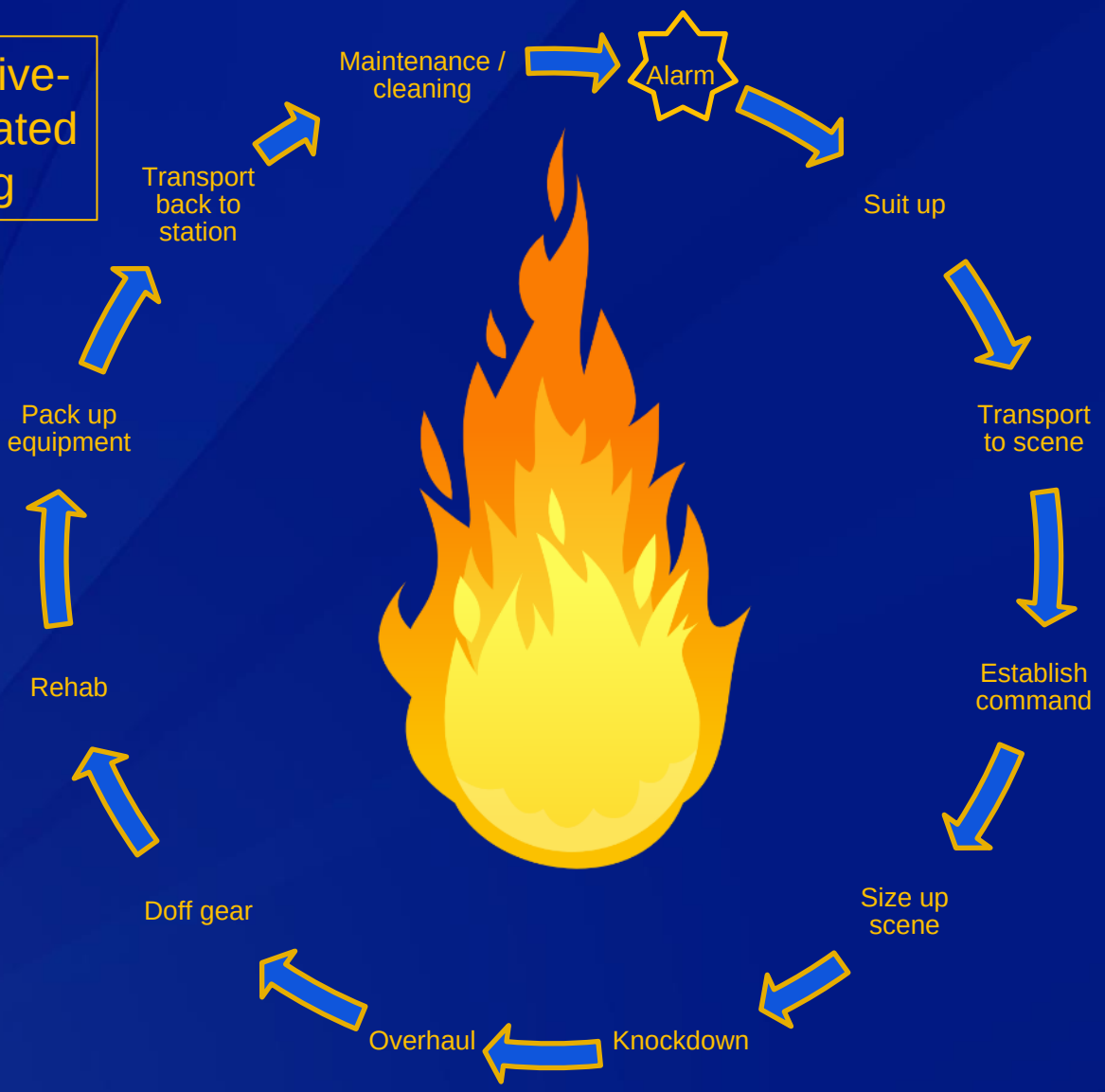
Composition of Smoke

- **Respiratory irritants (acrolein, acids, sulfur dioxide)**
- **Respiratory sensitizers (isocyanates, aldehydes)**
- **Chemical asphyxiants (CO, HCN)**
- **Cardiotoxicants (fine particulate, chemical asphyxiants)**
- **Carcinogens:**
  - Single-ring aromatic hydrocarbons (benzene)
  - Polycyclic aromatic hydrocarbons (benzo[a]pyrene)
  - Aldehydes (formaldehyde)
  - Halogenated compounds (vinyl chloride, PCBs, dioxins)
  - Diesel exhaust

