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CANCER AWARENESS & PREVENTION



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The Impact of Hidden Hazards



As you size-up the fireground, several life-threatening hazards are visible. But nowadays, it's the hidden hazards that can change a firefighter's life, specifically the toxic particulates that are leading to hundreds of firefighters being diagnosed with cancer annually.

Cancer is impacting the lives of firefighters and their families all too frequently. That's why Firehouse has focused this supplement on cancer awareness and prevention. We encourage you to read the articles, watch the videos and read the survivor stories in order to help you recognize and understand the realities of cancer in the fire service. And please take the time to share it with your crew and discuss how you can work together to reduce your exposures to cancer-causing carcinogens.

Supplement highlights:

- A4** Dr. Kenneth Fent, Alexander Mayer, Dr. Gavin Horn, Dr. Denise Smith and Stephen Kerber detail the findings of a research study on laundering firefighter hoods and PPE, and share the key findings that you can use at your station.
- A8** Brian Brown offers ways to limit exposures in and around apparatus, including a Cancer Prevention Initiative Standard Operating Procedure to consider for your department.
- A12** David Hultman and Stefan Magnusson, pioneers of Sweden's Skellefteå Model, consider how to overcome implementation barriers for health-focused changes at the station and beyond.
- A16** Jennifer Keir explains research focused on the use of products believed to help remove carcinogens from the firefighters' bodies.

Additionally, several firefighters who have battled cancer share their powerful stories of diagnosis, treatment and support. We greatly appreciate their openness and desire to make a difference in the lives of other firefighters. Read their stories and watch their videos in Firehouse's digital version of the supplement, and consider how you can help protect yourself from the hidden hazards on the fireground.

Firehouse thanks our Keystone Sponsor, MSA, and all our Cornerstone Sponsors for helping fund this project to better inform you about one of the most dangerous parts of the job. Stay safe!

— Peter Matthews, Firehouse Editor-in-Chief



Reinforcing the Support

To help bolster the efforts of organizations leading the fight against occupational cancer, Firehouse is making a financial contribution to the Firefighter Cancer Support Network (FCSN) and the National Fallen Firefighters Foundation's (NFFF) First Responder Center for Excellence. These organizations provide unparalleled support to the firefighters—and families of firefighters—impacted by cancer.

For more information about these organizations, visit:



Firefightercancersupport.org



FIRST RESPONDER
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Firstrespondercenter.org

SURVIVOR STORIES: IN THEIR OWN WORDS

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ONLINE EXCLUSIVE VIDEOS

- » “Now I Belong to a Community of Cancer Survivors” — *Engineer Ed Davila*
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View these additional Survivor Story videos, along with all the feature articles and Survivor Stories, in the digital version of the Cancer Awareness & Prevention supplement at tinyurl.com/cancer-awareness-2018.

Cover photo by Seth Lasko

CLEAN GEAR MATTERS



Study reviews the impact of laundering PPE to reduce exposure to harmful chemicals

by Dr. Kenneth Fent, Alexander Mayer, Dr. Gavin Horn, Dr. Denise Smith & Stephen Kerber

In recent years, cancer in the fire service has become a topic of growing concern, as numerous studies have highlighted firefighters' increased risk for certain cancers. Several numbers appear in fire service discussions regarding this increased risk; however, the most reliable data were published by the National Institute for Occupational Safety and Health (NIOSH) in 2014. This scientific research found a 14 percent increase in all cancer deaths for firefighters¹ relative to the general population rate. This increase in risk for cancer deaths may be, at least partially, explained by firefighters' occupational exposure to toxic chemicals.

During fire responses, firefighters are routinely exposed to smoke (particulate and gas) that contains a variety of chemicals, including polycyclic aromatic hydrocarbons (PAHs) and flame retardants (FRs). Exposure to PAHs are especially concerning because some PAHs are known human carcinogens. In a study conducted by Illinois Fire Service Institute (IFSI) and NIOSH, elevated levels of

PAH metabolites were identified in firefighters' urine after a live-fire scenario even though SCBA were used throughout, suggesting PAHs may be absorbed through the skin.²

It has been hypothesized that FRs in household products may be released into the environment when they burn and could also present an exposure hazard for firefighters. Some FRs, like the phased-out polybrominated diphenyl ethers (PBDEs), have been associated with altered hormone regulation.³ Some organophosphate flame retardants (OPFRs) have been associated with cell toxicity,⁴ and a few non-PBDE brominated flame retardants (NPBFRs) have been observed to be endocrine disruptors (chemicals that may interfere with the hormone systems and can produce developmental, reproductive, neurological, and immune effects).⁵ Recent studies have found elevated levels of brominated and organophosphate flame retardants in firefighters' bodies compared to general population levels.⁶

Firefighter hood contamination

PPE, including protective hoods, helps reduce firefighters' exposure to these toxic substances by reducing skin exposure during a fire response. Protective hoods are characterized by the NFPA as the interface element of the protective ensemble that provides limited protection to the coat/helmet/SCBA face-piece interface area.⁷ This PPE ensemble element is in direct contact with neck and face skin, which is thinner and tends to be more absorptive than skin on most other parts of the body.

Previous studies have characterized chemical exposures on the neck following firefighting. It is often assumed that most of this exposure happened during the firefight (via penetration of chemicals through or around the hoods). However, if hoods are worn for multiple responses, there is a possibility that the hood itself will retain fireground products of combustion and be a source of chemical exposure. This dirt or soot has the potential to contain PAHs, FRs

Figure 1: Unlaundered hood (left) and laundered hood (right).
Photos courtesy IFSI

and other compounds. Thus, over time, hoods with residual contamination may contribute to firefighters' overall exposure to dangerous chemicals.

Laundering sock hoods

Historically, protective hoods may have been worn for multiple responses without laundering. However, over the past few years, many fire departments have implemented hood exchange and/or laundering programs in an attempt to reduce potential exposure through contaminated hoods. This is a positive step for the fire service and a reasonable solution in light of available evidence. However, we are unaware of any data that tells us just how effective laundering is at removing contamination on hoods, or if there are any unintended consequences of this action. In other industries, it has been suggested that cleaning efficiency will depend on the solubility (fat-soluble compounds are harder to clean) and molecular weight (heavier compounds are harder to clean) of the contaminants.

To address this knowledge gap in the fire service, we set out to determine the effectiveness of laundering to reduce or remove PAHs and FRs from sock hoods. PAHs are fat-soluble but generally lighter than FRs. Brominated FRs are fat-soluble (and persistent in the environment), while OPFRs tend to be water-soluble. So there are materials with a range of different properties that we want to remove in a single-wash cycle.

