



## Time to Change Directions...Hearing Conservation to Total Workforce Hearing Health Wellness

*Submitted by: Kathy Gates, AuD*

*Dr. Kathy Gates works for the Department of Defense (DOD) Hearing Center of Excellence (HCE). Her primary area of focus within the HCE is to promote hearing loss prevention initiatives and is currently working on the launching the DOD Comprehensive Hearing Health Program/Campaign.*

*There is nothing wrong with change, if it is in the right direction. - Winston Churchill*

Churchill's observation about change reminds me that we can be proactive, moving in the right direction to protect and improve Hearing Health. No one is immune to the hazards of noise exposure. Noise-induced hearing loss (NIHL) can affect all of us, not just those who work in noisy environments. We live in a noisy world. All workers should be taught strategies to protect their hearing, on and off the job.

With respect to hearing loss prevention, I propose a paradigm shift away from the traditional at-risk hearing conservation model and toward a broader population health model. This is to embrace *Hearing Health* as part of a total workforce wellness program, rather than a regulatory program. Such a shift would offer many advantages to the employee as well as the employer. Most important, the individual worker stands to benefit through improved overall well-being and quality of life.

A total workforce wellness program can help to ensure that hearing loss is identified and treated early, supporting a worker's need to function optimally on the job. It is important to understand that the American population is aging. By 2026, 30% of Americans will be over 55 years of age; 18% will be older than 65. Many older Americans still active in the workforce will have already sustained a mild to moderate initial hearing loss [1]. Untreated hearing loss significantly impacts social well-being and can create an economic burden on individuals, families, and communities. Recent studies have found that unidentified or untreated hearing loss contributes to an increase in both cognitive and physical



decline in adults. Psychosocial health declines with increasing hearing loss [2]. According to the Hearing Loss Association of America, people tend to wait, on average, seven years before treating hearing problems. Of those who need intervention and treatment for hearing impairment, fewer than 20% will seek help [3].

Early identification and treatment of hearing loss may help to prevent other debilitating medical problems such as depression and cognitive decline [4,5,6,7,8,9]. With this in mind, it's reasonable to expect that a hearing health program for all workers would promote a healthier workforce, increased productivity, and reduced downtime due to worker illness. A safer, healthier, and less stressful work environment will tend to improve employee morale and perhaps also help to reduce employee turnover. Hearing health is associated with many aspects of overall employee engagement, capability, and well-being.

How might you as a *Hearing Health* professional advocate for a paradigm shift to influence this type of program in your local hearing conservation mission? First, you need to encourage your own management to embrace and adopt a total workforce Hearing Health Program. You have an opportunity to educate your own clients about hearing health, and encourage them to consider expanding their current programs to include all workers.

Additional research findings and success stories are available for discovery on the Internet. Expanding your hearing health mission may

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# Update

Published by the Council for Accreditation in Occupational Hearing Conservation, a not-for-profit organization dedicated to the establishment and maintenance of training standards for those who safeguard hearing in the workplace.

Articles should be submitted along with a photograph of the author to [ghaugen@caohc.org](mailto:ghaugen@caohc.org)

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## Message from the Chair

Submitted by: Laurie Wells, AuD

Can you remember being a kid and feeling the joy of summertime? We played 4-square in the street once it got cool enough so that the tar didn't stick to the ball and the pavement didn't burn our bare feet. The days were long enough that bedtime arrived well before dark, which meant for my brother and me, lying awake in bed, listening to the laughter of the other neighborhood kids at play and the buzz of cicadas.

My mother was not only the enforcer of the consistent bedtime rule, she also taught me to listen: to tune my violin, sing on pitch, identify a single instrument's voice within the symphony, localize the call of a bird, and to fully appreciate that happy suction sound of lids sealing our jars of canned peaches. We talked a lot about the art and skill of effective communication and about the significance of being heard.

Ironically, soon after I became an audiologist, my mom suffered a sudden onset sensorineural hearing loss. Ultimately, she lost all of the hearing in her right ear, much in her left ear, the entire sense of balance, and on top of that, she acquired constant tinnitus. The auditory-vestibular disorder was only one of the disabilities she endured throughout her adulthood. Eventually she was diagnosed with an auto-immune disease.

Although my mother's hearing loss was not caused by noise, she shared the same consequences of damaged hearing that those with noise-induced hearing loss experience. She had difficulty understanding conversations in noisy backgrounds, had to watch people's faces and mouths, and she lost self-confidence because she literally couldn't believe her ears. Once I interviewed Mom about how her hearing impairment was affecting her life. After some thought, she welled up, and explained, "I know that I am an intelligent, educated woman...but because of my hearing loss, people treat me as if I am stupid." Coming from a long line of educators, this was particularly insulting to her.

During her lifetime, Mom wanted people to be able to learn from her condition. University hospitals and clinics were her first choice for receiving health care. A willing, cheerful patient, she accurately recounted her medical history, observations, and as well as her own theories, with her health care providers. Several years ago, Mom decided to donate her temporal bones to the NIDCD National Temporal Bone, Hearing and Balance Pathology Resource Registry. This single act gave her the most hope that one day, researchers would reveal a treatment, or even a cure, that would ultimately prevent disabling hearing loss. Last August, she completed her end of the bargain, and her temporal bones are now in the care of some of the most specialized and esteemed histologists in the world.