CO = carbon monoxide, HCN = hydrogen cyanide, PCB = polychlorinated biphenyl

Potential for Chemical Contact

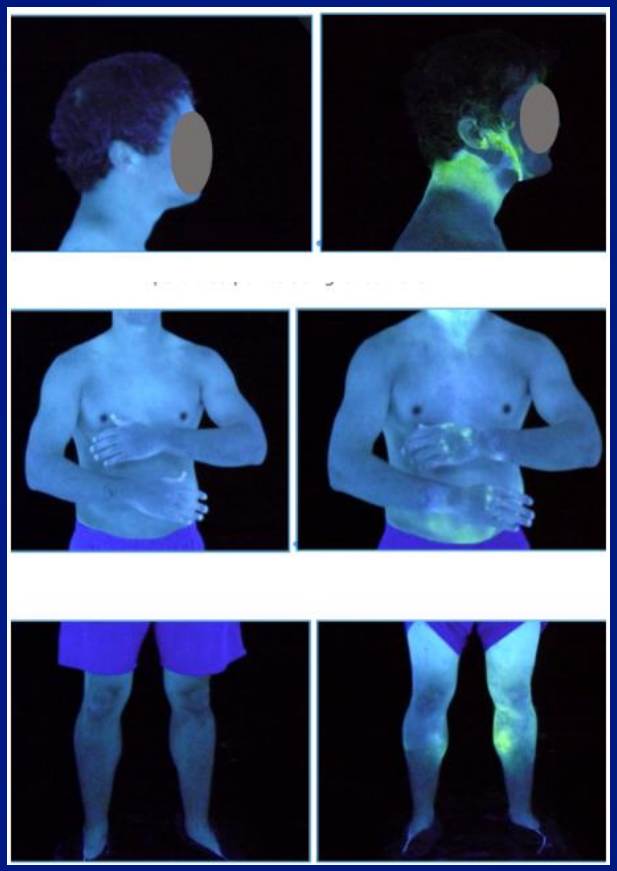
* Also during live-fire and simulated smoke training



Dermal Exposures during Knockdown

- **PAH contamination on wrist, neck, forehead, and back[1]**
- **Neck may be especially vulnerable**
  - Significantly higher PAH levels on neck after firefighting[2]

Before After



Jeff Stull, RTI study commissioned by IAFF

1. Presentation by Dr. McCarry, McMaster University (2013)
2. NIOSH Report 2010-0156 (2013)

PAH = polycyclic aromatic hydrocarbon

Dermal Exposures during Knockdown (cont'd)

- **Particles/soot that contact the skin can be absorbed[1]**
- **Some vapors (e.g., benzene) can also be absorbed[2]**
- **Chemicals absorb faster through thinner skin (e.g., neck)**
- **Dermal absorption may increase with increasing:**
  - Concentration, ambient temperatures, skin temperatures, humidity, and sweat[3]

Hydrocortisone relative absorption[4]

Plantar foot arch	1
Lateral ankle	3
Palm	6
Ventral forearm	7
Back	12
Scalp	25
Forehead	43
Jaw angle	93
Scrotum	**300**

1. VanRooij et al. (1993)
2. Bader et al. (2008), Piotrowski (1967, 1971), Weschler and Nazaroff (2012)
3. Franz (1984), Jones et al. (2003)
4. Feldmann & Maibach (1967)

Exposures during Overhaul

- **Inhalation exposure possible if respiratory protection is not worn**
  - Compounds > short-term exposure or ceiling limits: Acrolein, CO, formaldehyde, glutaraldehyde, benzene, NO_2, SO_2, PAHs[1,2]
- **Levels of exposure will depend on:**
  - Time-lapse from suppression to the next activity
  - Amount of natural or mechanical ventilation
  - If materials are still smoldering
  - If there are any dead-air spaces
- **Dermal exposure possible if protective clothing is not worn**

1. Bolstad-Johnson et al. (2000)
2. NIOSH Report 2010-0156 (2013)

CO = carbon monoxide, NO_2 = nitrogen dioxide, SO_2 = sulfur dioxide, PAH = polycyclic aromatic hydrocarbons

Fireground Exposures

- Sizing up the fire without SCBA
- Exterior operations without SCBA
- Diesel exhaust exposure – Group 1 human carcinogen[1]

* Currently lacking reliable data on fireground exposure levels

1. IARC (2012)

Contaminated Gear & Equipment

- **PAHs, phthalates, metals, and flame retardants on turnout gear[1,2]**
- **Hose and other equipment contaminated**
- **Hands especially vulnerable and any body parts touched by the hands**
- **Contaminated dust in fire stations[3]**

Photo Courtesy of Anderson Career and Technology Center

* These exposure pathways have not been well characterize.

* Baby wipes should help to remove skin contamination and lessen absorption, but we do not have quantitative data to support this.