In a collaborative effort between IFSI, NIOSH and Underwriter Laboratories (UL) Firefighter Safety Research Institute (FSRI), we asked 10 firefighters, who were paired, to complete different fireground job assignments while responding to realistic fire scenarios. For each pair of firefighters, one hood was routinely laundered after every scenario and one was not. The hoods that were cleaned were laundered together in a washing machine following manufacturer and NFPA guidelines. In total, each firefighter responded to four sce-



narios. At the end of the study, we took samples from five routinely laundered and five unlaundered hoods and analyzed them for PAHs and three classes of FRs—PBDEs, NPBFRs and OPFRs—that

were on the surface and embedded in the hoods themselves.⁸

The results: We found that some chemicals were removed fairly well and some were not. For example, concen-

Figure 2A. Average concentrations of PAHs on unlaundered and routinely laundered hoods

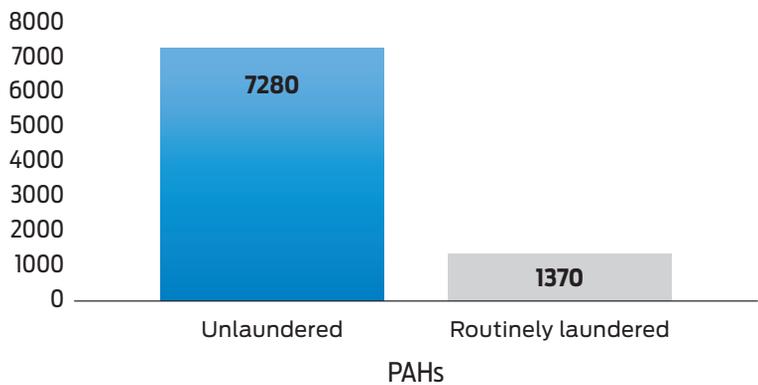
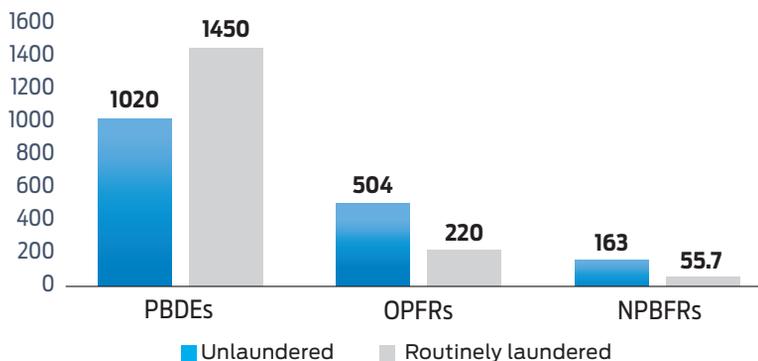


Figure 2B. Average concentrations of PAHs on unlaundered and routinely laundered hoods





The hoods that were cleaned were laundered together in a washing machine following manufacturer and NFPA guidelines.

trations of NPBFs, OPFRs and PAHs were at least 50 percent lower in the routinely laundered hoods compared to the unlaundered hoods. PAH levels—the most abundant contaminant found on the hoods—were lowered by approximately 80 percent after routine laundering (Figure 2A). These results show that laundering will likely reduce the amount of contamination available

for transfer to the skin upon subsequent hood use.

Surprisingly, PBDEs were almost 50 percent higher in the laundered hoods compared to the unlaundered hoods (Figure 2B). A previous study had indicated poor extraction of PBDEs contaminating polyester fabrics into laundry water.⁹ Thus, we were not surprised to find significant residual PBDE contamination on laundered hoods, but we were surprised to find *higher* contamination. Where did the additional PBDE contamination come from? Because of this finding, we conducted a follow-on study to examine cross-contamination during laundering.

Cross-contamination study

For our follow-on study, we laundered brand new, unexposed hoods and a set of exposed hoods similar to those used in Figure 2, along with a set of heavily contaminated hoods (containing relatively high levels of PAHs and FRs). Altogether, 12 hoods were laundered at one time in a load of laundry representative of what may be done at a fire department where all hoods are gathered and laundered after a structure fire response regardless of contamination level.

After laundering, we collected and analyzed samples from the hoods to evaluate differences before and after laundering. Interestingly, all hoods that were brand new—and had no PBDE, NPBF or OPFR contamination before laundering—had

measurable contamination after laundering (Figure 3). This finding clearly indicates there can be cross-contamination of FRs between hoods during the laundering process. Additionally, some previously exposed hood samples had even higher PBDE levels after laundering than before, corroborating our earlier findings.

PAH concentrations were low on the brand new hoods after laundering, and PAH contamination on the exposed hoods were significantly reduced after laundering. This finding is of particular importance because PAHs are the only known human carcinogens in the class of chemicals analyzed in this study. Overall, cross-contamination of hoods during laundering appears to occur for FRs, and is less of a concern for PAHs.

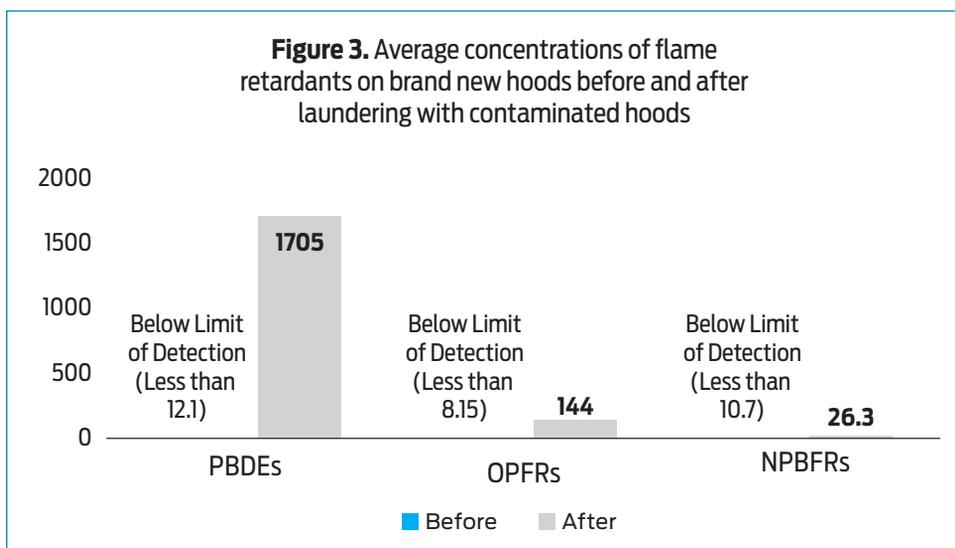
Ongoing sweat extraction study

Our study on laundering hoods highlighted some interesting findings regarding cross-contamination of FRs. These findings may be important because protective hoods can come in direct contact with the skin of the neck and head. However, it is not clear just how much of this contamination could transfer to the skin. On the one hand, some the cross-contamination may be embedded in the inner layer of the sock hood that touches the skin. On the other hand, if the FRs are not readily extracted in laundry water (containing detergents), will they be extracted in human sweat?

And if some contamination did transfer to the skin, how much would be absorbed into a firefighter's body?

To begin addressing these remaining questions, we have embarked on a study to determine the amount of residual contamination on hoods that can be extracted in synthetic sweat solution. Importantly, the sweat solution contains both water and lipids (fats) and other properties that are characteristic of actual human sweat. Routinely

Figure 3. Average concentrations of flame retardants on brand new hoods before and after laundering with contaminated hoods



laundered hood samples from our previous study will be placed in the sweat solution for a period that represents how long firefighters may wear hoods before, during and after an emergency fire response. Hood and sweat samples will then be analyzed for a variety of FRs. This experiment will increase our understanding of how hood contamination relates to dermal exposure and potential for absorption.

