

The reduction of occupational hearing loss for the firefighters of North Whatcom Fire and

Rescue

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Certification Statement

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotations marks so indicate, and that the appropriate credit is given where I have used the language, ideas, expressions or writings of another.

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Abstract

The problem was that the firefighters at North Whatcom Fire and Rescue, (NWFR), have had exposure to high levels of noise during their work hours. The purpose of this study was to create a department policy which would reduce the exposure levels of damaging noise that are inherent to the position of firefighter at North Whatcom Fire and Rescue. This study was developed on the hypothesis that many firefighters were suffering from occupational noise exposure due to a lack of knowledge, equipment and guidance. Although there are state and national occupational guidelines which identify the basic parameters for hearing protection, North Whatcom Fire had not written any policy which was currently implemented. This research developed a department policy by answering the following questions, using an action research method: a) What are the sources of damaging noise? b) What are the acceptable levels of noise exposure? c) What equipment and procedures, through policy, can be implemented to protect and preserve the hearing systems of our firefighters?

By studying both state and national standards for hearing protection at the workplace, conclusions were gathered to establish an acceptable guideline for the crews to follow. It utilized data from existing sources, as well as conducted field tests for actual exposure levels, based on tools and equipment NWFR's firefighters used. The findings of this study revealed what the damaging levels of noise were, their sources, and established a department policy for occupational hearing protection. This research recommends that all crews adhere to this new policy to maintain the current health of their hearing so not sustain any further damage to their hearing capabilities.

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Rescue

Frequently, the firefighters that work for North Whatcom Fire and Rescue, (NWFR), are exposed to damaging noise levels. These full-time first responders work in intervals of 24 to 48 hours and perform many tasks that are necessary to provide quality care to their community. This is considered an “all hazards” agency who attempts to mitigate any call for service within its 200 square mile boundary. Incidents that the crews are trained to mitigate include: fire, EMS, hazardous material releases, motor vehicle crashes and various technical rescue incidences. Being a diverse department, the firefighters/EMTs are required to use many different types of tools and equipment, which have various mechanisms. All of these can create high levels of potentially damaging noise.

This project was developed to provide a policy in which guidelines for hearing protection are identified. An action research method was used to gather data necessary to formulate the policy, and to support the original hypothesis: NWFR’s firefighters are experiencing hearing loss while on the job, due to the high levels of noise emitted from their “tools of the trade”. The following questions were used to support this project’s findings:

1. What are the sources of damaging noise?
2. What are the acceptable levels of noise exposure?
3. What equipment and procedures, through policy, can be implemented to protect and preserve the hearing systems of our firefighters?

Washington State has implemented into law, safety guidelines that assist in providing information that supports this research; Washington Administrative Code (WAC) 296-817 ("WAC hearing loss prevention," 2015, p. 1). Although these are general hearing loss prevention rules and regulations, they do apply to the profession of firefighter, specifically those employed by NWFR.

Previous research of this nature has been done in many occupations that contain high levels of noise exposure. Definitions and criteria to aid in identifying "noise", both healthy and damaging, have been studied and documented by many agencies and physicians. A study called "exposure criteria, occupational exposure levels" was developed as a joint effort using American, European and International standards that described how hearing can be damaged while on the job (Johnson, Papadopoulos, & Takala, 1990, p. 1). Some companies have developed, and are using programs that provide training and equipment to protect their workers. The significance is apparent while operating loud machines and tools based on definitions and findings from this joint effort.

Firefighter's professions are unique simply because hearing protection may not always be available or prudent to use during emergencies. The basis of this project was to support the theory that the firefighters at NWFR are experiencing damaging levels of noise exposure and can greatly benefit from a hearing conservation policy. This method of research provided a product in which the department can use as a benchmark for safety. It will benefit the hearing systems of its workers. There are limitations to any policy. Appreciating the uniqueness of the profession, providing a defined method of hearing conservation, and supplying the necessary equipment, the health of the firefighters at NWFR will be enhanced. Data gathered from existing plans in the industry, and examining actual noise exposure levels at NWFR were used to develop this policy.

Background and significance

North Whatcom Fire and Rescue was established by merging of Whatcom County Fire Districts 3,4,13 and The City of Blaine. These consolidations took place over a twenty year period and since that time; there have been many changes in organizational leadership and philosophy. One detriment, because of these changes, has been on adequate policy development. A hearing conservation policy is one such area, the department has failed to address as a necessity for its firefighters.

Occupational hearing loss affects approximately 25 million people in The United States each year ("Damaging noise exposure," 2016, p. 1). The United States Department of Labor has developed research and guidelines for safety relating to noise exposure; it is enforced by The Occupational Safety and Health Administration (OSHA). Washington State has its own requirements for hearing protection while on the job outlined by The Washington State Department of Labor and Industries. Firefighters at NWFR use common tools and equipment needed to perform the tasks of an "all hazards" fire department. Many of these tools create high levels of damaging noise, which can cause mild to significant hearing loss, if used without hearing protection (see appendix B). Although hearing protection programs exist at both a national and state level, NWFR has been reluctant to adhere to such regulations, possibly due to a lack of enforcement by the department or any other outside influences.

Societal costs associated with hearing loss can be significant. According to a publication written in 2000, at Johns Hopkins University, "severe to profound hearing loss is expected to

cost society \$297,000 over a lifetime of an individual” (“costs to society,” 2000, p. 1). Some local costs that are associated within NWFR include, but not limited to; an increase in time loss, insurance payouts, premium increases and a decrease in job safety.

