

# **Firefighter Cancer Prevention in Deerfield Township Fire Rescue**

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### **Abstract**

Cancer among firefighters has been a topic of concern for a very long time. Because of the elements they are exposed to, it is proven that firefighters are at a significantly higher risk of contracting cancer than the general public. While many states have presumptive cancer laws in place for job related cancers in firefighters, there needs to be more focus and effort placed on measures to prevent cancer.

The problem is that Deerfield Township Fire Rescue does not have adequate measures in place for firefighter cancer prevention. The purpose of this research is to identify why firefighter are vulnerable to job-related cancers, evaluate proactive methods of cancer prevention in firefighters, and determine if any of those would be applicable for Deerfield Township Fire Rescue (DTFR).

Descriptive research was conducted in the form of a literature review and a survey regarding cancer prevention that was sent to multiple fire departments in Southwestern Ohio. The descriptive research was conducted to answer the following questions;

- 1) Why is there such a high risk of firefighters contracting job related cancer?
- 2) What are effective measures towards cancer prevention in the fire service?
- 3) What proactive measures are other fire departments taking towards cancer prevention?

The results found a direct correlation between firefighters and certain cancers. It was found that cancer among firefighters is a true concern, but preventative measures can be taken to significantly reduce a firefighter's chance of being diagnosed with job-related cancer.

The recommendations from this paper found, a) The need for a cancer prevention policy within DTFR, b) Continuing the current cancer prevention measures DTFR is taking, and c) Investigate the feasibility of instituting other proven cancer prevention measures within DTFR.

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## Introduction

There has been significant research linking the harmful chemicals that firefighters are exposed to with certain types of cancer. Because of this, firefighters are at a significantly higher risk of contracting cancer than the general public. This concern has grown enough interest that states have signed into law, presumptive cancer bills that give firefighters medical coverage for job related cancer. This is apparent by Ohio recently becoming the 37<sup>th</sup> state to have a presumptive cancer bill signed into law. While this is very important and relieves some of the burden when a firefighter is diagnosed with job related cancer, it is an obligation of the firefighter and employer to take proactive measures to prevent job related cancer.

There are many ways to prevent cancer within the fire service, some of which have no monetary impact; others might not be feasible for some departments due to cost. Regardless, departments need to have measures in place to prevent firefighters from being diagnosed with cancer. The concern for job related cancer has increased within the fire service due to items burning being predominantly made from synthetic and petroleum based materials. This causes deadly smoke that is filled with toxic chemicals and carcinogens. These deadly and cancer causing elements can enter the body through inhalation and absorption even when firefighters are wearing protective clothing. Because emergency vehicles are parked in an enclosed garage area which is often connected to the living area, firefighters are also exposed to diesel exhaust. Repeated exposure to these chemicals can lead to multiple types of cancer.

The problem is that DTFR does not have adequate measures in place for cancer reduction or prevention. Because there are many proven measures that can be taken towards cancer prevention in the fire service, the purpose of this research paper is to identify and evaluate proactive methods of cancer prevention in firefighters. This research will also determine if any

of those methods would be applicable for DTFR. While DTFR already takes some measures towards cancer prevention, the increase in firefighters being diagnosed with job-related cancer along with the cancer risk among firefighters, justifies investigating the feasibility and institution of a policy regarding some or all of the proactive measures found in this research within DTFR.

Descriptive research was conducted for data collection and analyses regarding what are the best preventative measures that can be taken to reduce cancer in the DTFR. The descriptive research was done through internet searches and a survey sent to multiple, random fire departments in southwestern Ohio in an attempt to answer the following questions; 1) Why is there such a high risk of firefighters contracting job related cancer? 2) What are the most effective measures towards cancer prevention in the fire service? 3) What measures are other fire departments taking towards cancer prevention?

### **Background and Significance**

Deerfield Township Fire Rescue (DTFR) serves the residents of Deerfield Township, Ohio since its independence after splitting from the Mason-Deerfield Joint Fire District in September of 1998. Deerfield Township is a diverse, thriving urban area located in Warren County where 36,059 residents reside within 14,084 housing units (Rice, n.d.). Deerfield Township is about 16 square miles and mostly residential but also offers large number of commercial, office buildings, retail shops, hotels, an open air style shopping mall and a minimal amount of industrial buildings. Deerfield Township is bordered by the City of Mason which has almost as many residents as Deerfield Township, with a large amount of commercial, industrial, and office buildings, as well as a hospital, a large theme park and a large water park.

Deerfield Township Fire Rescue is a career department with a full-time and part-time staff. The department has 36 full-time members and an average of 60 part-time employees. The

fire department operates with three platoons, each shift working a 24 hour shift followed by 48 hours off, with full-time employees having a Kelly day every three weeks which equals a 48 hour work week. DTFR serves its residents out of three fire stations with 6 firefighters at each station and a total maximum staffing per day of 18 firefighter EMT/paramedics with a Battalion Chief and a minimum of 13 firefighter/EMT paramedics with a Battalion Chief.

The department delivers a number of services to its residents as well as to mutual aid departments. These services include, but are not limited to, paramedic and EMS transport service, fire suppression, technical rescue, and hazardous materials mitigation. In 2016 DTFR responded to 3,923 emergencies with 2,684 being emergency medical details and the remaining 1,239 being fire details (FRMS, 2016). Of those fire details, 136 were classified as actual fires where DTFR personnel were subjected to fire and/or smoke conditions.

