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HIAWATHA FIRE-RESCUE

MEMORANDUM

TO: HONORABLE MAYOR, HIAWATHA CITY COUNCIL

FROM: MIKE NESSLAGE, FIRE CHIEF

SUBJECT: PURCHASE OF HOODS AND GLOVES

DATE: 10/14/2016

There is considerable attention being given to the effects of firefighting on the human body. Anecdotally, the number of retired firefighters who perish from the effects of cancer appear to be higher than that of the normal population. Personally, I can name firefighters 10-15 years older than me that died from cancer in their 50's or early 60's. This has led to specific research on firefighter's exposure to carcinogens while wearing personal protective equipment. In particular, the study *"Systemic Exposure to PAHs and Benzene in Firefighters Suppressing Controlled Structure Fires"* by Fent, Kenneth W., ETAL (Fact Sheet Attached) discusses that exposure. Of significance in that study was that, even when wearing personal protective equipment, measurable amounts of PAHs and Benzene were found in firefighters. One key point was that **area of higher concern was the neck**. Because firefighting hoods currently in use are single layer, and the skin on the neck is thinner, this presents a significant route of exposure. **The hoods we are using provide less protection than the rest of the protective ensemble**. We currently provide each firefighter only a single hood and pair of gloves. This means that they are faced with wearing a dirty hood and gloves, or having a period of time where there hood and gloves are being washed and is out of service.

When we became aware of this study, we started taking steps to reduce that exposure. We provide decontamination kits on the fire engines, conduct gross decon at the scene of a fire, and require the washing of gear after a fire exposure. We are requesting this purchase to further reduce the risk of exposure. The hoods we are requesting are TWO layers thick, and have an imbedded carbon filter, that will reduce both thermal and chemical exposure. Additionally, we are requesting to update our glove inventory at the same time. Our goal is to provide each firefighter with two pair of gloves, and two hoods, which will insure that they will always have a back up set available while washing a set.

Concerned about this study, I placed in my CIP request funding to purchas two hoods and two pair of gloves for each firefighter. During the CIP discussion with Mrs. Downs, she said that she was aware of this issue as a hot button issue through her Administrator circles. Ms. Kudrna and her discussed that funding was available and Downs said to move forward with this purchase immediately, as it is a safety concern. We obtained quotes and moved forward.

On the agenda tonight is item authorizing the purchase of personal protective equipment for firefighters. Specifically, the purchase of 100 pair of gloves, and 100 protective hoods. We have acquired quotes from six vendors (See matrix below). The lowest quote is from Municipal Emergency Services of Fremont, Nebraska. The estimated total is $14, 430. I have spoken with Mrs. Downs and Ms. Kudrna and they have money in the LOSST funds to cover this important purchase. I request the purchase of 100 gloves and 100 hoods from MES. I will have examples of the old hoods, and available for your review Wednesday.

If you have any questions regarding this, please contact me.

The matrix is attached.

Here are the bids. As you can see, MES had the lowest price individually and as a total.

Vendor	Gloves per item	Hood per item	Total
MES	$56.80	$87.50	$14,430
Feld Equip	No quote	$88.86	
Paul Conway	No quote	$89.27	
Illinois Fire Store	$59.95	$99.95	$15,990
Danko	$57.00	No quote	
Heiman Fire	$65.95		

FACT SHEET

SYSTEMIC EXPOSURE TO PAHS AND BENZENE IN FIREFIGHTERS SUPPRESSING CONTROLLED STRUCTURE FIRES

Authors:
Kenneth W. Fent
Judith Eisenberg
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Deborah Sammons
Joachim D. Pleil
Matthew A. Stiegel
Charles Mueller
Gavin P. Horn
James Dalton

Organization:
The Annals of Occupational Hygiene

Original Article:
www.ncbi.nlm.nih.gov/pmc articles/PMC4124999/#CIT0005

SUMMARY

Turnout gear provides protection against dermal exposure to contaminants during firefighting; however, the level of protection is unknown. This study explored the dermal contribution to the systemic dose of polycyclic aromatic hydrocarbons (PAHs) and other aromatic hydrocarbons in firefighters during suppression and overhaul of controlled structure burns.