The Temporal Bone Registry allows researchers to examine the hearing and balance system directly by studying exact layers of carefully prepared and preserved tissues. This is particularly important because the audio-vestibular system is so well-protected by the surrounding temporal bone, it is difficult or impossible to access in living people. These physical specimens, together with the historical information provided by the donor's medical records, stories, and families, present rich cases for in-depth study. Through this research, hundreds of papers have been published which have shaped our understanding about both the normal and abnormal functioning of the hearing and balance mechanisms. For example, a few months ago, I was reading journal articles in preparation for a presentation on bone conduction. Words I previously would have glossed over, became intensely personal:

*When recording the vibrations of the basilar membrane in isolated human cadaver temporal bone specimens... (Stenfelt, 2007).*

Of specific interest is the role that the Temporal Bone Registry plays toward understanding noise-induced hearing loss. How will future research findings affect our understanding and intervention efforts to prevent noise-induced hearing loss? Will there be new tools available someday to help us identify noise damage sooner? Will we have treatment options to both prevent

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### Opt-Out Option

If you wish to have your name removed from Update mailing list, please notify CAOHC Administrative Office at (414) 276-5338; or email [info@caohc.org](mailto:info@caohc.org).

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require creative thinking about how to integrate it into a general worker health program. Here are several suggestions to consider:

Reach out to your customers and provide them with information about the benefits of providing hearing health services to all workers. Share with them that a program that emphasizes “wellness” reflects that they care about their employees’ well-being and quality of life. Your message is simple: healthy hearing leads to a healthy, more effective and dependable worker. At a minimum, consider a group education class that serves as a touchpoint for hearing loss prevention strategies. Another option is to develop and implement a periodic hearing monitoring program to assess hearing (maybe every two years) in workers who are not routinely noise-exposed. Education and hearing protection fitting could be included as part of a periodic monitoring program. Without increasing a company’s liability, such a program would allow for early identification of workers who have hearing loss, and to provide individual counseling, hearing health education, and information on the possible need for further audiological evaluation, treatment, and rehabilitation. The model you use for at-risk (routinely noise exposed) workers might be useful in some modified form for all workers.

Participate in health fairs and other organizational events to provide hearing health education and hearing protection fittings. Consider an interactive display such as the Jolene (Dangerous Decibels) to measure loudness levels of individual personal listening devices. This is a great opportunity to provide education and increase awareness regarding how hearing works, and how easily it can be damaged if not protected from hazardous noise.

Work with a Health Promotion/Wellness coordinator, if available, or Safety personnel to suggest inclusion of *Hearing Health* services. Team up with these professionals and offer to provide hearing health education classes and hearing protection fittings. This is a great opportunity to increase the awareness of other health care providers, and to educate them about how hearing relates to other areas of worker wellness and quality of life. Provide educational and motivational posters for posting in work areas, lunchrooms, and breakrooms.

Support *Hearing Health* outreach within your Community.

Additional ideas regarding total workforce Hearing Health and Hearing Loss Prevention are available on several Hearing Health websites.

### Websites for Hearing Health Information:

American Speech Hearing Association: <http://www.asha.org/>

Listen to your Buds: <http://www.asha.org/buds/>

American Academy of Audiology: <http://www.audiology.org/>

Turn it to the Left: <http://turnittotheleft.org/>

How’s Your Hearing? Ask an Audiologist: <http://howsyourhearing.org/>

Defense Hearing Center of Excellence: <http://hearing.health.mil>

National Hearing Conservation Association : <https://nhca.site-ym.com/>

National Institute on Deafness and Other Communication Disorders: <https://www.nidcd.nih.gov/>

It’s a Noisy Planet. Protect their Hearing: <https://www.noisyplanet.nidcd.nih.gov/>

Hearing Education and Awareness for Rockers: <http://www.hearnet.com/>

Starkey Hearing Foundation: <https://www.starkeyhearingfoundation.org/>

Listen Carefully: <https://www.starkeyhearingfoundation.org/Listen-Carefully>

Hearing Loss Association of America: <http://www.hearingloss.org>

Deafening Sound, Nebraska Educational Telecommunications: <https://marketplace.unl.edu/net/deafening-sound.html>

Dangerous Decibels: <http://dangerousdecibels.org/>

Operation Bang: <http://militaryaudiology.org/resources/be-aware-of-noise-generation/>

Hear-it (European General Public): <http://www.hear-it.org/Noise-and-hearing-loss>

National Institute for Occupational Safety and Health (NIOSH): <https://www.cdc.gov/niosh/topics/noise/toolbox.html>

Hearing Health Foundation-Safe and Sound: <http://hearinghealthfoundation.org/safe-and-sound>

Occupational Safety and Health Administration: <https://www.osha.gov/SLTC/noisehearingconservation/>

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## My Story: An Occupational Audiologist

*Submitted by: Dee Hightower, Au.D.*

Dee Hightower is a Doctor of Audiology and Occupational Audiologist with Examinetics. Before joining this company, she worked for the Department of Defense, Veteran Administration, and in private practice. She relaxes by playing roller derby.

I remember graduate school like it was yesterday. The hours spent in lectures, studying, learning clinical skills, learning about hearing aids, and completing the nightmare causing central auditory processing reports are forever etched in my mind. To me, becoming an Audiologist meant a life of diagnostic testing, counseling, and hearing aid sales. It was a life that I looked forward to. So, when I graduated I jumped with both feet into the exciting field of Audiology. I stayed current on the most effective hearing aids for my patients. I took as many continuing education courses as possible on my interest areas and honed my counseling skills. Eventually my career took me to government service, which increased the need for counseling. At that point I had to counsel to ensure that the patient was willing to wear the government issued device (the Veterans did not privately pay for the hearing aids), so it would not go to waste.