Implications for other firefighter PPE

Our findings may have implications for other components of the turnout gear ensemble. If chemicals are capable of cross-contaminating hoods during laundering, then cross-contamination may also happen during the laundering of turnout jackets or trousers, gloves or helmet liners. It is possible that some contamination on exterior materials could transfer to interior materials that are in direct contact with the skin if outer shells and liners are not separated during laundering as recommended by NFPA and others. Certainly, further research is needed. Studies are underway by fellow researchers to determine “How Clean Is Clean?”

Further, NIOSH, IFSI, and UL recently completed the field experiments for the “PPE Cleaning Study” to examine residual contamination with repeated laundering. Importantly, this study also aims to understand how repeated laundering affects the protective properties of turnout gear, including tear resistance, flame resistance and thermal protection performance. These studies, as well as the aforementioned sweat-extraction study, should provide further insight into how laundering firefighter PPE impacts firefighters’ potential exposure to chemicals. These results, along with previous research projects, will be made available to the fire service through our websites at cdc.gov/niosh/firefighters and fsi.illinois.edu/CardioChemRisks.

Final thoughts

While the potential for cross-contamination of FRs during laundering is something that should be explored further, the preponderance of evidence suggests that it is still prudent to launder con-

Key Take-Home Messages

- Laundering hoods is effective at removing a large portion of PAH contamination, which is by far the most abundant contaminant found on the hoods and is an important part of firefighter hygiene and PPE cleaning.
- Consider segregating firefighter hoods by contamination level to reduce the potential for cross-contamination. If a firefighter responds to a call but is exposed to low levels of contamination compared to the rest of the crew, it may be beneficial to avoid washing with other crewmembers’ hoods.
- Do not launder hoods with base layers or station wear to reduce the risk for cross-contamination to these pieces of clothing that may directly contact skin.
- This study suggests the possibility that some contamination on turnout gear outer shells might transfer to inner liner materials that are in direct contact with the skin if they are not separated during laundering as recommended by NFPA and others.

taminated hoods after fire responses to reduce the potential for exposure upon subsequent use. Based on our study findings, laundering will remove a large proportion of the PAHs from hoods, and it is likely that other hazardous or potentially carcinogenic compounds will also be removed. Also important are other measures to minimize skin exposure, such as careful removal of hoods and gloves to limit the amount that transfers to the skin (see videos at youtube.com/watch?v=QyAt5WHf5uM and youtube.com/watch?v=9uYp0ZQP158), on-scene cleaning of skin (e.g., skin cleansing wipes), and showering as soon as possible at the station. ■

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Fire Apparatus & Cancer Prevention



Sample protocols for reducing risks inside and outside the station

by Brian Brown

Heart disease used to be the number one cause of firefighter deaths, with the second-leading cause being apparatus/automotive accidents involving water tankers/tenders. No longer is this the case, as numerous studies have proven that firefighters are at greater risk of contracting occupational cancers as a result of their assigned duties. In fact, the International Association of Fire Fighters (IAFF) reports that 61 percent of firefighter deaths from Jan. 1, 2002, to Dec. 31, 2016, were caused by cancer; heart disease accounted for 18 percent of career line-of-duty deaths (LODDs) for the same period.

The National Institute for Occupational Health and Safety (NIOSH) reports that firefighters have a 9 percent higher risk

of being diagnosed with cancer and a 14 percent higher risk of dying from cancer than the general U.S. population (firefightercancersupport.org/resources/faqs). Fortunately, many agencies are committed to the overall health of employees, which includes recognizing the increased risk of cancer associated with firefighting activities. In an effort to provide a safe and healthy work environment, agencies are creating dynamic guidelines to reduce the cancer risk to its employees.

Further, many studies have shown that proper use of PPE and SCBA will minimize exposure to hazards that cause serious workplace illnesses. These illnesses may result from exposure to dangerous atmospheres, including chemical, radiological, physical, electrical, mechanical,

During incidents that involve exterior exposure to products of combustion and or running apparatus in close proximity of each other, air monitoring should be considered for the protection of crewmembers in that area.

Photo courtesy of Eric Hurst, PIO, South Metro Fire Rescue

or other workplace hazards. In addition, a complete decontamination process after training or clean-up on scene is proving to be beneficial in limiting the duration of firefighter exposure to toxic carcinogens left on the PPE and the personnel themselves.

But what about apparatus-specific guidelines or changes? What can departments, personnel and manufacturers do to reduce the risk?

Inside the station

Apparatus vehicle exhaust, mainly diesel exhaust, is a carcinogen that could affect firefighter health, and efforts should be made to minimize exposure at all times. For years, we dealt with black walls, black gear, and dayrooms/bunk rooms that

smelled like diesel exhaust. That was when the only exhaust removal system was to open the bay door(s). I remember washing the walls at the station to remove all the black soot when the old Detroit Diesel 6V and 8V92s were the predominant engines in fire apparatus. These engines were the “Rock Stars” that were almost bulletproof, but smoked and leaked oil like crazy.

This is where the engine manufacturers have really stepped up, as required by the U.S. Environmental Protection Agency (EPA) starting Jan. 1, 2010, to reduce the amount of diesel engine particulate matter. The current EPA emissions standards are some of the most stringent in the world, reducing diesel particulate matter and nitrogen oxides (NOx) to almost zero levels on all diesel engines.

Here’s how it works, per the Diesel Technology Forum (dieselforum.org; see diagram below): The Selective Catalytic Reduction (SCR) system uses diesel exhaust fluid (DEF) injected into the exhaust stream of the engine, which sets off a chemical reaction that makes the engine “REGEN” to convert NOx into nitrogen, water and tiny amounts of carbon dioxide (CO₂), which are the natural elements of the air we are breathing.

Are these SCR systems more costly? Yes, but according to the Diesel Technology Forum, most fleets and truck operators have reported a 3–5 percent gain in fuel economy for agencies that do track their fuel costs on fire apparatus with diesel engines.

In addition, several manufacturers make great station exhaust extraction systems that are automatically programmed and started when the battery or ignition

switch is turned on by any unit at the station or when the unit arrives back to the station from a call. Further, there are vehicle-mounted diesel filters that can be used instead of a station exhaust removal system. The nice part about the vehicle-mounted diesel filter is that it can be included in your apparatus specification or retrofitted to your existing trucks without making expensive station modifications. Also, it can also be used on scene in areas that need to be cordoned off but where people are still operating.