Polycyclic aromatic hydrocarbons (PAHs) are components of incomplete combustion that can exist in both particle and gas phase. "Of the 18 PAHs that are commonly produced during fires, the International Agency for Research on Cancer (IARC) classified benzo[a] pyrene as carcinogenic to humans (Group 1) and eight others as probably or possibly carcinogenic to humans (Group 2A or 2B) (IARC 2002 , 2010). In addition to PAHs, nearly all fires will produce other potentially carcinogenic aromatic hydrocarbons such as a benzene (IARC, 2012)".

The results of this study found:

- Firefighters wearing full NFPA compliant protective ensembles (recently washed or brand new) absorbed combustion products into their bodies.
- Statistically significant positive correlations between personal air concentrations of PAH (external exposures) and :
  - Change in urinary PAH metabolite levels (biomarkers) in Round 1, and
  - Change in breath concentrations of benzene in Round 2.

Combined, these results suggest that firefighters, wearing full protective ensembles, may still absorb combustion products into their bodies. The PAHs most likely entered firefighters' bodies through their skin, with the neck being the primary site of exposure and absorption due to the lower level of skin protection afforded by hoods.

FSTAR
FIREFIGHTER SAFETY THROUGH ADVANCED RESEARCH

Visit www.fstaresearch.org to search for research and information you can use.

FSTAR is managed by the International Association of Fire Chiefs and is funded by a FEMA/AFG/Fire Prevention and Safety grant award.

FINDINGS

Key findings of this study include:

- Significantly elevated ($P < 0.05$) post-exposure breath concentrations of benzene compared with pre-exposure concentrations for both rounds.
- Statistically significant positive correlations between external exposures (personal air concentrations of PAHs) and biomarkers (pre- to post-exposure change in urinary PAH metabolite levels in Round 1 and breath concentrations of benzene in Round 2).
- The dermal exposure data suggest that the neck skin was the most exposed part of the firefighters' bodies.
- Across firefighters, a ranking of the change in PAH levels on the neck from lowest to highest corresponds with the same ranking of the change in urinary PAH metabolite levels.
- Aromatic hydrocarbons can be:
  - absorbed through the skin during firefighting,
  - inhaled due to poor adherence in wearing full protective ensembles too close to exposure site, or
  - inhaled from off-gassing contaminated gear as this can occur for several minutes after a response.

The chart below explains the firefighter exposure times for each of the controlled burns. Each burn simulation looked at the total time of each scenario, including active fire, fire control, and overhaul operations. The period of active fire was intended to simulate a typical interior attack where firefighters would be exposed to products of combustion. For the first set of fires, firefighters took a stationary position (standing or squatting) in the target room. In the second set of fires, firefighters were mobile and rotated working positions during the burns. The simulated activities included searching for victims, pulling down a ceiling, and taking a break at the back of the structure.

Round/fire scenario	Day/ burn	Exposure times by response phase (min)			
		Active fire	Knock down	Over haul	Total
ROUND 1. Timber-framed structure, drywall interior, 33 m^3 burn room, 33m^3 target room, firefighters wre mostly stationary, hoods shorter than in round 2, exercises involving wood smoke also took place at the training facility.	1	10	1	4	15
	2	11	3	16	30
	3	15	7	7	29
ROUND 2. Intermodal metal container, drywall interior, 15 m^3 burn room, 35 m^3 target room, firefighters were mobile and rotated positions (except for nozzle-man and company officer)	1	10	2	8	20
	2	10	3	5	18
	3	10	4	4	18