Working with the government gave me my first experience with the Hearing Conservation Program, which led me to my current career as an Occupational Audiologist. Specializing in Occupational Audiologist, my day is drastically different compared to my days as a clinician. No longer do I sit behind my diagnostic audiometer. Instead, I sit behind a desk looking at data on a computer monitor. Instead of reviewing the results of each patient scheduled and tested during my work day, I review hundreds of audiometric results for multiple companies (clients) tested throughout the year. When I was in the clinic, my patients wanted to know if they had a hearing loss, if it was bad compared to other people their age, or if their wife was correct that they had a hearing problem. As an Occupational Audiologist the questions have changed: Does the employee need a retest, is the hearing loss work related, and is the hearing shift recordable?

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and restore auditory function before and after noise exposure? Can the underlying cause of “hidden hearing loss” be explained? There are tantalizing early findings that suggest that it will (Viana et al., 2015). However, we need more answers to all of these questions in order to help us develop practical hearing conservation solutions.

While our daily tasks of measuring noise and hearing thresholds, documenting, interpreting, teaching, and digesting hearing conservation program information continues, it is helpful to know there are countless numbers of people searching for deeper knowledge and better ways to achieve our goals. Even to the degree that some people are motivated to donate their temporal bones to research so that someday, somehow, discoveries can be made, and suffering avoided.

Most of my clients are following OSHA guidelines but some are under MSHA or the FRA. As a clinical audiologist, my contact was with the person under assessment (my patient). As an Occupational Audiologist, I rarely see or speak with the person tested (the employee). Instead, my contact is with the nurse overseeing the hearing conservation program, or the site contact (often, the safety manager). Again, in my setting, I rarely interact with the worker being tested. When I was in clinical practice, I would see my patients annually for evaluation, and multiple times for hearing aid follow-ups - if they had a hearing aid. As an Occupational Audiologist, I normally communicate with the nurse, or site contact, multiple times each month, while reviewing data or addressing client concerns. As you know, for various reasons, patients may become upset in the clinic. Similarly, my occupational contacts can become upset, if they must report a safety incident (e.g., hearing threshold shift) on their respective safety log.

I remember being in clinic, and watching as people came to calibrate my audiometer every year. They were amazing and so critical to the precision of my clinical practice! Now, I am that person that comes in annually to calibrate the audiometers. Noise surveys? I do those, too! And, I also have the opportunity to do one of my favorite parts of Occupational Audiology, which is teaching CAOHC courses at my workplace. The people that attend my CAOHC courses go on to complete the audiometric tests that eventually populate my computer screen. It is the circle of life for occupational audiology, and I enjoy every part of it!

Working as an Occupational Audiologist has allowed me to meet and work with an amazing team of professionals. I have also had the opportunity to travel throughout the United States to visit client businesses. Although I never would have imagined myself as an Audiologist without my patients, I am glad that my paradigm has shifted. I would highly recommend this area of Audiology for clinicians that appreciate reviewing data, interacting with clients, traveling, as well as teaching.

Thanks Mom, for giving and teaching and working so hard to hear. And thanks to all of you who stay up late, working after bedtime, so that others can continue to hear the joyful sounds of summer.

For information about the NIDCD National Temporal Bone, Hearing and Balance Pathology Resource Registry go to <http://www.tbregistry.org/> Stenfelt, S. (2007). Simultaneous cancellation of air and bone conduction tones at two frequencies: Extension of the famous experiment by von Be'ke'sy. *Hearing Research* 225, 105–116.

Viana et al., (2015). Cochlear neuropathy in human presbycusis: Confocal analysis of hidden hearing loss in post-mortem tissue. *Hearing Research* 327, 78-88.



## CD Spotlight

Submitted by: Gabriela L. Haugen

### 1. When did you teach your first CD Course?

I was certified as a CAOHC Course Director in 1979, and taught my first course in 1980. I've taught a number of courses over the years.

### 2. What do you believe is the most rewarding element of the OHC course?

I love to teach! It's very rewarding when I teach students, especially the ones that get really excited about hearing conservation during the course.

### 3. What is something you highly recommend should be emphasized during the course?

I think the most important part of the CAOHC training is audiometric testing. It clearly is what most of the students are going to be doing most of the time as an Occupational Hearing Conservationist. I want to really impress on each student the importance of doing an appropriate, valid, and reliable audiogram.

### 4. What was the most interesting question a student has asked you in the course?

When I was discussing the calculations for the OSHA Age Correction tables, specifically the tables for males and females, one of my students asked me how to apply the tables for transgender patients. This was a very thought-provoking question!!

### 5. What unique methods do you recommend for teaching learners about how to properly conduct hearing conservation training?

First, I stress that effective training cannot be accomplished with a 5-minute video or a booklet. In other words, the purpose of hearing conservation training is not merely to satisfy compliance with OSHA regulations. Videos and booklets can serve as tools to assist you in the training. But to really get your message across to each worker, I think OHCs must talk with them, ideally, in person, or in small groups. The goal is to convince workers to change their behavior and to help them understand how important it is to save their hearing.

### 6. What do you think is the most beneficial about the new edition of the CAOHC Hearing Conservation Manual?

I can't say enough about the new 5th edition manual. I have read it from cover to cover. It is so packed with valuable, up to date information. In my opinion, the CAOHC Manual should always be used as part of the course!