Due to the township being split geographically by the City of Mason, DTFR relies on mutual aid from neighboring departments to fulfill manning requirements on fire and EMS scenes. This assistance is reciprocal in that DTFR offers mutual aid to neighboring departments as well. According to data, in 2016 DTFR gave mutual aid on 831 occasions to neighboring communities, and received mutual aid on 313 occasions (FRMS, 2016).

There have currently been no documented cases of job related cancer reported by any current or retired DTFR employees. Just recently, the state of Ohio signed into law a presumptive cancer bill that covers job related cancer in firefighters. This is a huge step towards the protection of health within the fire profession in Ohio, but this law is not the end all cure all for job related cancer. The fact that firefighters have a 29% higher risk of contracting cancer than the general population has heightened the awareness of DTFR to take steps towards cancer prevention (FFCF, 2017). DTFR has taken proactive measures towards cancer reduction,

however with the new research that supports many other ways to prevent cancer, DTFR would benefit from the examination and possibly institution of other methods of cancer reduction.

DTFR realizes that a primary goal is the health and wellness of its firefighters. The research provided from this paper will address the U.S. Fire Administrations Strategic Framework goal to *Enhance the Fire and Emergency Services' Capability for Response to and Recovery From All Hazards*, by promoting and enhancing the health and wellness of emergency responders (FEMA, 2017).

### **Literature Review**

Firefighting is an inherently dangerous job in which firefighters are exposed to many dangerous chemicals and place themselves in atmospheres that are considered to be Immediately Dangerous to Life and Health (IDLH). The toxic environments that firefighters are exposed to give them a 29% higher risk of contracting cancer than the general population (FF Cancer, 2017). There are requirements that fire departments abide by to keep this risk down, but many studies have proven that abiding by the minimum standards isn't enough to prevent the risk of cancer, and more measures need to be taken.

Many studies have been conducted to answer the question of why is there such a high risk of firefighters contracting job related cancer. Unfortunately this data takes a very long time and much research to confirm. In 2010, NIOSH began a groundbreaking cancer study that lasted almost 6 years and followed almost 30,000 firefighters from three different fire departments from 1950 - 2009. This study confirmed the correlation of cancer and firefighters, along with certain types of cancer that firefighters are more prone to.

In an article released by Matthew Dahm in conjunction with the NIOSH study states that there is an increase of "evidence linking occupational exposures from firefighting to various



forms of cancer including cancers of the brain, digestive tract, genitourinary tract, lymphohaematopoietic and respiratory systems” (Dahm, 2015). During the same NIOSH study, it was found that there was an increase in mortality in some cancers among the 20,000 eligible firefighters in the study. The study found that of those almost 20,000 firefighters there was 2609 incidents of cancer cases and 1333 deaths as a result of cancer (Daniels, 2015). The findings confirmed the chemicals that firefighters come into contact with are carcinogens and were linked to the different types of cancer. The findings of the NIOSH study also confirmed an increase of mesothelioma in firefighters, a rare type of cancer linked to asbestos exposure, as well as cancers in younger firefighters that is not common in the general population (Cancer Study, 2016).

According to an article published from the Firefighter Cancer Support network titled *Taking action Against Cancer in the Fire Service*, there is credible statistics linking fire fighters to cancer at a much higher rate than the general public. The article offers that firefighters are two times more likely to develop testicular cancer, one and a half times more likely to develop multiple myeloma and Non-Hodgkin’s lymphoma, one and a third more likely to develop skin cancer, prostate cancer, brain cancer and malignant melanoma, as well as an increase in breast cancer in women (FCSN, 2013). These cancers, proven to be job related in firefighters cover many organs within the body including bone marrow and blood.

Due to fire prevention and technological advances in fire detection and extinguishment, the amount of fires that most fire departments are responding to is decreasing. Although with budget cuts, lowered manpower, brown outs and station closures firefighters are being exposed to elements containing carcinogens for a longer period of time. These budget cuts also limit the measures that fire departments can take towards cancer prevention. Homes are being furnished with more and more furnishings and interior elements that are made from synthetic materials.

During pyrolysis these synthetic materials put off deadly toxic chemicals that are carcinogenic, and burn at a faster rate than legacy materials made from natural elements. The Firefighter Cancer Support Network shares that “Today’s residential fires have more in common with hazmat events than old-fashioned house fires due to the materials now common in homes such as plastics and synthetics” (FCSN, 2013). This is not to mention the other fires that firefighters come in to contact with such as dumpster fires, chemical fires, commercial vehicle fires, and passenger vehicle fires.

A meta-analysis study conducted by the University of Cincinnati found exposure by firefighters to an array of chemicals during and after a fire have a direct correlation with the development of cancer. The meta-analysis showed that three types of cancer were probable “based on the quantitative meta-risk estimates” (LeMasters et al, 2006). These three cancers were; multiple myeloma which is cancer of the bone marrow, non-Hodgkin’s lymphoma which is cancer in the lymph nodes, and prostate. The meta-analysis offers that known risk factors other than race for multiple myeloma are occupational exposures which include engine exhausts and organic solvents of which firefighters are exposed to (LeMasters et al, 2006). LeMasters shares that in a review article from Parent and Siemiatycki, evidence shows that prostate cancer is associated with a number of different chemicals including diesel engine emissions and polycyclic aromatic hydrocarbons (PAH), again both of which firefighters are exposed to (LeMasters et al, 2006).