Source: www.ncbi.nlm.nih.gov/pmc/articles/PMC4124999/#CIT0005

TAKEAWAYS

- PAHs and benzene generated by the fires were absorbed into the firefighters' bodies even when wearing NFPA compliant structural firefighting PPE throughout the scenarios.
- Material of hoods provides less protection than bunker coat and pants. Furthermore, the neck has some of the thinnest skin on the body. Thinner skin absorbs contaminants faster than thick skin.
- Overall, higher external exposures (measured in air or on skin) appeared to be related to higher biological levels (measured in breath or urine) of combustion byproducts.
- Further study on hood design, turnout gear decontamination methods, and firefighters' absorption of combustion products through the skin during fire responses is warranted.
- This study used clean gear. If the gear had been unclean, it is likely that there would be higher dermal exposure levels to the hands and arms.
- To lessen exposure:
  - Wear SCBA throughout external suppression and overhaul.
  - Doff SCBA last after firefighting.
  - Keep contaminated/off gassing gear segregated from firefighters during rehab.
  - Air out gear before return trip to station and do not transport contaminated gear in apparatus or POV passenger compartment during return to station.
  - Air out structures before overhaul or investigation, and wear SCBA while exposures are likely.

FIRE STATION TALK

Firefighters need to understand the benefits of receiving annual physicals. Annual fire service specific medicals can provide a baseline for comparison in the event that an exposure was suspected. Firefighters should also consider self-documenting construction type, materials, actions, and conditions during the fire response. This may be the only information available to isolate an exposure that causes injury of illness in the future.

- All PPE has limitations. Do you understand the function and necessary maintenance of your PPE?
  - How often do you check the fit of your turnouts to reduce your exposures?
  - How well do the interfaces in your PPE overlap? Particularly your hood and bunker coat?
- In this study, PAH levels on the neck corresponded to a change in urinary PAH metabolite levels.
  - Does that change your perception about how toxins in the air can be metabolized into your body?
  - Knowing that hoods provide less protection and that some of the thinnest skin on the body is at the neck, a clean hood should be used every shift and/or after a major exposure. How clean is your hood?
  - The study found that hoods that were longer or secured down provided better protection. Are you taking the necessary time to making sure your hood is securely tucked down and not leaving points of exposures? Is your hood long enough?
- Contaminated gear is a concern due to both transfer/dermal absorption and off-gassing/inhalation of aromatic hydrocarbons. What can you do, as a crew, to reduce these exposures?
  - How conscious are you about how close to the incident you are before removing your protective gear?
  - Knowing that gear can off-gas after exiting a scene, always keep your gear in open ventilated area.
  - Never bring your gear into station living areas, to your home, or store in your personal car unless it has been decontaminated and cleaned.
- Participants of the study had lower PAH readings than in other studies because they had to avoid second-hand tobacco smoke and abstain from eating char-grilled foods for two days prior to the start of the study, and had at least one day off from firefighting activities.
  - Does this information change your perceptions of what your PAH readings might be based on your lifestyle and number of fire responses?
  - Do you understand NFPA 1500 and 1851? What is your responsibility?

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CONSIDERATIONS FOR CHIEFS

Department leaders should consider the following:

The results of this study suggest that firefighters, wearing full protective ensembles, may still absorb combustion products into their bodies. Develop procedures to help firefighters manage and limit these exposures.

- There are multiple NFPA guidelines to assist with use and care of PPE
  - NFPA 1500, Standard on Fire Department Occupational Safety and Health Program - Chapter 7 Protective Clothing and Protective Equipment
  - NFPA 1851, Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting
  - NFPA 1852, Standard on Selection, Care, and Maintenance of Open-Circuit Self-Contained Breathing Apparatus (SCBA)
  - NFPA 1971, Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting - Chapter 8
  - NFPA 1981, Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services
- PPE Safety and Training: Does your department conduct regular inspections of turnouts for possible rips and tears that could provide sources of exposure?
  - NFPA 1851, Chapter 6 provides inspection requirements
  - Set up turnout inspections at the start of each shift.
  - To better understand the limitations of PPEs, every firefighter should receive a copy, or have one made available electronically, of the manufacturer's PPE Usage Instruction and Safety Guide.