The firefighters employed by NWFR are required to attend an annual medical physical paid by the department. These physicals are very comprehensive and adhere to The NFPA 1582 guidelines. Within these parameters are definitions for the standard for hearing abilities, line 6.5 Ears and Hearing (National Fire Protection Association [NFPA], 2013, p. 1). A key component to these exams is the audiogram, which is a means of recording the results of a hearing test. If a firefighter’s hearing has been damaged, due to occupational exposure, the effects can be substantial.

Unfortunately, for a firefighter, not all loud noises are avoidable. For instance, during some normal job related tasks, hearing protection cannot be worn. While wearing structural protective clothing, ear muffs or plugs are not recommended. These devices could potentially interfere with the clothing manufacture’s fitting requirements or use, therefore creating other safety issues. Also when hearing is imperative to communicate with teammates or the public, hearing protection may prove to be more of a hindrance, than an aid.

This project and research were developed to provide a guideline for safety for the firefighters of North Whatcom Fire and Rescue. It adheres to the requirements set forth by The National Fire Academy’s outline from the curriculum within The Executive Fire Officer Program titled; Executive Leadership RO125. Setting and developing policy for the fire service industry is a leadership role that coincides with the needs of the people. This project’s overall scope can be applied to other agencies, as well as is part of any quality health and safety program. Many

different occupational noise exposures exist in industries nationwide. The data from this project can be applied in many ways.

The United States Fire Administration has set goals for its agency to follow. This research adheres to the specific objective within its strategic framework stating; *Reduce risks at the local level through prevention and mitigation*. Prevention of hearing loss can provide many benefits to workers and the community. Protecting the future of the firefighters at NWFR and their families is a valuable and worthwhile cause. The potential outcome, without such guidelines and education, may lead to costly results.

Literature Review

The inner ear contains small delicate structures that send signals to the brain for sound interpretation. When healthy, these tiny mechanisms vibrate when exposed to sounds. Normal ambient noises, created by our environment, generally are not hazardous. A common level of noise, like in an average household, ranges between 35-50 decibels. Louder and less frequent noises may peak at up to 130 decibels or higher and cause temporary and even permanent damage to the inner ear, specifically the cochlear hair cells. These tiny hair-like structures are the main sensory organs needed to hear effectively ("Occupational hearing loss," 2016, p. 1).

OSHA has determined that it is permissible for workers to be exposed to 90dbs in an 8 hour period; however, they recommend 85dbs to minimize noise induced hearing loss.

Some common noises workers may be exposed to include: (*loudest sound possible 194 decibels*)

1. Military jet 130db
2. Oxygen torch 120db
3. Riveting machine 110db

4. Rock music 108-110db
5. Outboard motor/lawn mower 100db
6. Average factory or garbage disposal 89db
7. Food blender or milling machine 85db

According to The Center for Disease Control, approximately 22 million US workers are exposed to loud noises at work each year and \$242 million is spent on worker's compensation due to hearing loss. Occupational hearing loss (OHL) is the third most common chronic physical condition among adults after hypertension and arthritis. It is estimated that 11% of US workers have hearing difficulties, of which 24% is caused by OHL ("Educating our workers," 2016, p. 1).

In 2006, The National Institute for Occupational Safety and Health (NIOSH) identified that a lack of data was hindering its attempt to reduce job-related hearing loss. They developed a *surveillance program* to gain insight into what causes certain types of damaging noises workers were experiencing. Various types of information began to build a foundation of support, which lead to better methods of prevention and protection for workers. By the end of 2015, over 18 data providers have partnered within the program. Millions of audiograms have been analyzed and the results are being used to assist in developing safety measures and devices for hearing protection ("Gathering data," 2016, p. 2)

The firefighters in the US perform many functions, and they use tools and equipment which can cause damaging levels of noise. Power saws, hydraulic rescue tools, diesel and gas engines and even fire pumps may exceed OSHA's permissible noise exposure levels. A more common damaging source of exposure for firefighters is the mechanical and electronic sirens and horns, used during emergency responses. These devices are required while driving to an emergent event to aid in clearing traffic for less interruption and delays. A modern electronic

siren can produce 120-135db at 30 feet. Air horns and mechanical sirens can also have output levels of 115-140 decibels. These are damaging to the human hearing system. Even though modern apparatus are well insulated, exposure to extremely damaging noises is still very prevalent.

In May, 2013, The Health and Human Services Division published a report that outlined specific firefighter noise exposure problems (Kardous & Afanuh, 2013, p. 2). In this document, many common firefighter tools and equipment were examined to determine their noise production. This was measured in decibels. The results from surveys, sent to various fire departments, revealed the noise output and their findings identified instances when workers were specifically exposed to damaging sounds (see appendix C) (Kardous & Afanuh, 2013, p. 2). These results clearly identified the many ways, in which, US firefighters are exposed to damaging levels of noise. In some cases, hearing protection may not be feasible, since they may need to listen for other important sounds on an emergency scene.

NWFR uses similar tools as an “all hazards” type fire department. Staffing 4 full-time stations and covering nearly 200 square miles, this agency responded to approximately 3500 calls for service in 2015. Although 84% of these responses were EMS in nature, firefighters/EMTs were still exposed to loud noises on the job that exceeded the permissible and safe noise levels established by NIOSH, 85dB for an 8 hour period. This research identified several situations in which a NWFR firefighter may experience loud noises. Using the averages of two smartphone noise meter apps, a summary of noise levels was established, and the results are listed in (Appendix B). These tests were taken at 5 feet from the equipment for 60 second intervals.