My former department created the South Metro Fire Cancer Prevention Initiative Standard Operating Procedure (SOP), which outlines several steps that should be followed to help prevent motor vehicle exhaust from exposing all PPE within the bays of the stations:

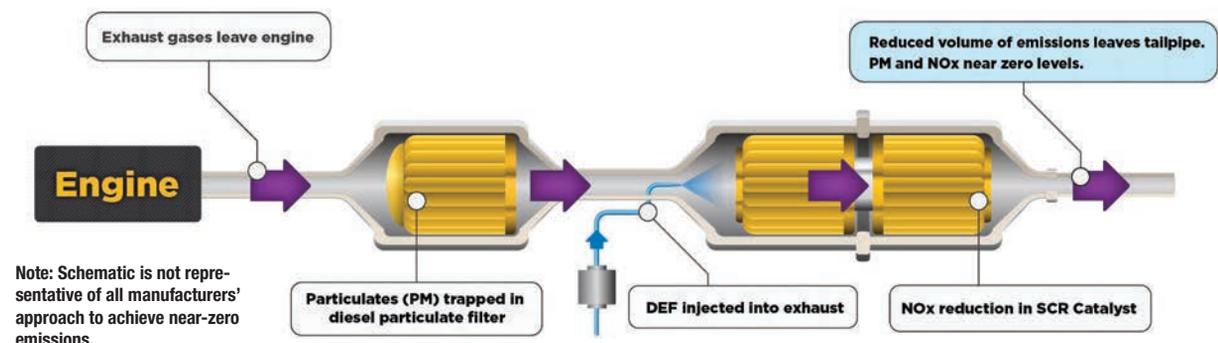
1. All crews and personnel should utilize the exhaust systems and never let any apparatus/equipment run within the bays unless absolutely necessary. In the unlikely event that need arises to run apparatus in the bay, the exhaust system hose shall be in place at all times and the apparatus shall not exceed idle speed. In the event that an exhaust system hose is unavailable, the operator of the apparatus shall move the apparatus to the exterior as quickly as possible. All bay doors shall be closed to prevent further exposure. Standard backing procedures shall be used when moving apparatus. It should be the intent of crews and companies to work together to attach the exhaust hose as the apparatus enters the bays and also ensure proper connection prior to exiting.

2. Crewmembers should not conduct compartment/tool inspections while the apparatus is running. Crewmembers should wait until the operator has finished the apparatus run up/inspection and shut down the engine prior to these activities.
3. All PPE on storage racks that have the potential to be exposed to exhaust contaminants should be protected by closing and zipping bunker coats and pants so as to prevent particulates from landing on and absorbing into the liners. No bunker gear liners should be exposed when storing for off-duty.
4. No exhaust from any vehicle should expose bunker pants that are stored on the bay floor, most specifically the groin area of bunker pants and hoods typically placed on top of pants for call readiness. When possible, store gear within the apparatus to prevent contamination by exhaust.
5. Bunker gear shall not be worn in the living area of the station. Every effort should be made to limit the exposure of contaminants to the living area of the station. Crewmembers shall not wear duty boots/shoes into the living area of the station. Crewmembers are encouraged to have clean footwear available in the bay to wear in the interior of the station or clean their footwear prior to entering the living area after each response. Station captains shall provide supplies for decontamination at each station.

Outside the station

Fires produce carcinogenic smoke, and efforts should be made to minimize

Diesel Emissions Control System



firefighter exposure from the PPE that was involved in any toxic type of environment. As such, the South Metro Fire Cancer Prevention Initiative SOP also addresses “outside the station” activities, defined as the conclusion of an incident involving products of combustion, including training fires.

Crewmembers must follow the policy following all structure, outbuilding, vehicle and dumpster fires; however, the incident commander (IC) may require personnel to follow this policy on any incident they deem necessary. The IC may exempt personnel who were not in close proximity and/or exposed to contaminants.

Following are the steps to assist in preventing exposure to contaminated PPE:

1. During incidents that involve exterior exposure to products of combustion and or running apparatus in close proximity of each other, air monitoring should be considered for the protection of crewmembers in that area. It is preferable to use a gas meter with a carcinogen ethylene oxide (EtO) sensor.
2. It is encouraged that apparatus that can be shut down, should be shut down during any incident to further limit crewmembers’ exposure to contaminants. Safety shall never be leveraged to meet this objective.
3. Upon the completion of suppressing fire and after exiting a fire event, a decontamination station (hoseline and decon bucket) should be setup to wash particulate from PPE. This includes bunker pants, jackets, helmets, structure boots (including soles), structure gloves, and SCBA. Personnel shall wear eye protection, medical gloves and N95 masks during decon procedures.
4. Hoods should be removed from around the neck area as soon as possible. District issued stocking caps should be worn for warmth in inclement weather in lieu of fire hoods.
5. Since PPE will continue to off-gas after exposure to heated environments, gear (including entire firefighter ensemble and SCBA) should be removed, bagged and placed in a

back compartment or hosebed of the engine for transport back to the fire station to prevent further inhalation of toxic off-gas within apparatus cabs. Personnel shall don their wildland gear if necessary in the event they have a significant medical or other call while returning to the station. This will require all personnel to keep their wildland gear and boots on their apparatus at all times.

6. Decontamination wipes have been provided and shall be utilized to clean any areas of skin that are considered to be higher body absorption sites and/or areas not covered by bunker gear. These areas could include face, neck, ears, legs, groin, wrists and hands.
7. Plastic seat covers have been provided for all apparatus and shall be placed over all seats for the return trip to the fire station to prevent any contamination to the apparatus cab seats.
8. After return to the station, all frontline PPE used on scene shall be laundered as soon as possible according to district policy. Bunker boots, helmets including shroud, SCBA and bottles shall be washed with a brush and light soap before being placed back onto the apparatus. All firefighters will move into their backup set of gear until their frontline gear has been laundered.
9. As immediate as possible, and at company officer’s discretion, all crewmembers shall shower and change clothes upon returning to the station. Personnel should keep contaminated clothing separate from other clothing and wash at the station if possible.
10. Reasonable effort should be made to prevent continued contamination while transporting contaminated gear in personally owned vehicles.
11. The IC or their designee shall complete an exposure report whenever an incident occurs with crewmembers exposed to products of combustion.

Manufacturer responsibility

So what are the apparatus manufacturers doing to reduce the risk of cancer in the cabs and around the vehicles themselves?

Sutphen Corporation released its Clean Cab Initiative, and the first truck

manufactured with its version of the clean cab concept for West Palm Beach, FL, includes:

- Exterior slide-out compartments for PPE gear and SCBA storage
- Diamond-plate floor covering
- No SCBA storage in the cab
- Low seam material on seating
- All surfaces are smooth, non-porous and cleanable
- HEPA filtering for the HVAC system
- Aegis anti-microbial spray for seats and hard surfaces

Pierce Manufacturing provides a Carcinogen Awareness and Reduction to Exposure (CARE) program that’s now been integrated into the apparatus design and construction processes. Spartan Emergency Response launched its own initiative for solving these problems with enhancements to its original Advanced Protection System (APS). Both manufacturers include the following:

- Warm water decon shower head outlets
- Smooth and cleanable apparatus seats and interior surfaces
- Non-porous door panels, headliners, doghouse covers, and seats
- Vertical exhaust that keep the fumes and heat away from the hose, compartments and walkways around the apparatus
- High-level HVAC filtering
- Compartment storage for all PPE gear and SCBA equipment

All manufacturers have started their own clean cab concept, which is now being accepted by many agencies that are making big efforts to keep all the contaminated PPE gear and SCBA equipment in outside compartments away from the firefighters and completely out of the cab occupancy area.

Seat manufacturers are also showing big initiatives to reduce the amount of absorption and contaminates in the fabric and cushion. Two seating companies, H.O. Bostrom and Valor, have removable seat fabric that can be easily removed and washed in an extractor, dried and placed back on the seat. Based on application and call volume, you can choose various options that include DURAWEAR material that is backed with a PVC liner that

prevents contaminants from getting in or out of the cover or the cushion or the AEGIS antimicrobial protection. Both products create a cleaner environment for both fire and EMS personnel.