1. UL Firefighter Exposure to Smoke Particulates (2010)
2. Huston et al. (2014)
3. Shen et al. (2015)

Off-Gassing Gear

- **Volatile compounds will off-gas from gear and can be inhaled**
  - Benzene, toluene, ethylbenzene, xylenes, styrene, and HCN have been measured at elevated levels (compared to background)
  - Well below short-term exposure limits, but yet another source of exposure[1,2]

* Semi-volatile compounds can off-gas for weeks, months, or even years, but this exposure pathway has not been well characterized.

1. Fent et al. (2015)
2. Kirk et al. (2015)

HCN = hydrogen cyanide

Training and Other Fires

- **Simulated smoke: High levels (above short-term exposure limits) of mineral oil mist and/or glycols[1]**
- **Simulated smoke and propane burners: High levels of formaldehyde and acrolein[1]**
- **Vehicle fires: High levels of formaldehyde, acrolein, carbon monoxide, and isocyanates[2]**

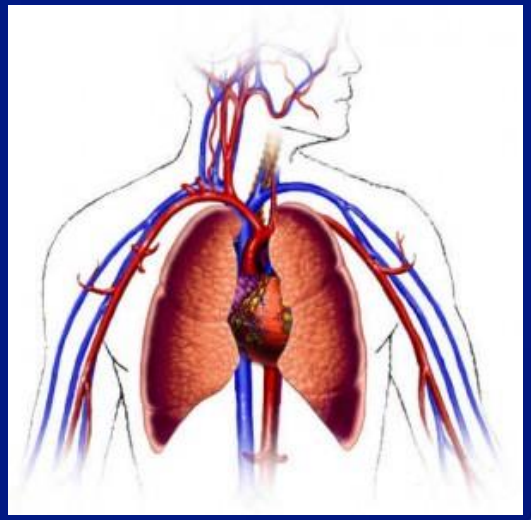
* Even Class A fuels (pallet and straw) may produce high levels of PAHs, aldehydes, HCN, and CO[3,4]

Simulated smoke training

1. NIOSH Report 2012-0028 (2013)
2. NIOSH Report 2008-0241 (2010)
3. UL Firefighter Exposure to Smoke Particulates (2010)
4. Kirk and Logan (2015)
5. Feunekes et al. (1997)

Exposure Duration

- **Initial exposure period is typically short**
- **High intensity, short duration exposures may be more hazardous**
  - Respiratory irritants, sensitizers, and asphyxiants – can overwhelm the respiratory system
  - Carcinogens – may present greater risk of cancer[1]
  - Particles – can precipitate cardiovascular events[2]
- **Can extend beyond the fireground (contaminated gear and equipment)**



1. Kodell et al. (1987), Chen et al. (1988), Murdoch et al. (1992), Halmes et al. (2000)
2. Brook et al. (2004)

Biological Absorption

- Several studies have found elevated levels of contaminants in the body after firefighting (despite use of turnout gear and SCBA)[1,2]
- We found that urinary PAHs and exhaled breath levels of benzene increased with increasing air concentrations of PAHs (in firefighters who wore SCBA throughout the response)[3]
- Dermal absorption was hypothesized as the primary route of entry[3]
- Systemic exposure levels generally similar to occupational groups with low exposures.
- Flame retardants and dioxins

1. Caux et al. (2002)
2. Laitinen et al. (2009)
3. NIOSH Report 2010-0156 (2013), Fent et al. (2014)

Knowledge Gaps

- **Production of flame retardants and dioxins during residential fires**
  - Deposition of these compounds onto turnout gear
  - Biological uptake of these compounds in responding firefighters
- **Fire-ground exposure levels**
- **Effect of attack methods and position on exposure**
- **Effectiveness of decontaminating turnout gear and its relationship with systemic exposure**
- **Effectiveness of skin cleaning and its relationship with systemic exposure**
- **Systemic exposure from routine training fires**

Cardiovascular & Carcinogenic Risks Study: Overview and Preliminary Findings

- Bulk sampling of fuel package for flame retardants
- Air sampling from within the structure for flame retardants, HCN, and VOCs
- Air sampling for VOCs and particulate in the fireground
- Testing surfaces of turnout gear for flame retardants and PAHs (before and after decon)
- Sampling HCN and VOCs off-gassing from used turnout gear

* Conducted a variety of other testing (e.g., biological monitoring), but results are still pending and will not be discussed here

VOC = volatile organic compound

Concentrations of flame retardants (µg/g)* in bulk samples of the burn room furnishings