A typical 24 hour shift that is worked by a NWFR firefighter consists of:

1. Pass-a-long information from off-going firefighters
2. Apparatus checks that include: running the fire pump, power saws, ppv fan, hydraulic tools and servicing all SCBAs, (self-contained breathing apparatus).
3. Responding to emergency calls-all hazards (Fire and EMS)
4. Public education-may require fire department demonstrations
5. Company inspections
6. Fire alarm testing
7. Drills/training
8. Station repairs
9. Fueling and driving peripheral apparatus-tenders, brush trucks, aerial rigs

During these times, many noise producing events may take place. In some instances, such as during routine morning apparatus checks, hearing protection can be used. Ear muffs and plugs are available at various locations in and around the fire stations. Some are stored on apparatus, while other hearing protection is available near noise producing pieces of equipment. Although this protection is offered, no conservation program had been established, in an effort to educate and protect workers on the effects of sustained loud noises.

Many firefighters, nation-wide, suffer from occupational hearing loss. Siren manufacturers have been blamed for excessive noise levels that are emitted from their sirens and have been

sued for damages. In an article published by The Associated Press, Joseph Nardone, (FDNY) stated that “The siren inside the cab was so loud, it physically hurt” (Associated press [AP], 2015, p. 2)

Numerous fire and rescue agencies have implemented hearing conservation programs into their policies and procedures. They have recognized the importance of protecting their workers from damaging noises. Some of these include; Seaside Oregon Fire, City of Phoenix Fire Department, Barkamsted Fire District Connecticut and Seattle Fire. All have strict policies that outline a protection plan that can reduce occupational hearing loss. All branches of the military also have strict guidelines on hearing conservation. The Department of Defense issued their directive, in a 25 page document, that specifies what is required for all military personnel for proper hearing protection, during daily operations, as well as in combat (Department of Defense [DOD], 2010, p. 1).

OSHA has identified two basic devices that are adequate protection from loud noises. The first is an ear plug that fits snugly into the ear canal. There are several types of plugs including; expandable foam rubber, preformed headset styles, and custom fitted versions. Ear muffs are the second approved device that completely covers the ears. OSHA does recommend the use of these devices together for added protection in some cases ("PPE selection," 2015, p. 1)

Based on review and study of existing policies and procedures, construction and implementation of a hearing conservation policy was initiated for NWFR. Occupational hearing loss, across numerous industries, is detrimental to millions of workers each year. Firefighters are one such workforce that uses loud tools and equipment in their normal operational period. Protecting their hearing is necessary to their health and safety. It is vital for their effectiveness as

an emergency worker. The ability to listen for detailed information, and the capacity to comprehend, is critical in the communication process.

During the data gathering for this project, it became apparent that other workers, besides firefighters, are exposed to high levels of hazardous noises. The fleet maintenance crew operates air driven tools, hydraulic machinery, and run the apparatus, just as the firefighters would. They also service the fire district's small gas powered tools as needed. During their day, they would potentially be exposed to many sounds that exceed OSHA's limits of safety. Other workers that would benefit from these findings also include, command officers, tender operators and rehab support personnel. All of these workers come in contact with damaging levels of noise. Although the duration of exposure may not be as extensive as a firefighter, protecting their hearing is as equally as important.

The goal of this study was to identify what the safe levels of exposure to noises were, what types of tools and equipment create these sounds, and what can be done, through policy, to protect the hearing of NWFR's workers. OSHA approved devices, that are used when appropriate, can greatly protect and the delicate hearing systems of the workers. Ear plugs and muffs greatly reduce the damaging sounds that enter the ear canal, causing temporary and permanent hearing loss.

Procedures

By analyzing NWFR's current procedures for hearing conservation, a deficit in policy, training and hearing protection devices was realized. Although NWFR has some available earplugs and earmuffs in random locations, a guideline and education for its firefighters was found to be inadequate. An inventory of noise producing tools and equipment, from all 4 staffed

stations, was taken to identify what the workers were exposed to (Appendix D). Several similarities were found from station to station. Similar apparatus, tool compliments and supporting equipment that create excessive noises, are common through-out each of the worker's areas. Current hearing protection devices were inventoried and identified as sparse and in random locations, with little or no direction for their use.

OSHA has strict guidelines for hearing conservation ("Damaging noise exposure," 2016, p. 1). Washington State also has issued laws which protect its workers from occupational hearing loss ("WAC hearing loss prevention," 2015, p. 2). With a better understanding of the human ear and what excessive levels of noise can do to their delicate mechanisms, this study developed a policy to protect NWFR's firefighters and shop workers. Several existing fire department policies were studied and analyzed for content and applicability to assist in the development of this policy (Appendix A).

For additional support to the outcome of this project, other industries were considered. This information was necessary to form similarities and differences between US workers and the noisy environments they are exposed to. Loud machinery in the military can emit noises over 100dBs during normal operations. Several studies written and published by the US Government supported the theory that NWFR was lacking sufficient protection to its workers. Troops that range from 18-28 years old are most likely being exposed to high levels of noise, while performing their duties. Their adherence to policy and the procedures assisted the development of this mission's product.