Final thoughts

For many departments, this is going to be a struggle with a very new concept. But believe it or not, many years ago, departments, mainly on the West Coast, started using this process and were able to put out fires when the PPE gear and SCBA were

kept in the outside compartments. While it used to be a badge of honor to have dirty, smoky gear, we should have realized why other departments started this protective protocol. Nonetheless, too many agencies still have all of their PPE and SCBA in the cab. Many refuse to move the potential carcinogenic hazards out of the cab, as they claim it delays their response and on scene time in order to get out and don their gear. It's inevitable that there will come a time when outside compartments will be mandated—so get ready. ■

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Brian Brown, a consultant with Craven and Associates, is the retired bureau chief of fleet services for South Metro Fire Rescue in Centennial, CO. He has over 30 years of fire apparatus experience. Brown is a member of the Firehouse editorial board.

IN THE FIGHT

"Do Everything Possible to Reduce Exposures to Carcinogens"

— Assistant Chief of Operations Troy Jackson

Troy Jackson has served with South Metro Fire

Rescue in Colorado in the roles of captain, training chief and, currently, assistant chief of operations. In 2013, he was diagnosed with adenoid cystic carcinoma, a rare and non-treatable form of cancer. The diagnosis brought the department's cancer initiative to the forefront, with an increased focus on everything from decontaminating gear to preventing exhaust in the stations to being more physically aware of one's surroundings.



What has been your cancer journey thus far, from diagnosis to treatment?

In 2013, after years of treatment for asthma-type symptoms, my breathing was getting worse and was affecting both my job and personal life. Some imaging revealed a very large tumor in my trachea. In May 2013, I had three inches of my trachea and the tumor removed. This was followed by both radiation and chemo.

I was diagnosed with adenoid cystic carcinoma. Since then I have had two more major surgeries to remove tumors and a second round of radiation treatments, over 70 in total. I am now in my third trial trying to find something that can put a dent in this disease.

After my first surgery, I spent a year offline trying to get strong enough to return on line. I made it back as a line captain and was promoted to training chief prior to my cancer returning. Today I am the operations chief and happy to be in a position where I can be productive and add value to the organization.

How has cancer impacted your life, on and off the job?

It has made me focus on the things most important to me, family and faith primarily. It gave me a killer new voice, as all the radiation damaged my vocal cords. It also made me step out of my comfort zone on the line and move up in the organization.

How did your brother and sister firefighters support you?

In more ways than I can articulate. Yard work, phone calls, rides to treatment, financially. Just knowing they were there if I needed anything at all.

What have you learned thus far through your battle with cancer?

Patience. That this disease has a profound impact on those fighting the battle and those supporting us during this time.

After learning that you had cancer, did you think back to any of your time on the fireground and question your actions?

Absolutely. Lots of stupid things as I look back. Bunkers next to the bed. No ventilation systems or exhaust capture systems in the bays. Only one set of gear. Never cleaning hoods. Culture of dirty gear and eating smoke makes you strong. Washing diesel soot of the bay walls without protective equipment.

Is there anything else that you would like firefighters to know about facing—and beating—cancer?

This is a wonderful and fulfilling career, but it does have its risks. Do everything possible to reduce exposures to carcinogens. Keep your body in tip-top shape to help fight the dangers our job has on our bodies.

Jackson and his doctors believe that his cancer is from firefighting because it is so rare and started in his airway. The doctors have told him that he will die from this cancer. Nonetheless, Jackson is a true champion at South Metro, as he is still fighting the good fight with a great attitude.

There are at least 15 additional members in the department who have some form of cancer.



Skellefteå Model

Develops Healthy Firefighters

Overcoming implementation barriers to health-focused changes at the station and beyond

by David Hultman & Stefan Magnusson

It is difficult today to find a firefighter who does not have colleagues affected by suspected occupational illnesses. Healthy Firefighters (healthyfirefighters.com) started as a cooperative project in 2006 after we lost too many of our close colleagues to suspected occupational diseases. The need for change was apparent: Firefighters need to be protected against work-related diseases.

In the early 2000s, there was already clear evidence that firefighters, through their occupation, have a higher rate of severe diseases. Most diseases could possibly be avoided by reducing unnecessary and involuntary exposure to foreign substances and particles. Because firefighters' risk of disease was not restricted locally or nationally, a generic global model was needed. Through knowledge,

routines and the right equipment, it is possible to methodically minimize the risks of exposure without complicating or impairing the work of firefighters.

The Skellefteå Model was developed as a standard that exemplifies and describes how firefighters can avoid hidden dangers in their working day with the use of simple routines and rational flows. The goal of the model is for the firefighters to avoid serious illness resulting from long-term and repeated contact with foreign substances. The model is based on the thesis "from one alarm to the next," which also summarizes the cyclic activities of firefighters called into duty. Embracing this way of thinking is comparable with always aiming for perfection, using the latest knowledge and technology for us to

carry out our work as efficiently and safely as possible.

The Skellefteå Model is now a tried-and-tested approach for creating a good and sustainable work environment with simple procedures. The model deals with normal operations found in all fire departments and emergency services in varying degrees and frequency. Naturally, local opportunities and conditions must be taken into account for the department in question.

Emergency services that introduce the entire Skellefteå Model protocol will quickly see tangible results in the work environment. It is only after implementing the new procedures and seeing the results that participants realize exactly what the situation was like before they instituted the Skellefteå Model.

The Skellefteå Model was developed as a standard that exemplifies and describes how firefighters can avoid hidden dangers in their working day with the use of simple routines and rational flows.

Photo courtesy of Healthy Firefighters

Education first

Most firefighters do not suffer from a serious occupational illness. However, for those affected, it often takes a very long time before the illness develops. This latency period is one of the biggest reasons for the situation not changing appreciably, particularly as many firefighters retire before they fall ill. Therefore, there is not always a direct correlation between the illness and the professional life. In order to change this situation for the better, knowledge and insight must be quickly disseminated.

The best way to begin to bring about change is to inform and educate firefighters about the hidden risks of contamination that exist in their work—and what can be done about this risk. Firefighters' perception of their own work environment does not always match reality. This is partially due to professional culture, attitudes and the fact that these threats or dangers have relatively unclear and vague forms.

To create motivation for change, it is necessary to provide information about the risks that exist and the harmful effects of poor or non-existent routines. When firefighters gain knowledge and insight into their own situation, it becomes apparent what changes and improvements are necessary. This will in turn make them easier to implement. It is crucial to the results that as many individuals as possible have knowledge about how firefighters are exposed to harmful substances. All personnel in all categories on all levels of the organization must be informed. In order to facilitate changes to ingrained routines and behaviors, everyone must help one another.

Established routines

Firefighters may feel that they rarely work on significant fires that would expose them to large amounts of foreign substances. However, it is easy to forget that they are most likely exposed to a larger amount of contaminants from the total number of small fires they are extinguishing than from fewer numbers of large fires. Firefighters may be exposed to hazardous substances during their own calls and training exercises, but also when they come in contact with the contami-

nated equipment of their colleagues, if it has not been properly handled. It may be tempting to skip the decontamination routines under poor conditions. If there are no established procedures in place, those affected may come to accept a hazardous environment under the premise "it was just this one time."