Pam duPont, MS  
CCC-A CPS/A

## UPDATE Call for Articles

### CAOHC Wants to *HEAR* from you!

CAOHC is currently accepting articles for future issues of *UPDATE*, our publication offered at no charge to the entire hearing conservation community. Each edition is posted on our new website, reaching over 22,000 occupational hearing conservationists. Writing for *UPDATE* is your chance to reach thousands of colleagues within the hearing conservation industry who are committed to occupational Hearing Conservation, just like you!

Articles that will be selected must complement CAOHC's mission and goals, as well as be relevant. We are interested in hearing about innovative hearing loss prevention programs, new innovations in training employees to be hearing conservation compliant, your challenges and your successes.

In addition, *UPDATE* places the "spotlight" on an outstanding Occupational Hearing Conservationist, Course Director, or Professional Supervisor. If you know of someone in your company deserves the "spotlight" for their commitment to hearing conservation, please craft a brief testimonial (approximately 75-100 words or less) and include that person's name, your company name and a recent head-shot photo. Your "spotlight" candidate will be added to our next issue, as well as, posted to the CAOHC website.

Submit your article or your "spotlight" testimonial along with your contact information to Gabriela Haugen at [ghaugen@caohc.org](mailto:ghaugen@caohc.org), or our *UPDATE* Editor, Dr. Antony Joseph, at [earsafety@yahoo.com](mailto:earsafety@yahoo.com). Also, please let us know what you would be interested in reading in future issues of *UPDATE*. You may send your comments or questions to the CAOHC Administrative Office at [info@caohc.org](mailto:info@caohc.org). Thank you again for your interest in *UPDATE*!





## A Paradigm Shift in Hearing Loss Prevention

Submitted by: CAPT William J Murphy, Ph.D

William J. Murphy is a Captain in the United States Public Health Service Commissioned Corps and is coordinator for the Hearing Loss Prevention cross sector for the National Institute for Occupational Safety and Health in Cincinnati. He is an active member of the National Hearing Conservation Association and a Fellow of the Acoustical Society of America. He is the chair the ASA's Technical Committee for Noise and the former the chair of the ASA's American National Standards Institute Accredited Standards Committee S12 for Noise to develop national and international acoustic standards on noise.

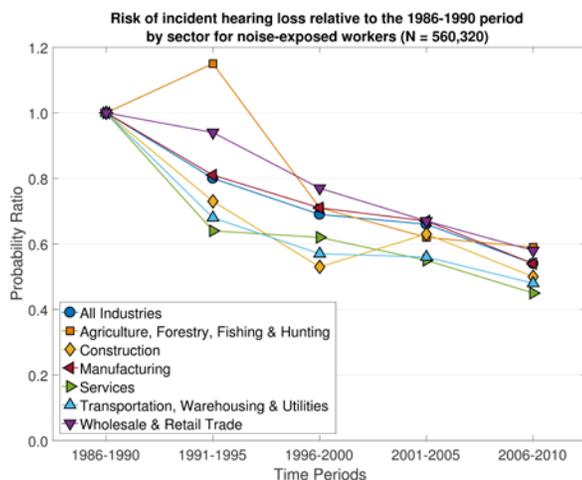
*Disclaimer: The opinions expressed in this article are those of the author and do not represent any official policy of the Centers for Disease Control and Prevention or the National Institute for Occupational Safety and Health.*

In 2005 and 2006, the National Academies of Science, Institute of Medicine (IOM) conducted a review of the NIOSH Hearing Loss Prevention research program. The IOM recommended that NIOSH develop a strategic plan to guide its research efforts. In 2007, the Hearing Loss Prevention research strategic plan was developed and focused upon five areas, surveillance, engineering noise control, personal protective technology, best practices and authoritative recommendations, and other risk factors for hearing loss. The three areas that this article will focus upon are surveillance, engineering noise control and best practices and authoritative recommendations.

### Surveillance

The challenge of surveillance is that you cannot determine what industrial sector to target until you know which sector has the greatest incidence of hearing loss. In 2009 NIOSH created the Occupational Hearing Loss (OHL) Surveillance program. The goal was to partner with hearing conservation providers to analyze cross-sectional audiometric data for workers across different industries and with time. The NIOSH Occupational Surveillance Hearing Loss Program now has a database of more than 15 million audiograms of workers over the course of their career. Several papers have been published looking at trends across industries, trends over time and trends targeting specific industries.

Masterson et al. (2015) conducted an analysis of the hearing loss trends with time and industry sector. Figure 1 displays the risk of incident hearing loss over time in five-year increments between 1986 and 2010. For each of the industrial sectors, we see a reduction of risk by nearly 50% when we come to the 2006 to 2010 time period.



Adapted from Fig 3, Masterson et al. Am. J. Ind. Med. 58:392-401 2015

Figure 1. The risk of incident hearing loss decreased over time relative to the 1986-1990 period across all industries.

This trend suggests that the efforts to prevent hearing loss are having some level of success. However, the same data when examined for the prevalence indicate that approximately 20% of the workers of all ages in these industries will experience hearing loss (Masterson et al., 2015). The construction and mining sectors exhibited higher prevalence of hearing loss, 25%, for their workers. When NIOSH developed its strategic plan for hearing loss prevention, it targeted three sectors, manufacturing, construction and mining. One statistic that is not clear with respect to the magnitude of the problem is the services sector. Like manufacturing, the prevalence rate was estimated to be about 20%, however, the services sector has a larger number of workers than manufacturing, but the noise exposures are somewhat more difficult to identify due to the diversity of jobs in the services sector. For example, these jobs include outdoor landscaping, maintenance workers, and law enforcement.