Actual sounds were recorded by utilization of 2 separate sound meter applications uploaded onto a 2016 Apple I Phone 6. Firefighters from NWFR were asked to participate in

providing the sounds as they operated various tools, equipment and apparatus that helped substantiate the findings for this report (Appendix B). As the experiment and recording of sounds ensued, many firefighters were not taking advantage of available hearing protection devices at their stations. For example, when backing into a bay, assistance was used from another firefighter to guide the driver safely in. However, the back-up alerting mechanism was emitting sound levels that reached 91db, and the backer didn't protect his hearing. Several different firefighters participated in these experiments. It became evident, that most didn't see the need for protection from these types of noises.

As one who has suffered occupational hearing loss, personal data was collected that shows a history of exposure. An audiogram dated 02/03/2012, (Appendix E), shows the beginning of damage in the ranges of 250Hz-8000Hz. These are the higher pitched frequencies that are more subtle to one's hearing. Sounds like birds chirping, water drops and high pitched voices are diminished, if not lost all together. This project, to develop a hearing conservation policy, was driven strongly from personal experiences and my failure to understand the importance of hearing protection. I learned firsthand and how easily hearing can be lost permanently.

Limitations to this research include ample or extremely accurate sampling devices. A more precise method of sound collection may have provided a better understanding of what the potential damaging sounds around the workplace truly are. Longer durations of samples may also have substantiated OSHA's research and stated acceptable levels of exposure to noise.

Because surveying individual firefighters would potentially violate HIPPA laws, no data was collected this way. Studying the hearing of full-time firefighters would have been a vital set of data, which may have supported the hypothesis that a hearing conservation policy was needed.

Results

Data gathered from other fire and rescue agencies, as well as similar industries, helped substantiate findings of the inadequacy of both policy and procedure for hearing protection. Firefighters, and other workers at NWFR, are subjected to damaging noises during normal working conditions, and they lack the knowledge and equipment necessary to protect their hearing.

This study focused on three specific determinants that would help identify areas of improvement for hearing safety. First, analyze what sources of noise were prevalent in contributing to potential hearing loss. Random tools and equipment used and stored on responding type apparatus were operated by a sample of firefighters. While in operation, a handheld sound meter recorded levels in decibels. Chainsaws, circular saws, positive pressure fans and other gas powered tools all emitted sounds ranging from 94 to nearly 100 decibels (appendix B). These levels are over the OSHA standard acceptable for workers to be exposed to without hearing protection.

This project also identified other noises the firefighters are exposed to. These include, but not limited to: back-up alarms, stationary generators, air filling stations and air escaping from pressurized cylinders. These ambient noises were identified during normal work periods, and, these noises were deemed insignificant by the firefighters. They believed the noises were not

harmful, or at least not loud enough to be damaging. The sounds were recorded in the same fashion, and did indeed exceed safe levels, 81-94 decibels, and could most likely be injurious.

The hearing mechanism in humans is comprised of delicate structures easily damaged when exposed to high levels of noises, either intermittently or over periods of time. Through years of study and data analysis, many agencies have comprised parameters and safety measures for all US workers to adhere to while performing their jobs.

Secondly, this project researched what acceptable levels of exposure really are. Guidelines, developed by OSHA, were integral in supporting the need to protect the firefighters hearing, and, these guidelines were incorporated into the outcome of this project in policy format. Acceptable noise levels have been established by OSHA as 85 decibels for an 8 hour period. When sounds were measured in and around fire stations and work areas, many instances revealed much higher sound outputs. Some sounds were intermittent with peaks reaching or exceeding 100 decibels. Depending on duration, proximity to these noises, and individual hearing health, firefighters may be experiencing hearing loss and not realize it. The scientific data has been established by several organizations, but no policy at NWFR was in place. Because firefighters lack education about hearing loss and do not have a “hearing protection protocol”, the workers may be continually suffering from occupational noise exposure. The results are temporary or permanent hearing loss.

Lastly, a policy was developed to determine what the necessary hearing protection was for NWFR’s workers, while on the job (appendix A). Sections of this policy adhered to proper formatting established by North Whatcom Fire and Rescue. Sections identified included a general description of the policy, purpose, scope, policy, definitions, policy statements, control

mechanisms and references. A final approved copy is submitted for approval by the Board of Fire Commissioners and recorded electronically on the department server.

Each section was supported by findings of this research. In the general section of the policy, a basic understanding of the guidelines was established. Data from other fire departments and the military, helped to clarify this section. The noisy environment of a firefighter was analyzed and was the basis of this project. Many agencies developed their own policy and training from state and federal regulations. This study also incorporated data from like sources, OSHA, NIOSH, Washington Administrative Code and others to solidify the necessity of hearing conservation.

The purpose section of the policy simply identifies what the document's objective is. The scope section helps to organize parameters of the policy, and it gives the reader the ability to understand, what is being acknowledged within.

As the body of the policy begins, definitions were established. This assists the user in comprehending technical terminology that supported the guideline. These definitions were imperative for the document, due to the technical verbiage used by a more scientific group. Responsibilities of the fire district were also identified in this document, to protect the workers and establish accountability of the employer. Education and training, of how hearing can be damaged, is the responsibility of any organization. A well-structured program will ultimately ensure better safety and health of its workers.

Unintentionally, this study revealed other instances of noise exposure, which may affect workers within the organization besides the firefighters. North Whatcom Fire employs 2 full-time EVT's (Emergency Vehicle Technicians). Their shop is an attached building to the busiest

fire station in the district. These technicians maintain and repair most of the tools and equipment owned by the agency. Exposure to loud noises is just as prevalent for them as is the firefighters, if not more. The duration to loud noises may be substantial. Hearing conservation training and protection applies to these workers within the organization. Some hearing protective devices were found to be available to them as well. However, without proper training and a policy to adhere to; they may be risking hearing loss also.