Further, consider this: One of a firefighter's regular duties is to decontaminate vehicles, materials and protective clothing that have been in contact with foreign substances in connection with fires, accidents and exercises. It is common for gear to be cleaned and handled by a firefighter who does not know how it was used or how it was contaminated. Because firefighters have irregular working hours, varied workloads and a large number of shifting operations, jobs can sometimes be interrupted and then completed by a different person. Frequently, in the event of interruptions, such as an alarm, shift change or abnormally long and large-scale operations that require relief or extra personnel, a firefighter may have to take over a colleague's tasks. This means that the firefighters lose a sense of context, and thereby control, over what the gear and equipment have been exposed to. Unfortunately, this can result in all particles



The Skellefteå Model encourages firefighters to remove contaminated gear at the scene and store in a part of the vehicle cabin separate from where firefighters are riding.



The room used for decontamination of gear should include a ventilation system that generates negative pressure to prevent contaminated air from escaping the room.

and pollutants being handled routinely. Because the firefighters are unable to verify which substances they risk encountering, they must use the precautionary principle. All unknown particles and remains from dense combustion gas should be considered harmful, as there is no evidence to the contrary.

Concise flows and routines are required in order to distinguish con-

taminated clothes, gear and vehicles from what is clean. However, these flows and routines should neither delay nor complicate everyday work. Experience clearly shows that anything that consumes time and energy, or includes a greater number of operations, tends to be avoided. Without a frame of reference, it is difficult to compare a thoroughly decontaminated work environment with

one that is imperceptibly contaminated. Controlling the work environment may not necessarily lead to a decrease in, or elimination of, serious illnesses. As future firefighters become healthier, it may be difficult to prove it is a direct result of improved routines and flow.

New routines that lead to a higher frequency of cleaning and decontaminating materials will take more time and resources if done improperly. Therefore, it is important to keep the new elements simple, so they remain a priority. One of the most common misunderstandings is that health awareness must be at the expense of aggressive firefighting. This perception could not be more wrong. As a firefighter, you do not have to choose between doing effective rescue efforts and avoiding occupational disease. On the contrary, a good routine for reduced exposure will provide all the conditions for even more efficient and rapid efforts. Organizations that implement the Skellefteå Model in a thought-out, well-prepared manner, and with the right resources, will find that everyday operations will be less complicated than before and certainly more efficient.

SURVIVOR STORY

“We Used to Believe Dirty Gear Was Cool. Now We Know It’s Not.”

— Assistant Fire Marshal Ian “Lance” Dahl



Ian “Lance” Dahl has been with the Spokane, WA, Fire Department for 23 years. In February 2017, he was diagnosed with colon cancer. He has been cancer free since July 2018.

How has cancer affected your life?

When you get that diagnosis, everything stops, and you start to reflect on, “Man, how did I get here, and where do I need to go to get better?” It sends you into that thought process of “Wow, how long do I have?”

What did you learn through your experience fighting cancer?

For me, it was to stay positive, to not let my emotions drag my family and coworkers down. The more I seemed to stay positive, everybody else’s attitude stayed up, and it let me really focus on treatment and getting better.

What do you want future generations of firefighters to know about the risks they face on the job?

I really want them to look at the direction the fire service is going—to help protect themselves, and use the best practices that have been generated and incorporate those into their daily life at the fire station. Washing their gear after fires. We used to believe dirty gear was cool, and now we know it’s not. Dirty gear has led to off-gassing and carcinogens that we end up absorbing into our body. Getting into those best practices—washing gear, not having gear in the truck, making sure your department is using an exhaust system and taking those exhaust gases from our diesel trucks out of the station. That’s the stuff I really want everyone to take away and help lessen those risks that we face on a daily basis.

Watch Dahl’s full interview at tinyurl.com/cancer-awareness-2018. Thank you to Spokane Fire Chief Brian Schaeffer and Spokane Fire Media Services for their assistance with this interview.

It is not enough simply to change behaviors and routines. There must be proper equipment to ensure the right conditions for a sound and health-conscious work environment. Recently the development of specialized encapsulation bags, gross decontamination machines, drying cabinets, wet wipes, etc., has been heading in the right direction. These items were not on the market a few years ago, but if there is a demand, there will be tools.

Buy-in and balance

Sound health is a fundamental condition for a good life and is therefore a precious gift. It is also an area that affects everyone. When the everyday behavior and routines of a given group change, regardless of which areas are concerned, there are individuals who deny or belittle new findings, changes or reforms. Fortunately, even these individuals become interested and are influenced by clear decisions concerning the vulnerability of their own health.

This is one of the reasons why it is so important that a well-composed, clear message about working with health issues is firmly established and communicated to everyone in the concerned organization. As the process considers everyone's health, even those opposed to change tend to stop hindering the development. It is then easier for those driving the process to garner attention for the necessary adaptations and improvements.

We are often asked how we cope with resistance and barriers in the change process. It is important to point out that doubts do not fundamentally have to be negative. All organizations benefit from the balance between new ideas and sound management. The fact that we work in such well-functioning organizations, as fire departments most often are, is largely due to having both colleagues who want to change and develop, and colleagues who value well-proven, pragmatic methods that work. Both parts are needed to make our work function efficiently.

Further, it is important not to confuse lack of willingness to change with the lack of empathy or understanding. Even our colleagues who do not want to fundamen-

Skellefteå Model Steps

With knowledge, education and insight serving as its foundation, the Skellefteå Model employs several tactics related to the following topics to help keep firefighters healthy:

- Transportation of contaminated clothing and equipment
- Routines at the fireground
- Storage of contaminated clothing and equipment
- Skin protection on scene
- Decontamination of body, clothing and equipment

Learn how to implement the Model at healthyfirefighters.com, and watch an informative video that details the steps at [youtube.com/watch?v=IV2ZsZ6WJMc](https://www.youtube.com/watch?v=IV2ZsZ6WJMc). Additionally, download a free educational PDF about the Skellefteå Model at msb.se/RibData/Filer/pdf/27621.pdf.



The Skellefteå Model includes steps for how to best store and clean gear to keep it separate from contaminated gear.

tally change their way of working often take the issues of occupational health seriously. If the directive for changing the working environment does not come with well-founded explanations, it may take time to make the change.

When introducing new elements that alter habitual behavior, the person who is to carry out the new element must be told why. Otherwise, there is a risk of interrupting the decontamination process, which would eliminate the use of the new work method. The emergency services constitute a utilitarian organization, and it is preferable if the benefits of a certain change can be shown in advance. Change will be promoted by the firefighters themselves if credibility and support for the method is established throughout the organization.

It is obvious that the work with firefighters' disease problems requires individual responsibility. This means that an individual who deviates from the routine will risk exposing themselves and their colleagues to what everyone

is trying to avoid. Hence, the Skellefteå Model is based on a team approach—"one for all, and all for one." Those who show respect for themselves quickly win respect from others.