Compound measured	Carpet padding (n = 3)	Curtain liner (n = 1)	Foam from inner spring mattress (n = 2)	Foam topper for bed (n = 2)	Head-board padding (n = 1)	Chair cushion (n = 2)	Liner for chair cushion (n = 1)	Flat screen TV plastic (n = 1)
Polybrominated diphenyl ethers								
BDE 47	< 0.1 - 0.41	0.19	< 0.1	< 0.1 - 0.74	5,600	< 0.1 - 4.1	< 0.1	< 0.1
BDE 85	< 0.1	< 0.1	< 0.1	< 0.1	840	< 0.1 - 1.6	< 0.1	< 0.1
BDE 99	0.11 - 0.56	0.25	< 0.1 - 0.44	< 0.1 - 2.9	15,000	< 0.1 - 25	< 0.1	< 0.1
BDE 100	< 0.1	< 0.1	< 0.1	< 0.1 - 0.6	2,500	< 0.1 - 3.8	< 0.1	< 0.1
BDE 153	< 0.1 - 5.6	< 0.1	< 0.1	< 0.1 - 2.0	2,000	< 0.1 - 13	< 0.1	< 0.1
BDE 154	< 0.1	< 0.1	< 0.1	< 0.1 - 0.69	1,400	< 0.1 - 5.0	< 0.1	< 0.1
BDE 183	< 0.1 - 1.1	< 0.1	< 0.1	< 0.1 - 2.0	67	< 0.1	< 0.1	< 0.1
BDE 206	< 0.1 - 14	2.8	< 0.1 - 6.3	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
BDE 209	0.41 - 102	440	< 0.1 - 61	< 0.1	< 0.1	< 0.1 - 0.68	< 0.1	< 0.1
Other brominated flame retardants								
TBBPA	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TBB	0.38 - 3.2	910	< 0.1 - 0.5	< 0.1 - 7.5	< 0.1	18,500 - 26,750	68.5	< 0.1
TBPH	0.22 - 5.7	340	< 0.1 - 1.2	< 0.1 - 3.7	< 0.1	5,800 - 6,380	19.6	< 0.1
DBDPE	< 0.1 - 0.53	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Organophosphate flame retardants								
TCEP	< 0.1	1.4	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TCPP	59 - 630	5.4	< 0.1	< 0.1	8.4	< 0.1 - 1.3	< 0.1	< 0.1
TDCPP	240 - 9,100	1.2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPP	0.43 - 3.8	4.0	0.16 - 0.23	< 0.1 - 1.3	1,690	1,400 - 7,380	22.6	19
TCP	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

* Flame retardants analyzed but not listed (BDE-28, BDE-66, BTBPE, and HBCD) were not detected (< 0.1 ug/g)

TBBPA = tetrabromobisphenol-A, TBB = 2-ethylhexyl 2,3,4,5-tetrabromobensoate, TBPH = 2-ethylhexyl 2,3,4,5-tetrabromophthalate, DBDPE = decabromodiphenyl ethane, TCEP = tris (2-chloroethyl) phosphate, TCPP = tris (1-chloro-2-propyl) phosphate, TDCPP = tris (1,3-dichloro-2-propyl) phosphate, TPP = triphenyl phosphate, TCP = tricresyl phosphate

Flame retardant air concentrations (µg/m^3) measured from living room during active fire and from initial burn room (bedroom) during overhaul on 6/25/15.

Compound measured	Fire period	Overhaul period
BDE 47	9.6	< 0.04
BDE 85	< 0.17	< 0.04
BDE 99	7.4	< 0.04
BDE 100	< 0.17	< 0.04
BDE 153	< 0.17	< 0.04
BDE 154	8.7	< 0.04
BDE 183	< 0.17	< 0.04
BDE 206	< 0.17	< 0.04
BDE 209	14	< 0.04
TBBPA	12	< 0.04
TBB	9.2	< 0.04
TBPH	1.2	< 0.04
DBDPE	< 0.17	< 0.04
TCEP	< 0.25	< 0.06
TCPP	< 0.25	< 0.06
TDCPP	< 0.25	< 0.06
TPP	2000	14
TCP	220	1.9

Photo by NIST

HCN and VOC air concentrations (ppm) measured from within living room during active fire and from within initial burn room (bedroom) during overhaul on 6/25/15

Compound measured	Fire period		Overhaul period
HCN	340	IDLH	1.2
Benzene	15	> STEL	0.17
Toluene	0.069		0.0038
Ethyl benzene	< 0.0004		0.0014
Xylenes	< 0.0008		0.0038