In 2017, Ohio was the thirty seventh state to sign into law a bill that will provide Occupational Cancer Presumptive Coverage for Firefighters within the state. According to the Ohio Association of Professional Firefighters (OAPFF) the bill will provide coverage for firefighters whose cancer is related to exposure to IARC level 1 or 2A chemicals (OAPFF,

2016). According to the International Agency for Research on Cancer (IARC) there are 119 Group 1 agents that is defined as agents that are “carcinogenic to humans”, and 81 agents classified as Group 2A which is defined as “probably carcinogenic to humans” (IARC, 2017). Along with studies correlating firefighting with cancer, there have also been studies that include the chemical agents found within smoke during fires and routes of entry into the body.

IARC offers that “All types of fire release toxic and carcinogenic substances, including benzene, 1,3 – butadiene, and formaldehyde”, and that the focus in the past has been on the common substances such as carbon monoxide (CO) and hydrogen cyanide (HCN) (IARC, 2010). With the increase of synthetic materials being produced, when burned will produce a number more particulates and chemicals that are more harmful than previous chemicals firefighters were concerned with (IARC, 2010). A presentation by Dr. Virginia Weaver (2012) states that “thousands of new synthetic chemicals are produced annually, making it impossible to study the toxic properties of each one, let alone the toxic properties of their combustion products”. This means firefighters are exposed to what some may call a toxic soup of chemicals.

Furthermore, the IARC conducted studies that found a number of different dangerous chemicals within smoke. The chemicals found in smoke by the IARC (2010), which were classified as Group 1 and Group 2A are;

- Arsenic; Group 1 carcinogen; Cancer sites in humans - Skin, lung and liver (angiosarcoma)
- Asbestos; Group 1 carcinogen; Cancer sites in humans – Lung, mesothelioma, larynx, and gastrointestinal tract
- Benzene; Group 1 carcinogen; Cancer sites in humans – Leukemia
- Benzo[*a*]pyrene; Group 1 carcinogen; Cancer sites in humans – Lung, bladder, and skin

- 1,3-Butadiene; Group 1 carcinogen; Cancer sites in humans – Lymphohaematopoietic system
- Cadmium; Group 1 carcinogen; Cancer sites in humans – Lung
- Dibenz[*a,h*]anthracene; Group 2A carcinogen
- Formaldehyde; Group 1 carcinogen; Cancer sites in humans – Nasopharynx
- Lead; Group 2A carcinogen
- Silica; Group 1 carcinogen; Cancer sites in humans – Lung

Underwriters Laboratory (2010) conducted a study that tested chemicals in smoke from the combustion of forty-three common residential building materials and furnishings as well as auto part components. There were also nine studies conducted representing fires in individual rooms, an attic, a deck and an automobile. The findings of this study found that “synthetic materials produced more smoke than natural materials” (UL, 2010). The chemical findings were in line with many other studies in relation to cancer causing agents found in smoke. The field events and controlled field tests found that that collected smoke particulates contained heavy metals including arsenic (group 1 carcinogen) and lead (group 2A carcinogen). The health implications from the UL particulate study found,

Multiple asphyxiants (e.g. carbon monoxide, carbon dioxide and hydrogen sulfide), irritants (e.g. ammonia, hydrogen chloride, nitrogen oxides, phenol and sulfur dioxide), allergens (e.g. isocyanates), and chemicals carcinogenic for various tissues (e.g. benzene, chromium, formaldehyde and polycyclic aromatic hydrocarbons) were found in smoke during both suppression and overhaul phases. Carcinogenic chemicals may act topically, following inhalation, or following dermal absorption, including from contaminated gear. (UL, 2010, p. 8-3)

Studies have proven the correlation between cancers in firefighters and the chemicals that are produced via smoke in the combustion process. But there has to be a way for the chemicals to enter the body. Three routes of entry into the body are through ingestion, absorption, and inhalation. While not out of the question, it is uncommon for firefighters to ingest any particulates, soot, or burned materials. Firefighters have come a long way in terms of respiratory protection while conducting firefighting operations with the Self-Contained Breathing Apparatus (SCBA) being worn in IDLH atmospheres. An SCBA provides a protection factor of 10,000 which when worn correctly will provide the wearer with a tremendous amount of protection against these carcinogens within the smoke. The third route of entry is becoming the most area of concern, absorption.

It is important to note that the concern of airborne carcinogens is not limited to during the active combustion process, though needs to be addressed post fire as well, especially during overhaul. The fire service has become very concerned with post air monitoring, focusing on CO and HCN, but there are many other particulates and chemicals that are of more of a concern. The Firefighter Cancer Support Network states that there is two clear routes of entry into the body for chemicals, one being “through the lungs: when firefighters do not wear or prematurely remove SCBA, especially during overhaul” (FCSN, 2013). An article by Dawn M. Bolstad-Johnson (2000) confirmed that the “Concentrations of air contaminants during fire overhaul exceed occupational exposure limits”.

FCSN states that the other route of entry for chemicals into the body is through dermal absorption, in which chemicals can permeate through the skin (FCSN, 2013). This is a large area of concern in that as long as firefighters are correctly wearing respiratory protection, this is the only other likely way of entry. FCSN shares that there are certain areas of the body which are

more permeable than others. The areas of the body that are more permeable are “specifically the face, the angle of the jaw, the neck and throat and the groin” (FCSN, 2013). This report also offers that “Skin’s permeability increases with temperature and for every 5° increase in skin temperature, absorption increases 400%” (FCSN, 2013). Research from the Queensland Fire and Rescue Service Scientific Branch in Australia (2011) states that it is well established that polycyclic aromatic hydrocarbons (PAH’s) will be “absorbed directly from the vapour phase and penetrate the skin”.