Start the change process

There are a thousand excuses to delay or complicate the introduction of reducing exposure in a firefighting organization. One apprehension is that it takes a lot of work to get started. Fortunately, the actual solution is very simple, and in many cases, the concerns have proven to be unfounded. A risk during the introduction is that focus is placed on the problems rather than the solutions. But it's all about getting started. After that, the fine-tuning and the local adaptations will follow naturally. Each day that passes without addressing firefighters' health issues is a day wasted. ■

David Hultman is a senior officer fire protection engineer who studied at Luleå University in Sweden. Since his post-graduate studies, Hultman has worked within the fire and rescue service, and today he is district/unit chief in Strängnäs, Sweden. He is also a certified fire investigator and has a position on the Board of the Swedish Fire Protection Association and on the Swedish Fire and Risk Engineers Board.

Stefan Magnusson is a professional firefighter and the health and safety representative for the Skellefteå Fire & Rescue Service in Sweden. In 2006, Magnusson co-founded the Healthy Firefighters project, and he is the creator of the Skellefteå Model. Since 2007, he has delivered hundreds of lectures on the Healthy Firefighters project and the Skellefteå Model. Magnusson has a position on the board of Firefighters Cancer Foundation.

Hultman and Magnusson can be reached at info@healthyfirefighters.com.

Cancer Prevention Methods: Fact vs. Fiction

Reviewing research into the impact of decontamination involving skin-cleansing

by Jennifer Keir

It's understood that firefighters are exposed to a variety of chemicals from combustion emissions during fire suppression. These include organic chemicals (i.e., made up of mainly carbon and hydrogen), such as polycyclic aromatic hydrocarbons (PAHs); inorganic chemicals (i.e., anything that is not organic), such as brominated flame retardants; and metals, such as lead, antimony, cadmium and uranium.

The best way to avoid exposure to these chemicals is to avoid contact. Although manufacturers are working hard to develop protective equipment to do so, the technology cannot yet reduce firefighters' exposures to these chemicals to zero. Firefighters will be exposed to these compounds in some capacity. As such, the question remains: What do we do?

There are several products and approaches to decontamination being marketed to address this question. With this in mind, let's review the current information available from the scientific community so you can make the most informed decisions possible for your health and safety.

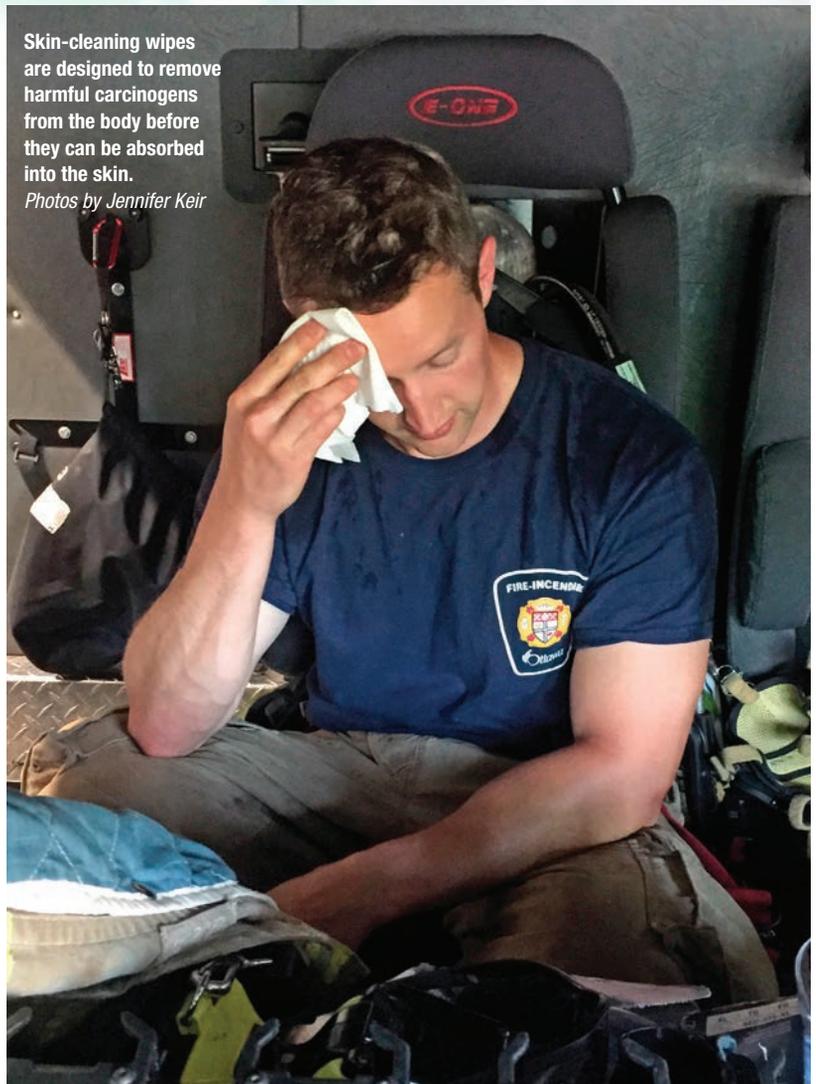
Skin-cleaning wipes

Between the anecdotal evidence of smelling like smoke and sweating out black "stuff" after a fire and studies suggesting skin as a major route of exposure to chem-



Skin-cleaning wipes are designed to remove harmful carcinogens from the body before they can be absorbed into the skin.

Photos by Jennifer Keir



icals for firefighters, skin-cleaning wipes have become an immediate approach to decontamination. Skin-cleaning wipes are designed to remove harmful carcinogens from the body before they can be absorbed into the body or cross-contaminated onto other surfaces (e.g., seats of the truck). This is particularly important for firefighters because as body temperature rises, as tends to happen on the fire and rescue scene, so does the skin's absorption level.

A study of wipes found that generic baby wipes removed 54 percent of PAHs,¹ some of which are known carcinogens. Further, wipes developed for firefighters are promoted to be superior to baby wipes and other wipe products. Specifically, some wipes use specialized formulas that are said to target fireground hazards as well as a thick, heavy-duty texture that are designed for tougher environments.

To date, two companies have undergone third-party testing of their wipes. One company reports a removal rate of up to 69 and 90 percent of two chemicals with known toxicity and presence at fires. Another company reports a removal rate of up to 99 percent for lead as well as other heavy metals, but details of how they tested this are not publically available.² Testing by other wipe companies is expected in the near future.

The results of testing from wipe companies seem promising, but more research is necessary to answer additional questions:

- Are all wipes able to remove a significant amount of the most worrisome chemicals firefighters are exposed to—and not increase the absorption of it?
- With multiple wipes on the market for firefighters, how does one decide on the best product for their department?
- Are there certain ingredients that will make a significant difference in the efficiency of one wipe over another to remove contaminants?

Work is currently being conducted to answer some of these questions. Researchers out of the University of Ottawa, in collaboration with the Ottawa Fire Services, are currently investigating different

decontamination methods. Results from this study are expected by summer 2020.