Tools and equipment used by the workers in this study emit loud noises that range from 70 to over 100 decibels at peak levels. Human hearing systems are measured in hertz and begin in the low range of 250Hz and reach 8000Hz. 250Hz would include low pitched sounds like the bass of a drum or a deep voice. Higher pitched sounds that are in 2000-8000Hz frequencies include birds, water drops, higher voices and distant sounds. Occupational noise exposure has been found to damage many frequencies in the human ear, but most commonly, the frequencies that begin at or around 1000Hz. As seen in appendix E, damage occurred at 1000Hz and got substantially worse at 2000-7000Hz. The delicate structures of the human ear canal and its mechanisms react to excessive noises, either from constant sources or intermittently. Without proper protection, temporary or permanent damage can occur.

Discussion

As outlined earlier, findings of others identified areas in which US workers are potentially exposed to damaging noises. The results of this study related and supported the hypothesis: without proper training, equipment and policy, workers at NWFR are subject to an unsafe and harmful work atmosphere.

Occupational hearing loss affect nearly 25 million people each year in the US ("Damaging noise exposure," 2016, p. 1). Costs to society and the individual worker are also substantial ("costs to society," 2000, p. 1). This study utilized strength from this data to emphasize the widespread problem of exposure. At inception and organization of this project, the scope of actual national hearing loss was not fully understood. Several government agencies at the local and national level have created studies. However, rules and regulations for hearing protection ("Educating our workers," 2016, p. 1), had not yet filtered down to NWFR.

By analyzing work areas at each staffed station, damaging noise levels to hearing were found in tools and equipment. Ambient and less recognizable noises can also be detrimental to hearing. There were also loud noises unique to each station that can cause hearing loss. These were thought of as background or ambient type noises, not thought to produce damaging levels of noise. The military has been much more organized in its method of training and policy than NWFR (DOD, 2010, p. 1). As a government agency, The Department of Defense constructed its method of protection for its workers that is applicable across all branches of the military and contractors alike. NWFR, in an attempt to provide adequate hearing protection devices, fell short of many aspects of a program. Ear plugs and muffs do exist, but scattered in different places and often found in poor condition.

A national study of firefighter tools and equipment, and the sounds they produce, showed results that exceed the safe level of noise (Appendix C). In the normal functions of a firefighter, emergency operations require the need to hear. For example, during a vehicle extrication evolution, the team attempting to remove injured victims uses loud hydraulic tools, saws and prying tools. Time is critical, and their ability to hear the victims is vital to the outcome. Since the workers are unprotected from loud noises, damage to their hearing may

occur. It was found, through this research, how hearing protection may not be suitable for every application.

Reducing the hearing loss of firefighters has significant impacts, other than to the individual. Currently in the US, approximately \$242 million is spent each year on occupational hearing loss ("costs to society," 2000, p. 2). For North Whatcom Fire and Rescue, cost savings are crucial to its survival. With ever increasing insurance costs and decreasing sources of revenue, any program that reduces claims will prove beneficial. A hearing conservation policy will assist in the reduction of money spent in this area. This policy will also contribute to other policy development. Mandatory hearing conservation will help keep the workers safe and potentially reduce costs in other areas.

Due to personal experience with occupational noise exposure, the need for a policy was critical for current and future workers at NWFR. Treatment and lifelong issues with hearing loss can be reduced with proper protection and education. Hearing protection was sporadic throughout the fire district during emergency and non-emergent events. Poor education and a lack of hearing protection was the norm at various departments over the last 15 years. Co-workers have reported similar deficiencies in hearing, and these are often apparent when speaking to them. They often need words or phrases repeated to them for clarity and understanding. Disease of the human ear may not always be from exposure. Genetics or other types of trauma may be at fault.

Manufacturers of various tools used by firefighters have been sued because of the damaging noises their products produce (AP, 2015, p. 1). Sirens are a common necessity for emergency responders, which are usually mounted on or near the cab of the vehicle. Depending

on the type and insulating value of the cab, occupants may be exposed to excessive noises. An earmuff system, specifically designed to help reduce cab noises, is used in a few apparatus owned by NWFR. When three (2012) engines were purchased, and put into operation, protective earmuff devices were installed. Within the devices are emergency radio speakers that allow the user to communicate with the dispatch center, as well as each other. Although this is a quality system, it is only in a few frontline responding vehicles and is not widely used by the firefighters. NWFR has an older fleet of apparatus that is used in volunteer training and response. These apparatus have no hearing protective systems at all.

It was the intent of this project, to provide adequate and applicable guidelines for hearing conservation, through a well formatted policy (Appendix A). Enforced by The Fire Chief and Assistant Chief of Operations, members of NWFR will benefit from new and well placed hearing protection. The members of NWFR will understand the guidelines and when to use them. Annual testing of the firefighter's hearing, with an audiogram, will help to monitor their health, and will provide results of this policy. A reduction in insurance claims may be an ancillary result.

The author of this project had the original hypothesis that most members knew where to find hearing protection if needed. The importance of protection and actual damage to their hearing is still unclear. Without individual reports of hearing loss, or claims, the firefighters continue to be exposed. Some were very cognizant of potential damage, where others were oblivious.

Recommendations

The results of this study identified a lack of knowledge, education, and hearing protection for the workers at North Whatcom Fire and Rescue. There was no written policy or procedure to

ensure its firefighters had adequate guidelines, for protecting their hearing, during a normal work period. A policy that outlines such practices was developed for these purposes.