Regulations in regards to turn-out gear offers protection for the skin and clothing of firefighters against smoke and toxic gases, although there are ways that chemicals can be introduced through the gear and onto clothing or skin. Studies have found that two most common ways are through the “bellows effect”, in which the firefighter bends over and air is expelled and when he/she rights themselves, outside contaminated air is sucked back in; and the “chimney effect” where the firefighters normal movement cause the introduction of contaminated air to contaminate the skin and clothing (Queensland, 2011). There are also many penetrations that can cause the introduction of contaminated air into the clothing such as cuffs and collars. Toxic carcinogenic particles will bond to the firefighter’s perspiration and because of the heat already intensifying the dermal permeation will enter the body and bond to the molecules in the body. If not removed, these toxic chemicals will stay in the body until released and the longer these toxins stay in the body, the more chance a person has to develop long term health issues, including cancer. This essentially turns the skin into a sponge for toxic chemicals.

The nomex hood worn by firefighters provides the least amount of protection given the thickness of the material the protective equipment provides. Given the skin around the area in which the nomex hood is worn are some of the most permeable areas of the body, it can be

assumed that this area is a huge concern in terms of routes of entry for carcinogens. The soot that is found on gear, hoods and gloves is a major concern as well. Soot is usually wiped into a firefighter's body during or after a fire. According to the article by the Firefighter Cancer Support Network (2013), "Soot has ultrafine particles that enter the lungs and it is also absorbed through the skin traveling to most organs including the brain". It is also noted by LeMasters (2006) that firefighters have often reported soot on their skin, especially in the groin area, stating that "It is noteworthy that testicular cancer had the highest summary risk estimate and skin cancer had a summary risk assessment". The groin area is prone to pooling of sweat while wearing turn out gear, which could be the cause of the soot in the part of the body.

There has been research that solidified the relationship between job related cancer and firefighting, but there is research that answers what are effective measures can be made to prevent job related cancer in firefighters. For many firefighters, it is a rite of passage to have and wear dirty turn out gear and a dirty helmet. This shows the "grit" these firefighters have been through, but this might be one of the worst things that could be done. Studies have shown that toxic chemicals from smoke are able to breach protective clothing and come into contact with clothing and skin, now contaminating many things including gear/protective equipment, clothing and skin. There are many actions that can be taken to protect firefighters that have no monetary aspect.

The lack of decontamination of equipment and people has a domino effect. Gear that is stored in the bay area where vehicles are parked is subject to diesel fumes which have benzene, which is a group 1 carcinogen which causes leukemia. Once the gear is put on, the firefighter's skin is exposed to the chemicals. After a fire, a firefighters gear and equipment is full of carcinogens along with small and large particles of soot, which if not properly washed off will

contaminate the fire apparatus, and if not properly cleaned after getting back to the station will then have the possibility of contaminating anyone else who rides in the apparatus. This is the same for firefighters who wear contaminated clothing or gear into the living areas of the fire station. This is a huge cross contamination issue. The same issue occurs if firefighters do not wash their gear for months at a time after a training burn or fire. The PPE will dry, but will still be full of toxic chemicals and carcinogens.

Being correctly fitted for personal protective equipment as well as being fit tested annually for a SCBA face piece has an effect of toxic exposure as well. Gear that is not fitted correctly, or not worn correctly will defeat the purpose of the protection of the gear and moisture/thermal barrier and allow exposure. Wearing the wrong size mask will also allow the possibility of the firefighter to inhale toxic chemicals and carcinogens.

There are many organizations that offer prevention suggestions that help prevent cancer. The Mayo Clinic (2017) offers the following on their website;

- Stop smoking
- Avoid excessive sun exposure
- Eat a healthy diet
- Exercise most days of the week
- Maintain a healthy weight
- Drink alcohol in moderation, if you choose to drink
- Schedule cancer screening exams
- Ask your doctor about immunizations

While the Firefighter Cancer Support Network offers the following suggestions based more specifically around firefighters;



1. Use SCBA from initial attack to finish of overhaul. (Not wearing SCBA in both active and post-fire environments is the most dangerous voluntary activity in the fire service today.)
2. Do gross field decon of PPE to remove as much soot and particulates as possible.
3. Use Wet-Nap or baby wipes to remove as much soot as possible from head, neck, jaw, throat, underarms and hands immediately and while still on the scene.
4. Change your clothes and wash them immediately after a fire.
5. Shower thoroughly after a fire.
6. Clean your PPE, gloves, hood and helmet immediately after a fire.
7. Do not take contaminated clothes or PPE home or store it in your vehicle.
8. Decon fire apparatus interior after fires.
9. Keep bunker gear out of living and sleeping quarters.
10. Stop using tobacco products.
11. Use sunscreen or sun block.

Exercise is another important aspect of cancer reduction. According to an article by Robert Fling (2015), exercise should be an integral part of a firefighter's life as it helps the body sweat, detoxify and rid the body of carcinogens. Fling goes on to offer that there have been findings that saunas also are a good way to detoxify.

The above recommendations are procedures that can be instituted that have no monetary impact, although there are many procedures for the prevention of cancer that will decrease morbidity and the risk of cancer, but at a cost. Annual physical examinations of firefighters are a safe but expensive practice that might find, treat and prevent many health issues including cancer. According to the Firefighter Cancer Support Network (2013), "The importance of

annual medical examinations cannot be overstated — early detection and early treatment are essential to increasing survival”.