Saunas

There is no denying that saunas have many health benefits, including improvements in certain respiratory conditions and cardiovascular health.³⁻⁵ Several studies have found that healthy lifestyle choices (e.g., sufficient sleep, hydration, well balanced diet, and exercise) coupled with sauna use improved health and sometimes levels of selected chemicals in

pies. In fact, one study found sauna use alone did not reduce cardiovascular and all-cause mortality whereas a combination of sauna use and good cardiovascular fitness did reduce this risk.⁵

Many studies have found that reduced body burden of chemicals after sauna use involved the individual avoiding the source of chemical exposure. For example, Sprouse et al found that when a man stopped going to work where he was being exposed and went through a “detox treatment,” his health improved.⁷ Was it



No study to date has assessed the ability of a sauna alone to remove toxic chemicals from one's body.

the body. As such, firefighters have taken to saunas as a way to reduce the amount of chemicals in their body. While this is a logical thought, there are several other considerations to keep in mind.

First, just because a chemical has been measured in sweat does not necessarily mean that sweating is the best method of detoxification. The proportion being removed from your body is important. In fact, it's been shown that less than 0.02 percent of one's daily intake of polychlorinated biphenyls (PCBs) can be sweat out.⁶

No study to date has assessed the ability of a sauna alone to remove toxic chemicals from one's body. All past studies have used a combination of therapies. It is therefore impossible to distinguish the effect of sauna use and sweating without considering the effects of the other thera-

the “detox treatment” that improved his health or simply the fact that he stopped being exposed? Was time and the body's natural detoxification system (kidneys and liver) the main reason why the individual's health improved?

Further, there are concerns with adding an additional heat stress event to a firefighter's life. Kidneys are a major part of the body's filtration system, and excess heat has been shown to injure firefighters' kidneys.⁸ Therefore, if sweating via sauna is only removing a small portion of a chemical in the body, but injuring the kidneys, it could impede detoxification and, in fact, worsen the situation.

Firefighters are exposed to hundreds of different chemicals. Chemicals can differ significantly in how they enter our bodies, where they are stored, how long they

are stored for, and how they are excreted. What may work for one method of detoxification may not work for another.

Overall, at the present time, there is insufficient evidence to support the use of saunas as a means of removing the chemicals firefighters are exposed to from the body. As more data and research emerges, the use of saunas will be re-evaluated.

Be proactive

There is no question that everyone is desperate to find a solution to the staggering rates of cancer within the fire service. Although there are products and approaches that may be a step in the right direction, we must be cautious to not declare any one approach to be the “magic bullet” before further research can address additional questions.

Although chemical exposures do impact cancer rates, we cannot focus solely on this issue without also addressing other issues that play significant roles in the risk of illness and disease. Specifically, absence of excess body fat has been

shown to lower the risk of most cancers, yet firefighters have staggering numbers when it comes to weight, with 80 percent of career and 78 percent of volunteer firefighters being overweight or obese.^{9–10}

The bottom line: We cannot lose sight of the basics. Reducing cancer risks in other parts of life (e.g., fitness, diet, smoking habits), limiting chemical exposure by wearing proper PPE and using SCBA from start of fire suppression to end of overhaul, and minimizing cross-contamination must be addressed and fully enforced. ■

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Jennifer Keir is a research associate and PhD student at the University of Ottawa studying toxic exposures to combustion-derived substances. She completed her master’s degree in chemical and environmental toxicology at the University of Ottawa where she assessed firefighters’ exposures during on-shift, emergency fire suppression. Keir also has bachelor’s degrees in chemistry and health science from the University of Western Ontario.

SURVIVOR STORY

“Treat Fires More Like a Hazmat Scene”

— Battalion Chief Jeff Novak

Battalion Chief Jeff Novak has been with the Fort Worth, TX, Fire Department for 25 years, currently serving in Battalion 1. He was diagnosed with non-invasive, low-grade, transitional cell bladder cancer in October 2015. He is now in remission.



How did you learn you had bladder cancer?

I learned I had cancer in a non-traditional way—the cancer dogs that can detect cancer on your breath. After about a month and a half, I got the news that the dogs had detected some sort of cancer. You’re sent on a hunch; you know you have something, but you don’t know where or what.

What were your first thoughts after you were diagnosed?

I was concerned about how it would affect my family—my wife and daughter, my friends—and how it will affect every aspect of my life, specifically the duration.

How did they locate the cancer?

I went through a series of tests. You’re on a wild goose chase. I went to a dermatologist, had a colonoscopy, went to my own family practitioner, had a ViaScan—everything we could do to find what the dogs had detected. I had a back injury, so in an unrelated MRI of

my back, the scan hit the right side of my bladder and the radiologist noticed a worrisome growth, so I went to a urologist . . . and he looked up at me and said, “the dogs were right.”

Do you believe that your cancer is a direct result of the profession?

I do believe that my cancer is a result of the job—the exposure to smoke and carcinogens at fires, and some bad practices that I would like to see corrected for future firefighters—and we can start as soon as right now.

What would you like all firefighters to start or stop doing to reduce their risk of contracting cancer?

I would like to see all firefighters treat fires more like a hazmat scene to reduce their exposure to the carcinogens that are produced in modern-day fires. Keep your SCBA on during overhaul, do decon on scene immediately, and then follow up with a more detailed decon when you get back to the station. Stay clean and live healthy.

To watch Novak’s full interview, visit tinyurl.com/cancer-awareness-2018. Thank you to the Fort Worth Fire Department and Glen E. Ellman for their work on this video.

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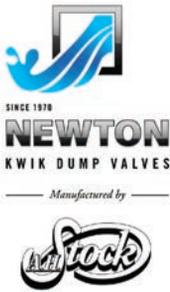
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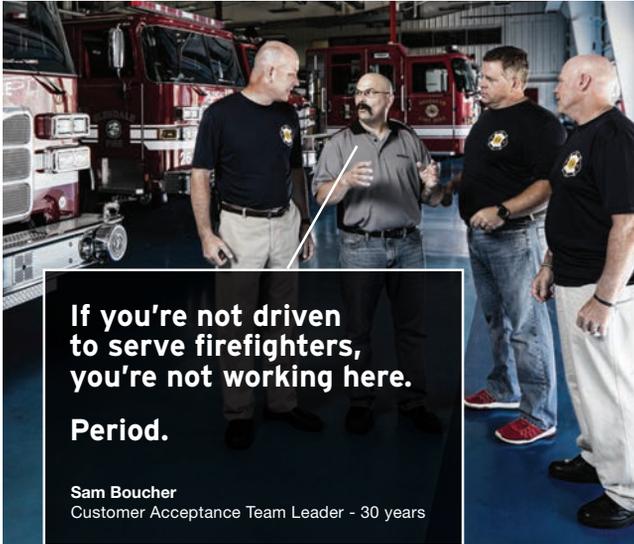
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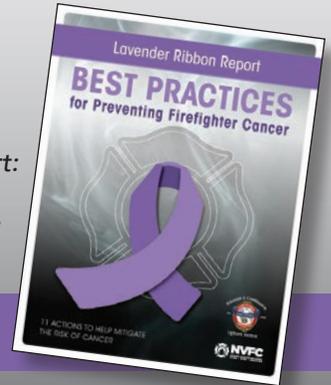


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11 Actions to Prevent Firefighter Cancer

The National Volunteer Fire Council and International Association of Fire Chiefs' Volunteer and Combination Officers Section have released a new guide highlighting 11 actions you can take to protect you and your crew from firefighter cancer.

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