Since specific tools and equipment have been identified as harmful to hearing, warning placards and hearing protection devices should be available and utilized. OSHA approved hearing protection devices are acceptable, and are recommended by all government agencies. These devices, either ear muffs, ear plugs or both, should be readily available for the user of such equipment. Ongoing inventory and logging of any expiration dates of hearing protective equipment should be part of a weekly inspection program. Rotation of stock may be necessary to avoid any unseen damage to hearing protective devices.

Installation of apparatus mounted ear muffs would protect the firefighters in other emergency vehicles that are not currently equipped. Only 4 fire engines, and some water tenders, have such hard mounted devices. Sound levels in other vehicles like ambulances, brush trucks and command cars should be measured to determine the potential for damaging noises. If deemed necessary, hearing protective devices for these units should be used and provided.

When analyzing sounds around the fire stations, some were found to be excessive and over the safe and acceptable levels. Ambient noises like house alerting systems, back-up alarms and radio volumes should be reduced to a safe level without reducing their usefulness. Additional insulation around other stationary equipment would benefit the people working around these loud noise producing machines. Each fire station is equipped with a back-up generator. These generators cycle automatically once each week and start unannounced. Workers are often near this equipment when it starts. Better enclosures with quality insulating capabilities would greatly reduce exposure.

Since firefighters perform their job in and around an apparatus, hearing protection must be available on the responding vehicle. A suitable location should be identified on each individual vehicle and easily reached. A clean and contaminant free area should be used so that these devices are kept in good working order.

Education and ongoing training is necessary for the success of any program. Hearing conservation for the firefighters at NWFR will prove to be one way to help ensure a healthier workplace. The Washington State Administrative Code # 296-817-20025 has identified the need to have annual training in hearing conservation. The department or agency that employs workers that are exposed to 85decibels for an 8 hour period must have this training. North Whatcom's Firefighters fit these criteria. It is required by law and policy, section 4.2.7, to receive initial and ongoing training in this field.

The Fire Chief is ultimately responsible for the adherence to this policy. Ongoing review and revision of this policy will be required to ensure that all statements still apply. New protective equipment and methods of protection should be analyzed and utilized, when applicable. State and federal laws will need to be reviewed on a periodic basis to verify the policy remains in adherence to such regulations. The Division Chief of Training will document electronically all members' adherence to this program, and he will exercise necessary methods of enforcement, when necessary.

It will be each member's individual responsibility to protect their hearing. Quality hearing conservation programs consist of education, policy, and related equipment. North Whatcom Fire and Rescue will establish a program within its organization. With the foundation of this policy, future development of new policies may arise.

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Appendix A
Hearing Conservation Policy #4001.2500.01

1.0 General:

In providing response to emergency incidents, maintaining tools and equipment, and during training, firefighters are often exposed to environments that may produce harmful levels of noise. The firefighters at North Whatcom Fire and Rescue are required to maintain and be proficient at many noise producing tools and equipment like: power saws, rescue equipment, Diesel/gasoline engines and high pressure cylinders which, when opened, create excessive high pitched noises. Because of these potentially harmful noise exposures, this policy was constructed to assist the firefighters in methods of protecting their hearing while on the job. It is imperative that the fire district provide proper protection from such exposures. It is equally imperative that fire district personnel comply with the provisions established to protect their personal health.

Recognizing that such conditions may exist, North Whatcom Fire and Rescue hereby establishes a hearing conservation program that is an adopted element of the firefighter safety program.

2.0 Purpose:

It is the purpose of this policy to provide methods of protecting the firefighter's hearing when applicable.

3.0 Scope:

This policy applies to all firefighters who are exposed to, or have the potential for being exposed to, an environment that produces high levels of noise, as defined by Washington State Department of

Labor and Industries, The Center for Disease Control and Occupational Safety and Health Administration. All firefighters will be required to wear the supplied hearing protection devices when applicable.

4.0 **Policy:**

4.0.1 North Whatcom Fire and Rescue, recognizing that firefighter response personnel may be exposed to high levels of noise, will establish a Fire District Hearing Conservation Program to protect the health of all firefighters.

4.0.2 All members of North Whatcom Fire and Rescue, who may be exposed to any high level of noise, will comply with the policies and procedures contained.

4.1 **Definitions:**

Audiogram-The audiogram is a detailed graph that measures your hearing ability.

(CDC)-The Center for Disease Control is also a federally owned agency, as part of the U.S. Health and Human Services that provides information, training and safety to all individuals.

DB-Decibel is a unit used to measure the intensity of a sound.

Duration-Duration is the time exposed to dangerous noise levels.

Ear muffs-Ear muffs are a hearing protection device that covers the entire ear.

Ear plugs-Ear plugs are hearing protective devices that fit inside the ear canal.

Exposure- Exposure is the act of coming in contact with something.

Hazardous noise-Noises that are damaging to a worker's hearing are considered hazardous.

Hearing Conservation training program-A hearing training program is a curriculum that assists the worker on how and when to use hearing protective devices.

Occupational Noise Exposure- Occupational noise exposure is any noise that workers are exposed to.

OSHA-Occupational Safety and Health Administration is a federally owned agency that's purpose is to provide training and guidelines to US workers for safety. This department is part of The US Department of Labor.

PPE- PPE is an acronym for *personal protective equipment*, for this policy, it refers to hearing protection.