According to the Cambridge Dictionary (2017), detoxification can be defined as “the process of removing harmful or toxic chemicals”. The ridding of toxic chemicals from the body is still being researched within the fire service but has been proven to be effective. According to an article written by Mike Schlags (2011), saunas being utilized as sweat therapy have shown to be effective at lowering the levels of fat soluble chemicals. Some of these chemicals include carcinogens and heavy metals that can cause illness to firefighters who are exposed to them. Schlags (2011) goes on to offer that the majority of environmental toxins are fat soluble, and unlike water soluble toxins that can be excreted through natural body functions, fat soluble toxins bind to the body’s fat molecules. These molecules ridden with toxins can then travel throughout the body including major organs such as the brain and nervous system if not properly excreted (Schlags, 2011). Toxin retention can lead to illnesses including cancer, and one proven way to rid the body of toxins such as this is through a sauna.

In an article titled *Traditional and Infrared Sauna Detoxification* (n.d), it is explained the benefits of detoxification, explaining that the body excretes toxins through sweating. Infrared rays will accelerate the body’s sweating mechanism, hence allowing toxins to be excreted in a quicker amount of time. The article goes on to say that the body is built to excrete toxins through different channels such as urinary tract, through bowels, and through sweat and tears (Sauna Detox, n.d.). As stated before, water soluble toxins will be excreted through urine, but the fat soluble toxins will bind to the molecules, and as the article states “there is no quick and safe way the body can get rid of them other than through a sweating program in the sauna” (Sauna Detox, n.d.)

The research supports different preventative measures, but with this supportive research being so new, and presumptive cancer bills becoming a hot topic, finding research on internet regarding departments who have instituted policies or procedures regarding cancer prevention was found to be rare. Many departments are actively researching this topic to produce a policy. Many departments have an impromptu replacement of hoods, gear, or decon during and after fires of gear and personal items and body, but not many have policies. This information will be solidified during the presentation of a survey that was sent to multiple departments later in this research paper.

### **Procedures**

There were multiple sources utilized during this research. The descriptive research was unbiased and conducted through internet searches, meta-analysis review, documented studies, and through a survey that was sent out to multiple fire departments. Since some of these measures are new, information found outside of the fire service proved to be informative and logical.

The internet was utilized to conduct searches of certain relevant terms and phrases. This internet search was conducted with Google using the keywords and phrases “fire department cancer prevention policy”, “firefighter cancer prevention”, and “cancer prevention measures”. Information found on the internet proved to be beneficial and helpful, giving the opportunity to branch off and find other advantageous information from websites outside of the fire service.

A survey was sent out to fire departments throughout the southwest Ohio region. The departments were chosen in no specific order, although an attempt was made to choose a diverse range of departments to give a broad variety of data. Departments ranged from all full-time, part-time/full-time, and all volunteer, with staffing numbers ranging from 0-50, up to 500. 13

departments were sent the survey, and only 9 responded. The survey and responses have been included in Appendix A. A personal interview with Deerfield Township Fire Rescue Chief Chris Eisele was conducted to gain internal information to solidify the research. Chief Eisele was very receptive and open-minded of this research, and was willing to take into account any research that would be applicable to his department.

The below are definitions of abbreviated terms within this research paper:

CO – Carbon Monoxide

FCSN – Firefighter Cancer Support Network

HCN – Hydrogen Cyanide

IARC – International Agency for Research on Cancer

IDLH – Immediately Dangerous to Life or Health

NIOSH – National Institute for Occupational Safety and Health

PAH - Polycyclic Aromatic Hydrocarbons

PPE – Personal Protective Equipment

SCBA – Self-Contained Breathing Apparatus

UL – Underwriters Laboratory

The limitations of the descriptive research included limited information on departmental policies regarding cancer prevention. It has been noted that since there is a wide variety of measures that can be taken towards cancer prevention, some of which have no momentary value while other have monetary implications, many departments are in the process of evaluating different cancer prevention measures. Departments are relying on research such as what is found within this applied research paper to help determine what will best fit their department.

The limitations of the survey included the lack of responses, and variety of answers. While many of the respondents advised that their department plans of taking preventative measures towards cancer prevention, not many offered policies in place within their department. Many departments seemed to be having the same problem this research is trying to identify. There were also 4 departments that did not send a response back. That accounted for 30% of the surveyed departments.

### **Results**

Through descriptive research, the answers to the questions within the abstract of this paper were reached. While there were limitations, valuable information was gained to answer the following questions;

Research question 1. *Why is there such a high risk of firefighters contracting job related cancer?* Historically firefighters have been known to be exposed to cancer causing agents, which gives them a 29% higher risk of contracting cancer than the general population (FF Cancer, 2017). In fact, one study conducted by NIOSH has confirmed that there is “evidence linking occupational exposures from firefighting to various forms of cancer including cancers of the brain, digestive tract, genitourinary tract, lymphohaematopoietic and respiratory systems” (Dahm, 2015). This study found that 13% of the 20,000 firefighters in the almost 60 year study contracted cancer, and almost 7% of the firefighters dies as a result of their cancer (Daniels, 2015).

The environment firefighters enter is sometimes called a toxic soup of chemicals, and due to the makeup of modern furnishings being predominantly synthetic, today’s fires “have more in common with hazmat events” due to plastics and synthetics burning (FCSN, 2013). While fires in previous years with modern furnishings consisting of wood, wool, and cotton did produce

carcinogens, today's synthetic combustibles produce many more toxic chemicals and carcinogens, which enter the firefighter's body and could cause cancer. This has been solidified with much research that has been conducted. One study by the IARC proves that there are eight different group 1 carcinogens found within the toxic smoke produced by synthetic material burning (IARC 2010). Another issue is that benzenes, also a group 1 carcinogen which is found in diesel exhaust has been linked to leukemia.