Other interesting statistics to consider are the annual reports from the Bureau of Labor Statistics (BLS). Starting in 2004, the Occupational Safety and Health Administration (OSHA) required that hearing loss identified during the required annual hearing screening of workers in a hearing conservation program be reported on the OSHA Form 300 (Hager, 2006). OSHA's regulation in 1904.10a states the following, "If an employee's hearing test (audiogram) reveals that the employee has experienced a work-related Standard Threshold Shift (STS) in hearing in one or both ears, and the employee's total hearing level is 25 decibels (dB) or more above audiometric zero (averaged at 2000, 3000, and 4000 Hz) in the same ear(s) as the STS, you must record the case on the OSHA 300 Log." Since the BLS started reporting this statistic in 2004, the number of cases of hearing loss has decreased from 28,000 to 18,000 workers in 2014. These numbers must be understood as a partial sample of the whole set of OSHA Form 300. They do not necessarily capture the same industries year to year and they are a partial estimate of the whole. Each hearing loss case must be reviewed for work-relatedness by a supervisor. Further, employers may have an incentive to determine that an STS or hearing loss was caused by non-occupational noise exposure, which allows the employer to not report that particular case.

Using the National Health and Nutrition Examination Survey (NHANES) data, Tak et al. (2009) estimated that 22 million workers are exposed to hazardous noise levels in their occupations. The National Health Interview Survey identified mining as having the highest estimated prevalence of hearing loss, ~24%, compared to other sectors. In mining, 76% of workers reported high-levels of noise exposure (Tak et al., 2008).

### Hierarchy of Controls

Once the magnitude of a problem is known, the question that must be asked is, "How do we control this problem?" Industrial hygiene attempts to answer the question with the hierarchy of controls shown in Figure 3. The most effective solution is to physically remove and eliminate the hazard. Substitution of one process for another can replace or reduce

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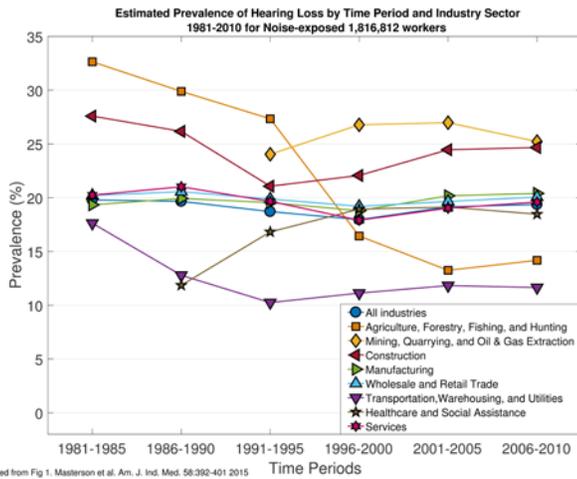


Figure 2. Estimated Prevalence of hearing loss by time period and industry sector from 1981 to 2010 for noise exposed workers.

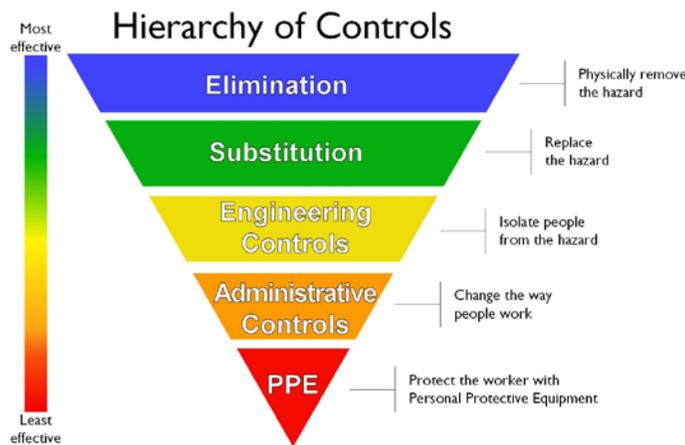


Figure 3. Industrial Hygiene’s hierarchy of controls.

the hazard. For instance, bismuth-based bullets are used instead of lead bullets at a firing range, the hazards for lead exposure are minimized. The substitution may not reduce the noise hazard, but the reduction of lead exposure may ultimately reduce more adverse health effects because lead is a known ototoxicant. If workers can be isolated from the hazard, then this is where engineering controls, particularly noise controls, become important. By using engineering solutions to reduce the noise, the issue of employee compliance is also minimized. At the bottom of the hierarchy of controls are administrative controls and personal protective equipment (PPE). Administrative controls rely upon limiting the time of an employee’s exposure to the hazard. PPE requires that the employee properly wear hearing protection devices whenever he or she is in hazardous noise levels. These methods are least effective for preventing hearing loss. Administrative controls may allow the employee to be exposed to high noise levels for a limited time. According to the NIOSH Criteria Document for a Revised Standard for Occupational Noise Exposure (NIOSH, 1998), the risk of hearing

loss for an 85 dB(A) time-weighted average, for 8 hours a day, 5 days a week and a 40 year career is expected to result in 8% of the exposed population suffering material hearing impairment. From other research, noise exposures that have significant impulsive components have an increased risk of hearing loss beyond the exposures that were used in the NIOSH analysis (Zhao et al., 2010; Davis et al., 2012). Hearing protection devices (HPDs) have the ability to reduce noise exposures to levels where the risk is minimal. However, in noise levels from 80 to 90 dB, workers are less likely to wear protection at all times because noise levels are not perceived as being hazardous (Rabinowitz et al. 2007; Heyer et al. 2011).