Safe distance- A safe distance is referring to the distance away from a high level of noise that requires no hearing protection.

Time weighted average(TWA)-This is used to calculate a worker's daily exposure to hazardous noise levels.

Washington Administrative Code (WAC)-Laws governing workplace safety developed by The Washington State legislation.

Washington State Department of Labor and Industries is a state owned organization that provides safety guidelines in many areas of job related arenas.

4.2 Policy Statements

4.2.1 The Fire District shall provide proper PPE, when necessary, to protect the health of all firefighters against recognized noise hazards including an excess of the permissible exposure limits or the potential for exposure to dangerous levels of noise. Permissible levels of noise, as defined by OSHA, are 8 hours (TWA) at 85dba. The following tools and equipment have been determined to create damaging levels of noise and require hearing protection while in operation:

1. Power saws of all types
2. Diesel and gas engines
3. SCBA filling machines
4. Fire pumps
5. Hydraulic tools-Rescue equipment
6. Striking and prying tools
7. While in the cab of large apparatus during emergency response(protection from engine, horns and sirens)
8. Generators and compressors of any type

4.2.2 The Fire District shall only provide ear muffs or ear plugs that are OSHA approved and that are suitable for the purpose intended.

4.2.3 All members who are required to wear any type of hearing protection shall comply with the policies and operating procedures of the hearing conservation training program. Members shall maintain proficiency in the care and use of all hearing protection devices to be used within the fire district.

4.2.4 The District Fire Chief shall determine whether or not a member may be assigned to a task requiring the use of hearing protection. The fire district approved Physician or other Licensed Health Care Professional (PLHCP) will assist the District Fire Chief in identifying an annual audiogram test in order to establish baseline hearing abilities and determine any occurring loss.

4.2.5 The District Fire Chief shall be responsible for the supervision and administration of the Hearing Conservation Policy. The District Fire Chief shall have the full authority to act on any and all matters relating to the administration and operation of this policy, including, but not limited to:

- Identifying job descriptions which require the use of hearing protective equipment in the course of performing the duties and responsibilities of the job description.

- Identifying all personnel that are qualified and authorized to wear hearing protective equipment in the course of performing their duties and responsibilities.
 - Assuring that members/employees identified in this program comply with all provisions and conditions of the hearing conservation policy and standard operating procedures of provided equipment.
 - Assuring that all fire district hearing protection devices in use are thoroughly inspected in accordance with the manufacturer's recommended inspection procedures.
 - Assuring that the hearing conservation program is adhered to by all employees/members who wear are exposed to high levels of noise.
 - Assuring that the hearing conservation program is reviewed annually in order to evaluate its effectiveness.
- 4.2.6 The Division Chief of Training shall be responsible for training all fire district members who wear hearing protection. The actual training of fire district personnel in the care and use of hearing protection may be delegated to additional/other instructors provided that the individual presenting the instruction is trained and qualified to provide such training, and that written and electronic records of all such training are maintained.
- 4.2.7 The Division Chief of Training shall be responsible for administering the required annual training as stated in WAC 296-817 to all members who wear hearing protection.
- 4.2.8 The Shift Captains and Shift Lieutenants shall be responsible for the operational readiness and maintenance of all hearing protection devices assigned to their specific shift and/or station.
- 4.2.14 All Fire District Members, when performing weekly apparatus checks, shall inspect all hearing protection devices assigned to that apparatus.

5.0 Control Mechanisms:

- 5.1 All fire district members shall maintain proficiency in the care and use of hearing protection devices. Firefighter personnel and their supervisors who fail to adhere to the policies and procedures contained, which have been established for their personal safety, shall be considered in violation of WAC 296-305-01511 and subject to discipline.
- 5.2 The District Fire Chief shall be responsible for reviewing the hearing protection policies and procedures whenever necessary, but in no instance shall such review be less than annually.

6.0 References:

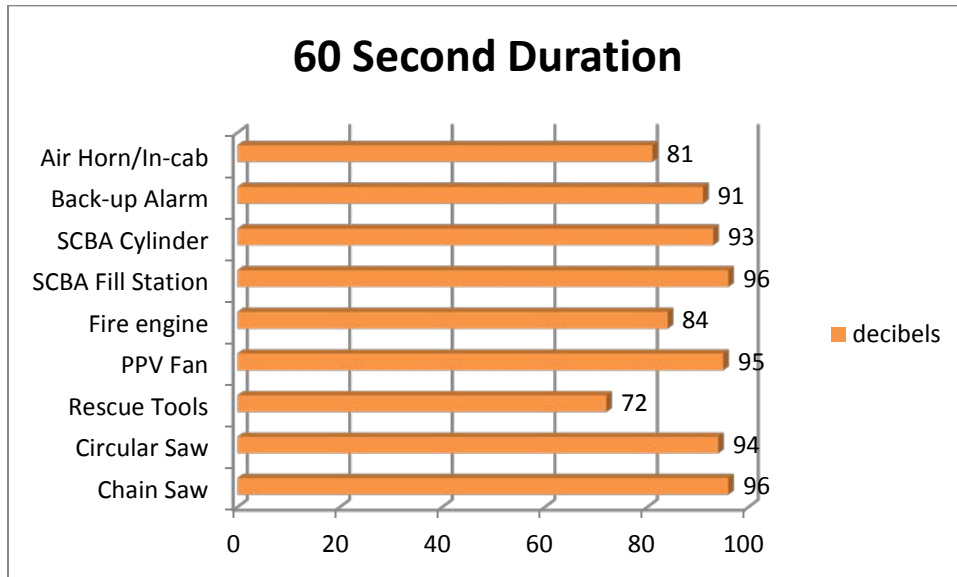
- WAC 296-817 Hearing Loss Prevention
- OSHA Hearing Conservation Program