While firefighters wear protective clothing, studies have found that carcinogens are able to still enter the body. The routes of entry are ingestion, inhalation and absorption. Ingestion is a very unlikely route of entry, and with the wide spread use of SCBA's the route of inhalation chances have been lowered. Although the premature doffing of an SCBA or mask after a fire is out, during overhaul or during investigation could be a logical inhalation route of entry for chemicals (FCSN, 2013). Toxic carcinogens have been found on the skin of firefighters after a fire. These carcinogens have been found to enter the body through absorption due to the skins permeation increasing 400% for every 5° temperature increase (FCSN, 2013). Soot has also been found to contain carcinogens, and if not properly decontaminated, soot and large particles from a fire can cause cross contamination through the living areas in a fire station and the fire apparatus.

Research question 2. *What are effective measures towards cancer prevention in the fire service?* Many different measures can be taken to prevent job related cancer in firefighters, some of which can be instituted with minimal to no cost, while other come with a cost. Some measures can be thought of as common sense and does not need much research to prove its effectiveness, yet there are some measures that extensive research has been conducted to prove its efficacy.

Basic lifestyle changes can prevent cancer in firefighters. The Mayo clinic offers a list that includes smoking cessation, exercise, maintain a healthy weight and diet, avoid sun exposure and schedule cancer screening exams (Mayo Clinic, 2017). Annual physicals provided by the fire department or by the individual are also a measure that will provide early cancer detection. A prostate-specific antigen (PSA) test can also provide early detection in male firefighters, and mammograms can provide early detection in female firefighters.

Initial and annual fit testing of an SCBA mask will ensure a tight and proper fit, eliminating the chance of any inhalation hazards. Wearing all PPE, and wearing it correctly throughout the entire incident, including overhaul and investigation is also a prevention measure. The Firefighter Cancer Support Network offered 11 preventative measures that have minimal to no cost to the firefighter or department. Those measures include; using an SCBA throughout the entire incident; conduct gross decon before leaving the scene to get rid of large particles on equipment and gear; use wet-naps or baby wipes to remove as much soot as possible; especially the areas of the body in which permeation through the skin is vulnerable (face, angle of the jaw, neck throat and groin); change contaminated clothing and take a shower immediately after a fire and do not take contaminated gear or clothing home or in personal vehicle; decon fire apparatus (especially cab area) and tools after a fire; keep bunker gear out of living and bunk areas; stop tobacco use, and; use sun block (FCSN, 2013).

Exercise is another measure that can be taken to prevent cancer. Exercise allows the body to sweat and naturally detoxify. Sweating is a good way to detoxify and rid the body of chemicals and toxins that have made their way into the body. During a fire, a firefighter's body temperature will naturally rise due to heat conditions and work load. This increases the permeation of the skin and allows carcinogens to enter the body. Water soluble toxins will be

flushed out of the body through natural methods, although fat soluble toxins will bind to the body's fat molecules and these molecules ridden with toxins can then travel throughout the body including major organs such as the brain and nervous system if not properly excreted (Schlags, 2011).

By using a sauna, specifically an infrared sauna, soon after a fire but before taking a shower will allow the bodies temperature to rise, and rid the body of these toxins through sweating, opposite of how these toxins are permeated through the skin. Quickly releasing these toxins through sauna detoxification will prevent these chemicals from traveling through the body and possibly infecting major organs. While there is little data to specifically support cancer prevention in firefighters by using a sauna since it is such a new concept within the profession, many departments use this technology and the detoxification concept is proven in sauna use outside of the fire service.

Research question 3. *What proactive measures are other fire departments taking towards cancer prevention?* Part of the limitations of this paper was the minimal amount of information found regarding departments who have already instituted a cancer prevention policy. As part of the research, a survey was sent out to a diverse range of departments to gain information regarding cancer and cancer prevention. Some departments surveyed are comparable to DTFR, although a range of departments which are significantly larger and significantly smaller were chosen as well to provide an all encompassing result. 13 departments were sent the survey which is included in Appendix A, and only 9 departments replied.

The information gathered from this survey provided much info including 56% of the department surveyed had some sort of cancer prevention measures in place. Most of these measures include decon on the fire scene prior to leaving, cleaning of turn out gear after a fire



and specific SCBA usage requirements and post fire air monitoring. Only 22% of the departments conduct annual physicals, and 11% have a hood exchange program, mandatory daily physical fitness or a diesel exhaust system in their fire stations. 33% surveyed carry decon kits for firefighters to utilize on the scene, and 2 departments have had firefighters diagnosed with job-related cancer. These cancers included renal, lung, brain, skin, testicular, and colon cancer. All 100% of the departments surveyed do plan on taking preventative measures in the future to prevent firefighter cancer.

### **Discussion**

Deerfield Township is obviously committed to the health and safety of its firefighters by the measures that are already taken to assist in firefighter prevention. The problem is just that, assisting the firefighters and not mandating employees follow strict policies on cancer prevention. DTFR has the opportunity to provide its full-time employees with two sets of gear while working diligently on getting back up sets for part-time employees, and also offers multiple protective hoods and gloves for routine replacement. With DTFR being so far ahead of many other departments, this should give the department an opportunity to look at further cancer prevention measures that was researched in this paper, and develop a prevention policy.

The research found a slim relationship between the study results and the findings of others. Most of the study results consisted of measures that can be taken by departments that do have a monetary value. Although many of the departments surveyed had little to no preventative measures in place, but were actively looking to do so. It was also found that most of what these departments wanted to institute was in line with what these study results found.