**Engineering Noise Control**

Due to our limited resources and personnel, NIOSH has focused its efforts in engineering noise control in three different sectors: mining, construction, and manufacturing. The NIOSH Pittsburgh Mining Research Division (PMRD) has developed several noise controls to reduce the exposure for miners using continuous mining machines, roof bolting machines and long-wall shear mining machines.

PMRD has both a reverberation chamber for measuring sound power of mining equipment and a hemi-anechoic chamber and beamforming array for noise source identification on mining equipment. One recent addition has been the use of numerical modeling for dynamic and acoustic prediction; as a result, ANSYS® and VA One are now used to develop finite element and boundary element models of mining equipment, respectively. For instance, changes in the design of the cutter head for a long-wall shearer have the potential to reduce the noise produced by drum cutter heads. NIOSH has developed solutions for continuous mining machines such as the coated flight bars and the dual-sprocket conveyor chain. In partnership with Joy Global Inc. these noise control solutions are available for commercial use. In Figure 4, the sales of the dual sprocket conveyor chain have reached a market penetration from 1.5% in 2009 to 35% in 2014.

In construction, NIOSH has examined the different controls for jackhammers. In response to regulations put in place by the New York Department of Environmental Protection, one suggestion to reduce jackhammer noise was to wrap the body of the jackhammer with a shroud. The particular shroud that was tested reduced the noise

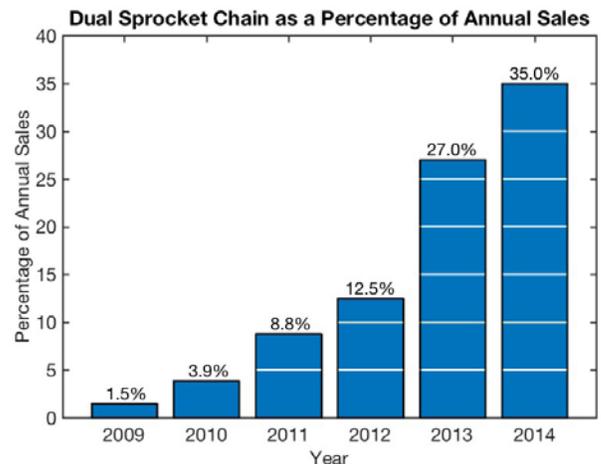


Figure 4. Market penetration of the NIOSH-developed dual sprocket chain for continuous mining machines.

that was radiated by the body of the jackhammer. However, the noise was redirected upwards toward the operator's head. (Zechmann et al., 2011). A second approach was to consider noise controls for the chisels. Using the PMRD beam-forming array, the most significant noise sources were the interaction of the chisel with the concrete and the exhaust of the pneumatic chisel. A retractable shroud over the chisel reduced noise levels, but was an impractical solution as the operator was unable to see what was being chiseled. A third method that was tried was to mill grooves into the sides of the chisel and then affix strips of constrained layer damping material, quiet steel, in the grooves. The damping material was successful in reducing levels and tonal components, but in testing, the strips of material were not durable under working conditions (Zechmann & Hayden 2012).

The NIOSH Health Hazard Evaluation (HHE) Program supports companies, employees, and organized labor unions to investigate unique industrial hygiene problems. The HHE program is a part of the NIOSH charter and is provided to companies at no cost. In 2008, NIOSH conducted an HHE for a company that manufactured galvanized tubing and steel conduit. The company opened a new plant that employs about 168 employees. The noise generated in this plant was primarily galvanized tubes and conduit that were rolling and dropping onto each other as they were rolling and hitting a stop. Some residual fluid remains in the tube from the galvanization process. To clear the fluid, the company used a steam cannon to blow the fluid out.

NIOSH researchers conducted noise dosimetry throughout the plant, and found a number of persons exposed to noise levels in excess of 85 dB(A). The NIOSH recommended exposure limit (REL) for an eight hour time-weighted average is 85 dB(A) using a 3-dB exchange rate. This NIOSH REL differs from OSHA's permissible exposure limit (PEL) of 90 dB(A) calculated with a 5-dB exchange rate and from the OSHA action limit (AL) of 85 dB(A) with a 5-dB exchange rate. The NIOSH REL is more protective for workers because it starts at a lower limit and has a 3-dB exchange rate rather than the 5-dB OSHA exchange rate.

Using the NIOSH REL, all of the workers were exposed to hazardous noise levels, whereas the OSHA PEL would suggest that about half of the workers were exposed to hazardous noise levels. The question that one must ask is whether or not it is feasible to control these noises? How much effort should an employer invest to assure that workers would not suffer material hearing impairment at the end of their working career?

Given the noise exposures, the workers were required to wear hearing protection while in the plant. The company offered three different types of foam-insert earplugs and one type of earmuff. Around the steam cannon, the instantaneous peak levels of the exposures were measured at 136 dB peak sound pressure level (dB peak SPL). These levels are similar to those measured when firing a .22 caliber rifle. The frequency distribution of the steam cannon is likely to have greater low-frequency content given the diameter of the steam cannon and pipes relative to the bore rifle.

In the NIOSH HHE report (NIOSH, 2006-0332-3058) recommendations were made to control the noise of various processes. For instance, by reducing the distance that the conduit pipes have to drop and fall upon one another, the energy with which the pipes strike one another is reduced. NIOSH further recommended that nylon pickups be used instead of metal pickups to moving the conduits from one place to

another. Another recommendation was to place a barrier around the steam cannon. These solutions do not require an extraordinary investment to reduce the noise levels.