- Washington State Labor and Industries Occupational Hearing Loss

Approved: _____
Commission Chair
North Whatcom Fire and Rescue

Date: _____

Appendix B
North Whatcom Fire and Rescue's results



Appendix C
Summary of noise level measurements from the fire department surveys

<u>Job description/source</u>	<u>Average noise levels (dBA)</u>	<u>Max noise levels (dBA)</u>
Driver	84-88	106-109
Jump seat	85-88	105-106
EMS	75	97
Ventilation	78	100
Vehicle extrication	90-106	98-115
Fire suppression	89-91	84-98
Fire station (testing tools/engine)	88-101	92-116
Fire station break room	67	68

Appendix D

Station 12Noise producing equipment (85dB or greater)

- E12-(and related tools and equipment)
- A12-(and related tools and equipment)
- BR12-(and related tools and equipment)
- T12-(and related tools and equipment)
- Air filling station
- Building generator
- Shop tools
- Station alerting system
- Gear washer/extractor

Current hearing protection devices available

- Foam ear plugs, random locations
- Firecom System, E12
- Ear muffs (near air filling station only)

Station 61Noise producing equipment (85dB or greater)

- E61-(and related tools and equipment)
- A61-(and related tools and equipment)
- L61-(and related tools and equipment)
- Shop tools
- Building generator
- Air compressor

Current hearing protection devices available

- Foam ear plugs, random locations
- Firecom System, E61

Station 63Noise producing equipment (85dB or greater)

- E63-(and related tools and equipment)
- T63-(and related tools and equipment)
- Br63-(and related tools and equipment)
- L63-(and related tools and equipment)
- Air filling station
- Shop tools
- Repair shop
- Exhaust system

Current hearing protection devices available

- Foam ear plugs, random locations
- Firecom System, E63
- Firecom System, L63
- Ear muffs near air filling station

Station 69Noise producing equipment (85 dB or greater)

- E69-(and related tools and equipment)
- A69-(and related tools and equipment)
- Br69-(and related tools and equipment)
- T69-(and related tools and equipment)
- Building generator
- Air compressor
- Shop tools

Current hearing protection devices available

- Foam ear plugs, random locations
- Firecom System, E69

Appendix E

PATIENT NAME: Joe Nonchester DATE: 2/3/2012

RELIABILITY	
<input checked="" type="radio"/> GOOD	
<input type="radio"/> FAIR	
<input type="radio"/> POOR	

OTOSCOPY	
<input checked="" type="radio"/> CLEAR	
<input type="radio"/> IMPACTED	

	AD	AS
Press (dbPa)		
Vol (cm ³)		
Static		
Admit (mmhos)		

ACOUSTIC REFLEXES					
STIM	MEAS	500	1K	2K	4K
AD	C				
	I				
AS	C				
	I				

EAR	AD	AS
A/C	<input checked="" type="radio"/>	<input checked="" type="radio"/>
AC msk	<input checked="" type="radio"/>	<input type="radio"/>
BC <	<	>
BC msk	<input type="radio"/>	<input type="radio"/>

MLV 6-22

WORD RECOGNITION					
Right Ear			Left Ear		
%	92		100		
DBHL	70		70		
MASK					

EAR	SRT	PTA	MCL	UCL
AD	25	28	70	
MASK				
AS	20	25	20	
MASK				

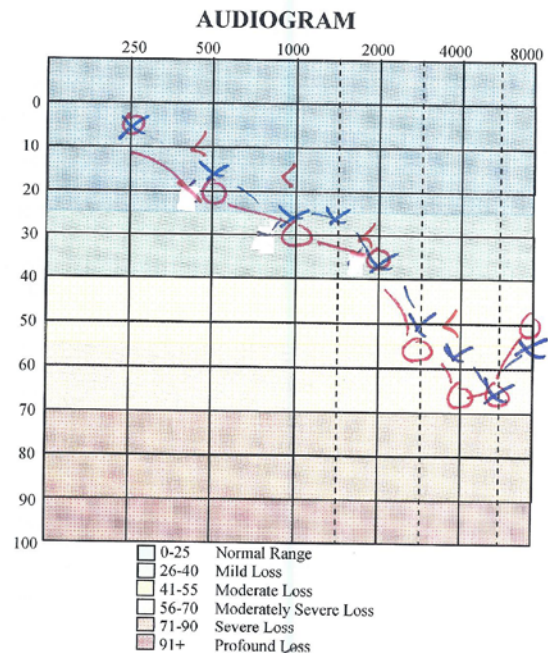
UCL		
Hz	R	L
0.5		
1K		
2K		
4K		
6K		

RIGHT EAR

Hz	250	500	1000	1500	2000	3000	4000	6000	8000
A/C	5	20	30		35	55	65	65	50
A/C Masked									
Masked Level									
B/C		10	15		30		50		
B/C Masked									
Masked Level									

LEFT

Hz	250	500	1000	1500	2000	3000	4000	6000	8000
A/C	5	15	25	25	35	50	55	65	55
A/C Masked									
Masked Level									
B/C									
B/C Masked									
Masked Level									



Audiometer: Fonia 140X
 Tested by: Terry Sanford, MA, CCC-A