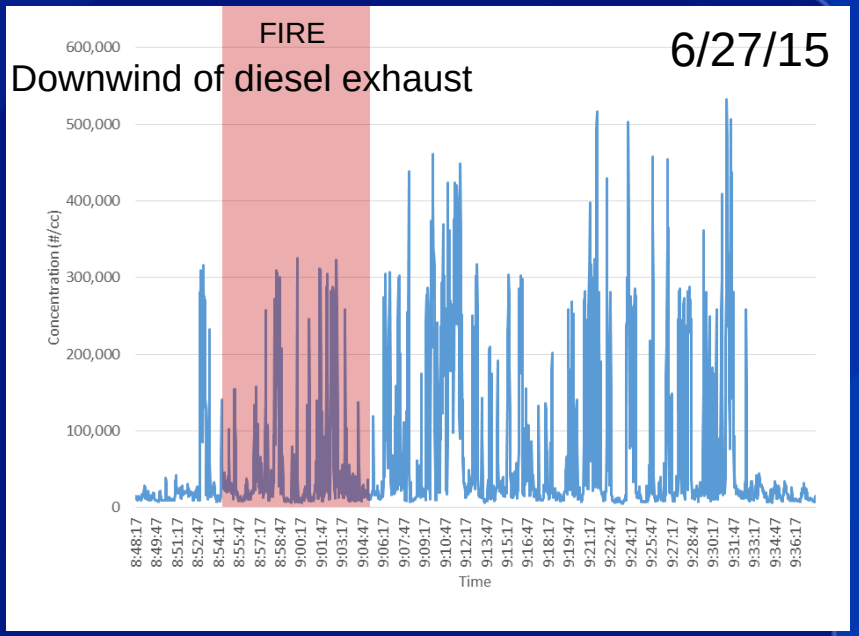
Above 8-hr NIOSH REL (0.1 ppm)
Below NIOSH STEL (1 ppm)

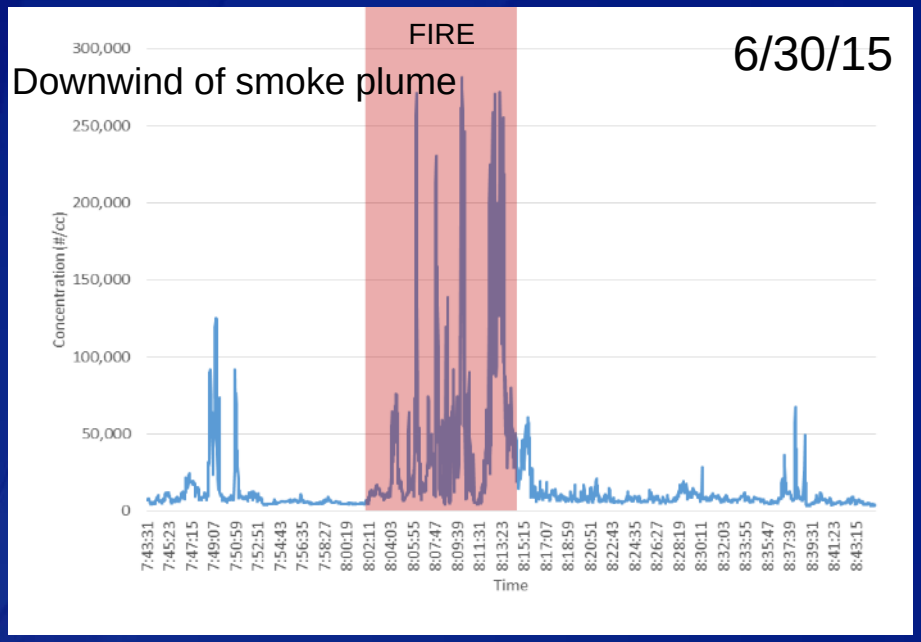
REL = recommended exposure limit, STEL = short-term exposure limit,
IDLH = immediately dangerous to life and health

Air concentrations of VOCs (ppm) measured in the fireground (south of Engine 1) on 6/27/15 and 6/30/15.

Compound measured	6/27/2015	6/30/2015
Benzene	0.029	0.060
Toluene	0.0034	0.0061
Ethyl benzene	< 0.0004	0.0012
Xylenes	< 0.0008	0.0032

Below applicable short-term exposure limits

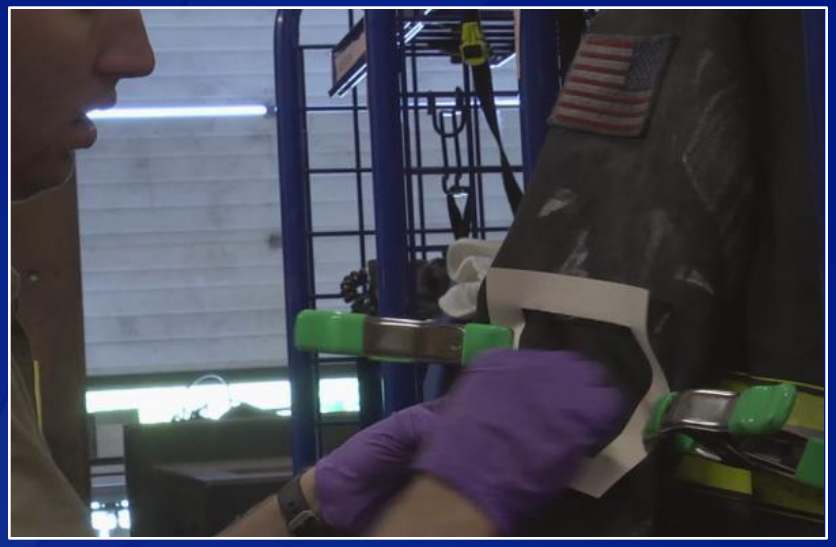




Surface contamination levels (ng/100 cm^2) of total PAHs measured from one set of gear before and after decon (6/22/15)