The interpretation of the results is that every department needs to be actively looking into instituting a policy or procedure that covers cancer prevention in the fire service. Now that

studies have been released strongly linking firefighters and job-related cancers, along with 37 states having presumptive cancer bills providing care to firefighters with job-related cancer, municipalities and fire departments have an obligation to protect their greatest asset, the firefighters. This can easily be done by developing and strictly adhering to a policy that addresses cancer prevention. Municipalities have a right to protect the employees against a now proven disease caused by elements of the fire profession, and it is only a matter of time before litigation is brought against municipalities that do not institute prevention policies by families, workers comp, or insurance companies.

It is proven through studies that there are indeed carcinogens in the smoke produced by fire as well as the diesel exhaust fumes from our apparatus. Furthermore, it is proven that these toxic chemicals can be absorbed through a firefighter's skin and inhaled into a firefighters lungs. This confirms that the best way to avoid entry of these toxic chemicals through inhalation is to wear an SCBA which provides a very efficient means of protection. Gross decontamination of turn out gear and tools on the scene will also eliminate cross contamination within the vehicles, and further cleaning tools, switching and cleaning gear gloves and hood, cleaning the cabs of the apparatus, taking a shower immediately and washing clothes will also prevent cross contamination in vehicles and within the fire station, thus reducing the chances of cancer.

Deerfield Township Fire Rescue has the opportunity to be the first in its area to institute such an in depth cancer prevention policy with the research findings. This has huge implications of what the surrounding area does in regards to cancer prevention. The survey results show that all of the departments surveyed have plans to implement changes towards cancer prevention within their department. The implication is that instituting a policy mandating current measures offered by DTFR, further researching the cost and upkeep of a sauna within the fire station(s)

will put DTFR at the forefront regarding cancer prevention in the area, further prompting more departments to institute policies to keep all firefighters safe.

### **Recommendations**

The research in this paper confirms that there is a higher than normal risk of firefighters contracting cancer due to exposures while on the job. Carcinogens within the smoke from fires and diesel fumes present a high risk of firefighters being diagnosed with cancer.

Given the information gathered from this paper, the author recommends the following:

1. Drafting a cancer prevention policy that institutes current and future cancer prevention measures. This should include gross decontamination of turn out gear and equipment while still on scene; utilizing wet wipes on scene; thorough decontamination of apparatus cab areas and tools; mandating a shower as soon as possible after returning and cleaning; mandating the cleaning of clothes at the fire station after the fire; and ensuring that dirty gear and/or uniforms are not taken home, into living areas of the fire station or in personal vehicles.
2. Implement a stricter post-fire policy that specifies SCBA usage during overhaul and investigation.
3. Continue to purchase gear to allow all full-time members to have two sets of gear, and the opportunity for part-time members to wear clean gear that fits them while gear is being cleaned.
4. Continue annual health physicals and cancer screenings as well as departmental physical fitness requirements.
5. Further research the cost, maintenance, and applicability of a sauna, specifically an inferred sauna, in each station. Research securing funds as needed.

## References

[Cancer Prevention](#). (n.d.). Retrieved February 08, 2017

Dahm, M. M., Bertke, S., Allee, S., & Daniels, R. D. (2015). Creation of a retrospective job-exposure matrix using surrogate measures of exposure for a cohort of US career firefighters from San Francisco, Chicago and Philadelphia. *Occupational and Environmental Medicine*, 72(9), 670-677. doi:10.1136/oemed-2014-102790

Daniels, R. D., Bertke, S., Dahm, M. M., Yiin, J. H., Kubale, T. L., Hales, T. R., . . . Pinkerton, L. E. (2015). Exposure–response relationships for select cancer and non-cancer health outcomes in a cohort of US firefighters from San Francisco, Chicago and Philadelphia (1950–2009). *Occupational and Environmental Medicine*, 72(10), 699-706. doi:10.1136/oemed-2014-102671

[Detoxification Definition](#) in the Cambridge English Dictionary. (n.d.). Retrieved February 08, 2017

FEMA, U.S. Fire Administration. (n.d.). *Strategic Plan Fiscal Years 2014-2018* [PDF].

[Fire Fighter Cancer Foundation](#). (n.d.). Retrieved February 08, 2017

[FIRE FIGHTERS](#). (2016, July 18). Retrieved February 08, 2017

Firefighter Cancer Support Network. (2013, August). *Taking Action Against Cancer in the Fire Service* [PDF].

Fling, R. (2015, June 17). [Just Washing your Gear is Not the Answer](#). Retrieved February 08, 2017

FRMS, Fire Records Management System. (2017, February). [2016 DTFR Fire/EMS Run Totals]. Unpublished raw data.

Data retrieved and sent to author by Battalion Chief Mark Miller, DTFR

[IARC Monographs on the Evaluation of Carcinogenic Risks to Humans](#). (n.d.). Retrieved February 08, 2017

[Infrared sauna detoxification: how exactly is it done?](#) (n.d.). Retrieved February 08, 2017

International Agency for Research on Cancer. (2010). [IARC Monographs on the Evaluation of Carcinogenic Risks to Humans](#). Retrieved February 08, 2017

Lemasters, G. K., Genaidy, A. M., Succop, P., Deddens, J., Sobeih, T., Barriera-Viruet, H., Lockey, J. (2006). Cancer Risk Among Firefighters: A Review and Meta-analysis of 32 Studies. *Journal of Occupational and Environmental Medicine*, 48(11), 1189-1202. doi:10.1097/01.jom.0000246229.68697.90

Queensland Fire and Rescue Service Scientific Branch, & Kirk, K., (PhD). (n.d.). *Firefighter Exposures to Airborne Contaminants during Extinguishment of Simulated Residential Room Fires* (pp. 1-100, Rep. No. 2011-01).