When NIOSH industrial hygienists revisited the plant two years later, many of these solutions had been implemented. They installed booths for the operators of the steam cannons to isolate them from the impulse noise providing about 13 dB of continuous noise reduction during the steam cannon operation. The booth reduced the background noise for the cannon operators by about 22 dB when the cannon was not operating. As well, the booth was positioned further from the steam cannon providing greater reduction of the impulse exposure for the operators. The company had attached nylon composite stop plates to the metal stop plates. However, because the plant was not in full operation at the time of the visit, comprehensive noise measurements were not collected.

### Evidence-Based Best Practices

Communication is critical to providing practical and workable solutions to employers. NIOSH has a range of communication products. NIOSH criteria documents are the most authoritative. NIOSH numbered documents such as the compendium of noise control materials or the NIOSH Hearing Protection Device Compendium are further examples of traditional communication products (NIOSH, 1980; NIOSH, 1995). HHEs have been a mainstay of NIOSH since its formation in 1972. Current products include Engineering and Physical Hazard Reports, Prevention through Design—Workplace Design Solutions, Workplace Solutions, and Alert documents. NIOSH maintains a strong presence through its [web site](#), through the [NIOSH Science Blog](#), through the [Director's e-News](#), as well as through social media such as Wikipedia, Facebook, Instagram, and Twitter.

In 2009, the hearing loss prevention program with cooperation from other NIOSH scientists and physicians published a NIOSH Alert on controlling exposure to lead and noise at indoor firing ranges (NIOSH, 2009). The NIOSH Alert provided several significant recommendations for law enforcement and operators of firing ranges related to required ventilation to minimize toxic lead dust, harmful carbon monoxide and high levels of firearm noise.

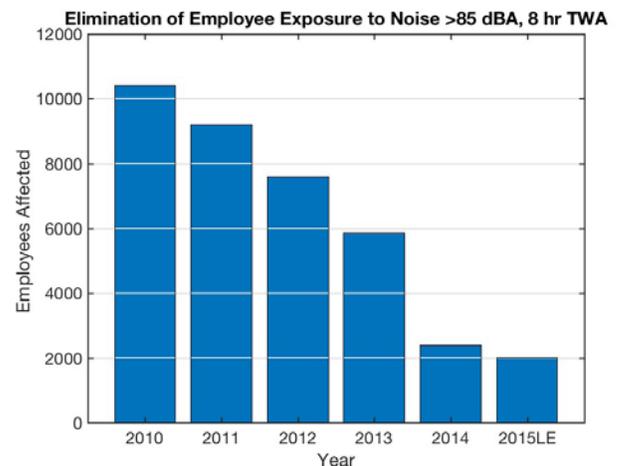


Figure 5. Reduction of workers enrolled in hearing loss prevention programs at United Technologies, 2010 to 2015.

NIOSH workplace solutions are intended to be simple and straightforward for a person to use. Typically, a workplace solution is three to four pages in length with practical remedial actions included. The document will highlight case studies that NIOSH has investigated and then provide a checklist of items that can aid the employer in addressing the particular hazard.

One example of NIOSH's partnership with external organizations is the Safe-in-Sound Excellence in Hearing Loss Prevention Award™. Thais Morata, a research audiologist at NIOSH, conceived the Safe-in-Sound award in 2007 and worked with the National Hearing Conservation Association to develop the procedures for accepting and evaluating nominations for the award. This program identifies companies in the manufacturing, construction, and the services sectors who have exhibited outstanding hearing loss prevention programs or companies or individual who have made significant contributions through innovative solutions to hearing loss prevention. The Safe-in-Sound Award has an interesting example of success leading to further success. In 2009, Pratt & Whitney won the Safe-in-Sound award for the efforts that they made to quiet their manufacturing facilities. After receiving the award, United Technologies – the parent company of Pratt and Whitney – began to implement the noise control solutions across the corporation. As a result of implementing noise controls and a targeted strategy to purchase quieter tools through a process called Buy Quiet, United Technologies reduced the number of workers in their hearing conservation program from 12,000 to 2,000 as shown in Figure 5. Consequently, United Technologies received a Safe-in-Sound award in 2015.

Lastly, NIOSH has focused on developing tools that would facilitate companies to implement Buy Quiet programs. NIOSH worked with Nelson Acoustics and a Cincinnati area contractor to develop a web tool that would allow a company to log their equipment into a database. The database would be populated with a wide range of product noise ratings – some from NIOSH evaluations and the majority from a European database of tools. These sound power levels (total energy radiated by the tool) would allow the user to identify whether comparable tools were available that would provide a lower sound power level. Thus when the time arrived to replace the aging tool, a progressive cycle of lowering the noise levels could be realized.

From a report provided by Nelson Acoustics, every decibel of noise reduction in the workplace that is reduced can save \$100 in terms of long-term cost of audiometric testing, personal protective equipment, and workers compensation (Nelson, 2011). When noise levels are reduced, then companies can more easily comply with OSHA regulations. When companies, actively promote hearing loss prevention outside the job, then employees, their families and society in general will have an increased awareness of hazards of noise and its effect on our lives.

## Conclusion

This article has touched on a small portion of the work that NIOSH has been involved with over the past 10 years since the Institute of Medicine's review of the Hearing Loss Prevention Program (IOM, 2006). Hearing protection devices and other risk factors will be discussed at a later time. Suffice it to say, the work that the NIOSH Hearing Loss Prevention Research Program has accomplished is significant. NIOSH is commencing the third decade of the National Occupational Research Agenda, starting in 2017. The Hearing Loss Prevention Research Program is seeking partnerships with organizations, individuals and

academic researchers to help reduce occupational hearing loss and to improve the hearing health for all Americans.