Pre-fire	Post-fire	Post-decon
< 300*	3,800†	< 300*

* Based on limit of detection for fluoranthene.
† Sum of 15 PAHs; PAH measurements below their limit of detection were assigned zero values.



Water, detergent, and scrubbing

Surface contamination levels (ng/100 cm^2) of flame retardants measured from one set of gear after use in four fires (6/30/15)

Compound Measured	Post-fire (jacket)*	Post fire (right glove)
BDE 47	48	35
BDE 85	< 1	< 1
BDE 99	< 1	40
BDE 100	< 1	12
BDE 153	< 1	< 1
BDE 154	< 1	< 1
BDE 183	< 1	< 1
BDE 206	< 1	< 1
BDE 209	1,200	1,200
TBBPA	< 1	30
TBB	22	30
TBPH	11	14
DBDPE	140	290
TCEP	5.5	< 1.5
TCPP	< 1.5	200
TDCPP	190	460
TPP	2	3,100
TCP	< 0.2	360

* Quality control samples were 60–80% less than expected, so measurements may be underestimated.

Air concentrations of VOCs (ppb) measured off-gassing from gear pre-fire, post-fire, and post-decon during the first scenario (6/22/15) for one crew

Compound Measured	Deconned gear			Gear without decon		
	Pre-fire	Post-fire*	Post-decon (45 min)	Pre-fire	Post-fire*	45 min
Benzene	< 0.6	75	< 0.6	< 0.6	66	0.84
Toluene	< 0.5	19	< 0.5	< 0.5	16	< 0.5
Ethyl benzene	< 0.4	3.3	< 0.4	< 0.4	2.8	< 0.4
Xylenes	< 0.4	2.2	< 0.4	< 0.4	2.1	< 0.4
Styrene†	< 0.4	120	0.42	< 0.4	98	0.95

* Quality control samples were 50% less than expected, so measurements may be underestimated.
† Results based on calibration curve for toluene.

Well below applicable short-term exposure limits

Air concentrations of HCN (ppb) measured off-gassing from gear pre-fire, post-fire, and post-decon during first and last scenarios for one crew.

Scenario	Deconned gear			Gear without decon		
	Pre-fire	Post-fire	Post-decon (45 min)	Pre-fire	Post-fire	45 min
First (6/22/15)	< 20	140	71	42	130	49
Last (6/30/15)	< 20	120	< 20	< 20	120	< 20

Same approximate volume as apparatus cabin

Next Steps

- **Dermal sampling results**
  - Did firefighters get PAHs on their skin?
  - Did the levels vary by position, tactic, and use of deconned PPE?
  - How effective were baby wipes at removing this contamination?
- **Biological monitoring results**
  - Did firefighters absorb PAH, VOCs, flame retardants, and dioxins and furans into their bodies?
  - Did the levels vary by position, tactic, use of deconned PPE, and skin cleaning?

Once we have all the data, we can run statistical tests to determine the significance of our findings. STAY TUNED!

Acknowledgments

Extra Slides

How to Protect Yourself

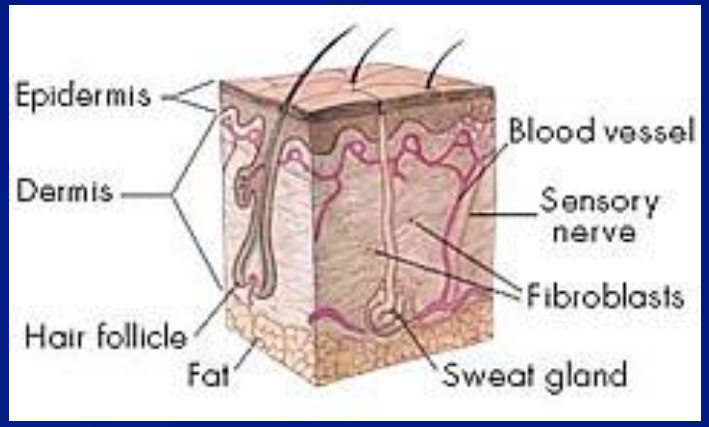
- **To minimize inhalation of contaminants during fire response**
  - Wear SCBA during knockdown, overhaul, and other activities where exposure to combustion products is possible
  - Remain upwind of fires if not directly involved in attack
    - If this cannot be done, wear SCBA
  - Remain upwind of apparatus diesel exhaust