Rice, G. (n.d.). [MCDC Census Profiles](#). Retrieved February 08, 2017

Stern, D. (n.d.). [Senate Bill 27](#) - OAPFF. Retrieved February 08, 2017

U.S. Department of Helath & Human Services. (2016, July 18). [FIRE FIGHTERS](#). Retrieved February 08, 2017

Underwriters Laboratories Inc. (2010). *Firefighter Exposure to Smoke Particulates* (pp. 1-8-3, Rep. No. 08CA31673). Underwriters Laboratories Inc.

Weaver, V., MD, MPH. (2012, May 22). *Testimony of Vrginia M. Weaver, MD, MPH*.

**Appendix A**

Firefighter Cancer Prevention Survey

**Question 1 - Can you provide your name, rank and department name?**

- Steve Kelly Fire Chief Miami Township Fire and EMS
- Mark Ober Chief Anderson Township Fire and Rescue Department
- Tom Butts Chief Kettering Fire Department
- Nicholas Overman Captain (Health and Safety Officer) Dayton Fire Department
- William Hursong Fire Chief. Harrison Fire Department
- West Chester Fire Department Chief Rick Prinz
- Chief Douglas Witsken Green Township Fire & EMS
- Steve Pegram, Chief Goshen Fire and EMS
- Kevin Hardwick OFE/OFC Fire Chief Glendale Fire Department

**Question 2 - Is your department; (check all that apply)**

-Full-time	8 = 88.89%
-Part-time	6 = 66.67%
-Volunteer/Paid on Call	2 = 22.22%

**Question 3 - How many firefighters does your organization currently employ?**

-0-50	1 = 11.11%
-50-100	5 = 55.56%
-100-200	2 = 22.22%
-200-500	1 = 11.11%
-500+	0 = 0.00%

**Question 4 - Does your department currently adhere to any cancer prevention measures or have a cancer prevention policy? If so, could you give a brief description?**

-We do not have a policy in place yet, but we practice various decontamination measures. These include regularly scheduled turnout gear washings, Nomex hood washing every Monday for all on-duty members, and baby wipes in the vehicles for quick decon on fire scenes. We also

provide annual physicals for all of our career members and have a policy on post-fire air monitoring.

-Yes PPE checking and cleaning.

-No cancer policy at this time / we are currently researching and discussing this topic / We do cover a few preventative topics in our current personal protective equipment - care and use guideline.

-We don't have a specific cancer prevention policy at this time. However, we have just updated our respiratory protection general order to require SCBA use during overhaul. We also have a PPE policy that requires the laundering of turnout gear after a fire (we provide two industrial extractors and dryers that comply with NFPA 1851). We are also on year two of a three year phase in process to provide all suppression personnel two sets of turnout gear(this was negotiated in our last CBA).

-SCBA requirement updated to include 24 hours post fire. Decon policy updated for all fires for personnel, apparatus and equipment. Decon kits added to all apparatus.

-We have gear washers in each of our stations to keep our gear clean, we are working on a hood exchange program where you can get a clean hood while your hood gets washed.

-Yes we have policies on fireground decontamination, SCBA usage, and turnout gear washing to mandate protective measures. We also provide diesel exhaust extraction systems at all fire stations, turnout gear washer/extractors, and turnout gear dryers to rapidly dry the washed gear.

-We conduct annual NFPA 1403 Physicals including blood work for cancer screening and chest x-rays every other year. We do daily PT We have a IDLH/Decon policy and kits on all our fire apparatus so we can hasty decon our fire gear and SCBA on scene before we leave. Both Chiefs have 14 spare hoods in their vehicle for a hood exchange at a working fire

-no

**Question 5 - Has any of the firefighters within your department been diagnosed with job-related cancer within the last 10 years?**

-Yes	2 = 22.22%
-No	7 = 77.78%

**Question 6 - If so, what type(s) of cancer was it and what was the outcome? Were those employees able to return to work?**

-None that are known

-We have had quite a few personnel diagnosed with prostate cancer (I don't have numbers). We have also had personnel diagnosed with skin cancers, testicular cancer and colon cancer. This is not something we track officially by number.

-2 firefighters with cancer, not sure if job related or not.

-Renal, lung, brain On light duty

**Question 7 - Does your department plan on taking any preventative measures in the future towards firefighter cancer prevention?**

-Yes	9 = 100.00%
-No	0 = 0.00%

**Question 8 - If so, what do you think those future measures might be? If not, what would be the preventing factor?**

-We will create some form of a policy that addresses this in a better way than what we're currently doing. We will also look at more productive ways to incorporate safety measures into our operations.

-Working towards - Cancer prevention awareness policy / Awareness and prevention trainings

-We have written an AFG grant to add gear extractors and dryers to two more fire stations and a specific cancer prevention policy is being worked on.

-Discussing options for annual physicals for early detection and evaluating current prevention measures

-turnout exchange, shower after fire policy, method to bag gear at scene and keep it out of cabs.

-Continue to look for and implement any other protective measures that are identified in our industry.

-Continue the programs above, also working on a second set of gear for all employees. Currently most FT staff have two complete sets.

-better procedures for gear cleaning/ maintenance awareness biggest issue is funding

**Question 9 - Any additional comments or information**

-Our department has began many awareness discussions and have continued researching many topics within the cancer prevention issue. We have moved forward with purchasing commercial



gear washers for every station and are diligent in gear washing and equipment decontamination efforts.

-This is a change in behavior for all firefighters. It will require an outlook change, education, steps in resolution, etc