CONSIDERATIONS FOR CHIEFS (continued)

- Are there protocols for washing protective gear on a regular basis – especially after possible high exposure incidents?
  - NFPA 1581, Chapter 7 provides cleaning requirements.
  - Set up protocols to wash hoods after responses or at least at the end of shift.
  - Is there a way to provide everyone more than one hood to reduce re-exposures to the neck, which has been shown to be one of the highest exposure sites?
  - Can your department support a hood exchange program?
- Review your protocol for rehab placement to include exposure due to off-gassing.
  - Is there ongoing training to ensure members do not remove gear (face piece, helmet, hood, gloves) too soon after after they exit the IDLH?
  - Consideration of a rehab location, even during simple training exercise, needs to be addressed to help reinforce the importance of exposure prevention.
  - Stress the importance of skin cleaning during rehab. Contaminants can be removed from the neck with skin wipes. Hands should be thoroughly cleaned, particularly if eating hand-held items such as fruit, sandwiches, snack bars or other common rehab foods.
  - Share and emphasize new research regarding the need for full protective gear during all phases of an incident, including post-incident (fire watch/overhaul), to your members.
- Based on possible accumulative PAH levels in firefighters (as well as other potential carcinogens), and the known links to cancer, should the number of consecutive shifts be a staffing consideration?
  - Are fire-hours and fire-runs being tracked to mitigate possible overexposures?
  - Is exposure reporting an easy process for your members?
  - What can be done to support firefighters proactively tracking their fire-hours and fire-runs?

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TERMS

Metabolite - usually refers to small molecules produced during metabolism; also represents building block of a larger structure or a degraded product destined for excretion.

PAHs - Polycyclic Aromatic Hydrocarbons - are a group of semi-volatile organic compounds from products like heavy oils, coal tar, roofing tar, or creosote.

Benzene - is a colorless, flammable liquid with a sweet odor.

Aromatic Hydrocarbons - a hydrocarbon that contains one or more benzene rings that are characteristic of the benzene series of organic compounds.

Benzene, benzine, benzol - a colorless liquid hydrocarbon; highly inflammable; carcinogenic; the simplest of the aromatic compounds.

Biomarkers - are key molecular or cellular events that link a specific environmental exposure to a health out come.

Overbreathing - overbreathing occurs when the firefighter requires more air than the SCBA's regulator can supply. When the inhalation rate exceeds the supply rate, the pressure in the mask can temporarily become negative, and combustion products could enter through any leaks (see Burgess)

STAY IN THE KNOW

Read the research, start the discussion.

Additional resources and tools for this study can be found at www.fstaresearch.org/resource/?FstarId=11476.

DRAFT

RESOLUTION NO. 16-
City Council

RESOLUTION AUTHORIZING THE FIRE DEPARTMENT PURCHASE OF PROTECTIVE HOODS AND GLOVES

WHEREAS, the Fire Department has determined the need to purchase 100 protective hoods and 100 pairs of gloves, and

WHEREAS, the Fire Chief solicited proposals and after receiving and reviewing proposals from six (6) qualified companies, hereby recommends the lowest responsive responsible bid as follows:

Company	Total cost for entire Bid	Included in Bid
Municipal Emergency Services of Fremont, NE	$14,430.00	100 hoods & 100 pairs of gloves

, and

WHEREAS, funding for the purchase of 100 protective hoods and 100 pairs of gloves at a total not to exceed $14,430.00, is available in Local Option Sales and Service Tax (LOSST) Funds, and

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF HIAWATHA, IOWA to authorize the purchase of 100 protective hoods and 100 pairs of gloves at a total cost not to exceed $14,430.00, with Municipal Emergency Services of Fremont, Nebraska utilizing available funding in LOSST Funds.

AYES:
NAYS:
ABSENT:

PASSED AND APPROVED this 19th day of October, 2016.

_____
Bill Bennett, Mayor

ATTEST:

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Kelly Kornegor, City Clerk