How to Protect Yourself (cont'd)

- **To minimize inhalation of contaminants off-gassing from gear**
  - Doff gear before entering rehab area
  - Do not store or wear gear inside apparatus during ride back to station
  - Do not store gear in personal vehicles or living areas

How to Protect Yourself (cont'd)

- **To minimize skin absorption of contaminants**
  - Decon and/or launder turnout gear, fire hoods, and other equipment
  - Do not take gear/equipment home
  - Wash hand and neck skin immediately and shower ASAP after a fire response



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HEALTH AND SAFETY SYMPOSIUM

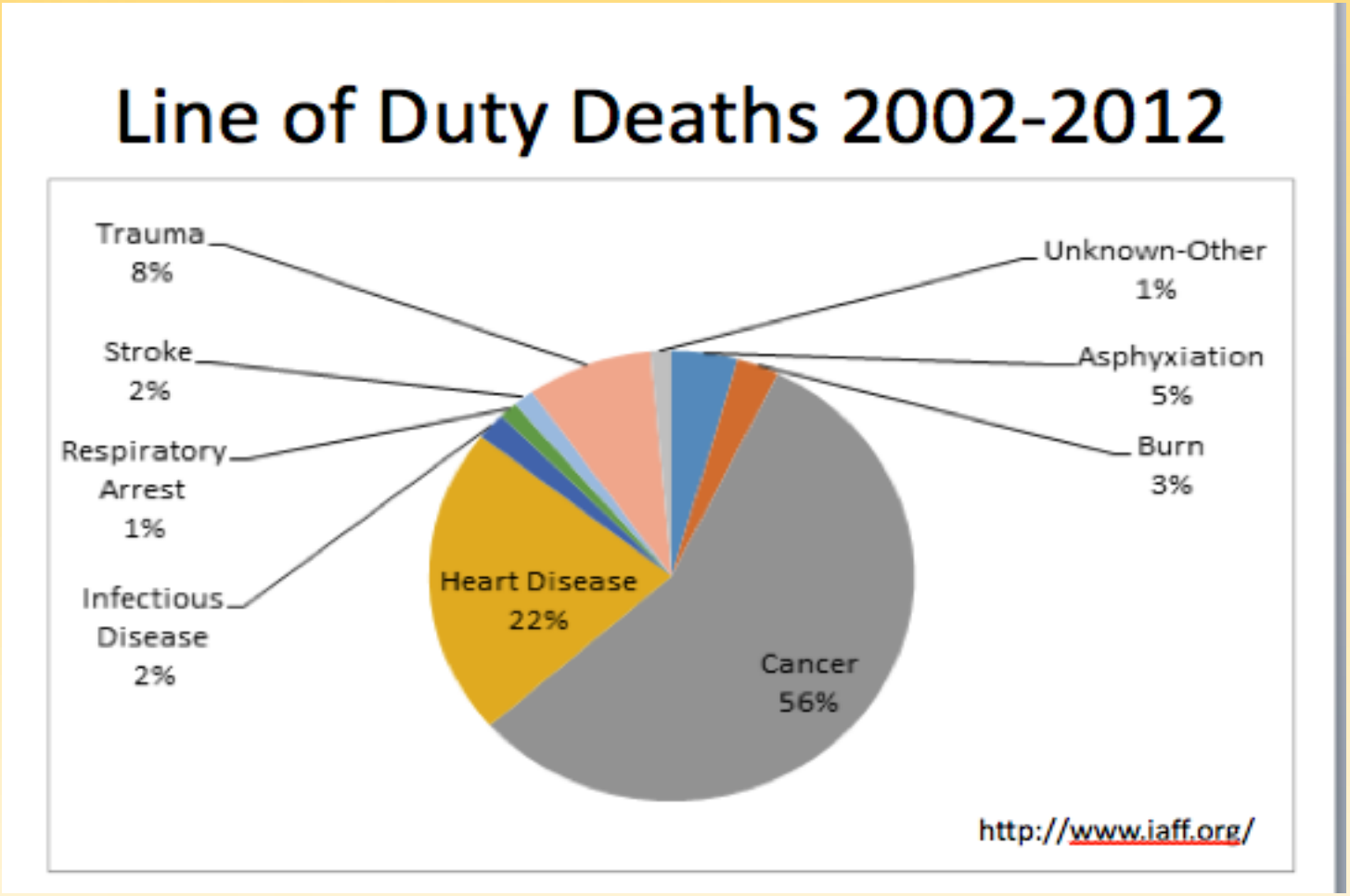
FR's—Legislation, Technical Committee's and Industry Future