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– continued from page 9: *A Paradigm Shift in Hearing Loss Prevention*

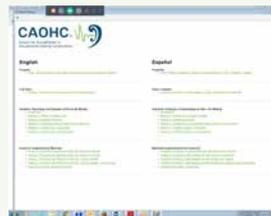
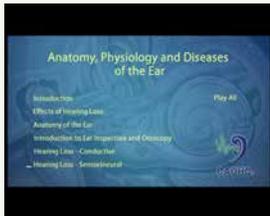
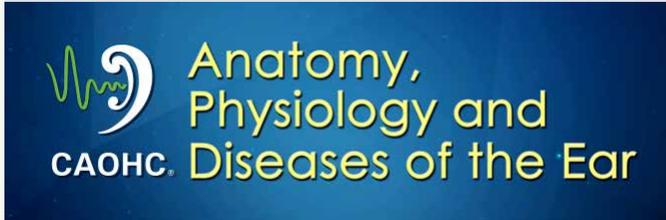
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## CPO Update: American Academy of Audiology

*Submitted by: Antony Joseph, AuD PhD CPS/A and Laurie Wells, AuD FAAA CPS/A*

The American Academy of Audiology (AAA) is an organization that was originally formed by audiologists in the late 1980's, and has grown to over 12,000 members today. The AAA mission statement is, "... promotes quality hearing and balance care by advancing the profession of audiology through leadership, advocacy, education, public awareness, and support of research." It serves as a home for audiologists around the globe, and provides several resources that may be useful to occupational health professionals, safety officers, medical staff, and practitioners.

For example, the AAA annual convention is the largest gathering of audiologists in the world. This conference delivers cutting-edge presentations, education, demonstrations of hearing technology, and networking opportunities. In 2018, the AAA conference will be held at the Music City Center in Nashville, Tennessee, April 18-21. Conference registration opens in November. Also, the first day of four-day convention includes the Academy Research Conference (ARC) 2018, which is a day-long program of top-flight presentations. Next year, the ARC will be on Genetics and Hearing Loss, an emerging topic for hearing loss preventionists and hearing scientists.

Audiology Today (AT) is the AAA's award-winning magazine of, by, and for audiologists. A full-color publication, AT is available on a bimonthly basis. It delivers reports on a wide range of audiology topics, including clinic, research, news, and more. This magazine is available online.

For the past 25 years, the AAA has published the *Journal of the American Academy of Audiology* (JAAA), a scholarly peer-reviewed publication. The JAAA publishes reports on various topics such as hearing assessment, hearing aids, audiologic habilitation and rehabilitation, balance assessment, and electrophysiology. This journal is available online also.

Audiologists may choose from a variety of sub-specialty areas in which to practice. One sub-specialty, Occupational and Environmental Audiology (commonly referred to as Industrial or Military Audiology) aligns well with the mission of CAOHC. Audiologists in private practice, medical and rehabilitation centers, and academic institutions may also benefit from the CAOHC mission. Audiologists of varying backgrounds attend or facilitate CAOHC's OHC, CD, or PS courses. Accordingly, the American Academy of Audiology is a community of practitioners and hearing-care professionals that should be aware of CAOHC, and the hearing loss prevention resources it offers. Your AAA CAOHC Council representatives are Dr. Laurie Wells (presently Council Chair) and Dr. Antony Joseph. For more information about the American Academy of Audiology, visit the website at <https://www.audiology.org/>.



MILITARY  
AUDIOLOGY  
ASSOCIATION 

## CPO Update: Military Audiology Association

*Submitted by: LTC J. Andrew Merkley AuD CC-A CPS/A and Maj. Johnny Foster, USAF BSC CCC-A*

The Military Audiology Association (MAA) is an organization dedicated to preventing noise-induced hearing loss and is one of the nine component professional organizations that make up the CAOHC Council. The MAA's goal is to advance the profession of audiology within the US Department of Defense in 4 ways:

- Disseminating knowledge and information promoting quality health care.
- Protecting and maintaining the hearing sensitivity of those exposed to hazardous levels of noise.
- Establishing and maintaining cooperation among medical, biological, engineering and other sciences associated with the profession of audiology.
- Further professional growth and social contact among audiologists and other allied professionals.

From February 6 - 8, the MAA, along with the Association of VA Audiologists (AVAA) held their 9th annual conference, known as the Joint Defense Veterans Audiology Conference (JDVAC) 2017, in Anaheim, California. This year's conference, "Road to CA 'Clinical Application'," focused on innovation and future directions in the field of audiology with a strong focus on helping both military and VA audiologists expand their clinical skills and capabilities.

Following the JDVAC conference, a CAOHC Course Director Workshop was held at the Los Alamitos Joint Forces Training Base, located in Anaheim, California. Over twenty Active Duty Military and Department of Defense (DoD) Civilians participated in the course. DoD and Military audiologists combine to teach an average of 147 OHC courses a year, certifying thousands of OHCs to care for our nation's heroes. The next Joint Defense Veterans Audiology Conference is in Atlanta, Georgia from March 26 - 28 2017.

For more information or to register, please refer to the following link: <http://militaryaudiology.org>

## Leadership

The CAOHC leadership otherwise known as the Council consists of two representatives from each of the following Component Professional Organizations (CPO).

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