John Martell
President
Professional Fire Fighters of Maine

May 16, 2016


"The connection between fire fighting and cancer is real, and there is scientific data to support our position. But we cannot stop here – we must continue to learn more so we can prevent our members from contacting this horrible disease and help them if they do."
– Harold Schaitberger, Gen. President, IAFF
Marine Environmental Research Institute

Impact on FF Lives



IAFF Involvement in Standards and Codes

- NFPA and ICC Codes and Standards Committees
- Importance of participating in the Process
- IAFF Commitment and Member Involvement

IAFF Involvement with Standards

- NFPA Technical Committee on Fire Tests
- Responsibility and Scope of the Committee
- Make up of the Committee

Direction of NFPA Flame Test Committee

- Currently Two Tests for Upholstered Furniture, NFPA 260 and NFPA 261
- Both Use Cigarettes Smoldering Ignition
- Proposed New Test-NFPA 277
- Primary Task Group Favoring Large Open Flame Test
- Secondary Task Group
- Likely to increase use of Flame Retardants

Safer Solutions to Meet Fire Tests

- Alternative methods using barriers.
- The Role of Sprinklers and Photoelectric Smoke Alarms.
- NFPA Standards Should Consider Consequences on Firefighter Health In Development of Fire Tests.
- Boston's Enforcement of TB 133

Change For California Fire Test Standard

- California Has Now Enacted TB-117-2013.
- Smoldering Fire Ignition Vs Open Flame.
- Consumers have option to purchase non FR treated products.

Summary of the Toxic Substances Control Act

15 U.S.C. §2601 et seq. (1976)

The Toxic Substances Control Act of 1976 provides EPA with authority to require reporting, record-keeping and testing requirements, and restrictions relating to chemical substances and/or mixtures. Certain substances are generally excluded from TSCA, including, among others, food, drugs, cosmetics and pesticides.

TSCA addresses the production, importation, use, and disposal of specific chemicals including polychlorinated biphenyls (PCBs), asbestos, radon and lead-based paint.

Quick Links

- PDF of TSCA, from U.S. Senate (106 pp, 263K, About PDF)
- The official text of TSCA is available in the *United States Code* on FDSys, from the U.S. Government Printing Office

History of TSCA

- Passed in 1976.
- Regulates new and already existing chemical.
- Mandated to protect public from unreasonable risk of injury.
- TSCA specifically regulates polychlorinated biphenyl products (PCBs).
- Since inception roughly 22,000 new chemicals produced.
- Both House and Senate Have Passed Competing Bills.

Change in Position by Industry

- Petition before the Consumer Product Safety Commission (CPSC) to ban non-polymeric organohalonganated FR's.
- Consumer and Industry pressure to change more towards a "green" product line.
- Some furniture manufacturers, large corporations and department stores have moved towards eliminating the use and sale of FR's.

State Legislation

- Individual States, Not Congress, Has Led Fight to Remove Toxic FR's
- Washington, Maine, Vermont Were in Early to Ban PBDE's
- Recent Success in Washington DC And Minnesota
- Number of States Have Legislation Pending

Presumption Laws

- 34 States and 12 Provinces Have Rebuttable Presumption Laws For Cancer, Heart, Lung and Infectious Disease.
- Varied Success in Protecting and Compensating FF's Who Become Injured
- Usually Related To A State's Worker's Compensation Laws.
- Federal Fire Fighters Have No Presumptions

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Firefighter Cancer Support Network

Bryan Frieders
President

May 19, 2016

Making a Difference…

Impact of Cancer in the Fire Service

- Awareness
  - No longer a mystery
  - Action is being taken at all levels
  - Proven nexus between cancer and firefighting

- Train-the-Trainer Program
  - Boston FD, Indianapolis FD, San Diego FR, Cal Fire
    - Program aimed specifically at cancer prevention
    - Includes sample SOP/SOG's, station evaluations, best practices

Leadership

Labor/ Management relationship is the key to success

- Review practices and standards
  - Overhaul teams
  - Rehabilitation standards
  - Use of the SCBA
  - Care and maintenance of PPE
  - Station design and retrofit
  - Post fire operations (investigators)

Research

Ongoing research

- Research projects addressing the following:
  - Female firefighters, and female specific cancer (San Francisco)
  - Non-White firefighters (IAPBFF Prostate Study)
  - Wildland firefighters
  - Ordinary exposures (EMS/ Apparatus operators)
  - Gear storage/ station ventilation
  - Biomarker analysis (University of Arizona)
  - Gear cleaning and maintenance
  - Medical screening exams

Moving Forward…

Together, we are making a difference

- FCSN Second White Paper (August 2016)
- IAFF Education and Awareness Video
- Redesign PPE
- Remove chemicals from furniture and products of combustion
- Gross decontamination at the scene
- Change the culture