



# 14th IC BEN Congress on Noise as a Public Health Problem



## **Loud, but not clear: Current challenges and opportunities to limit risks from overexposure to noise**

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### **ABSTRACT**

Given the practically omnipresent exposures to loud sounds –wanted and unwanted- the challenge to prevent hearing loss and tinnitus remains significant. The high rate of these conditions casts doubt on the effectiveness of preventive interventions. Today we have fewer obstacles and more tools than before. Two approaches will be discussed. The first includes research methods to evaluate the effectiveness of preventive interventions. The second focuses on the expansion of science communication efforts to: a) improve awareness of the negative effects of noise and ways to prevent these among the general public, and b) to motivate individuals and organizations to act.

Keywords (3-6): Noise, intervention effectiveness, outreach

### **INTRODUCTION**

This lecture will focus on recent examples from hearing loss research conducted at the National Institute for Occupational Safety and Health (NIOSH) in the areas of:

1. risk identification and characterization, particularly regarding chemical exposures and non-Gaussian noise;
2. implementation and evaluation of effective interventions to prevent the auditory effects of noise;
3. expansion of science communication efforts to reach the general public.

### **MATERIALS AND METHODS**

#### ***Study Design***

1. Towards identification and characterization, particularly related to chemical exposures and non-Gaussian noise.

Certain chemicals commonly present in the workplace may affect hearing even in the absence of noise (Johnson and Morata, 2010). In addition, reports from animal experiments demonstrate that chemicals can interact synergistically with noise or potentiate its effects. The interaction is modified by several factors, including the temporal distribution of the noise exposure (Fuente et al., 2018). NIOSH has participated in a series of field studies which measured exposure to noise, solvents, and fuels and collected hearing data. Work to identify and characterize occupational chemical ototoxicity continues, as well as study of damage risk criteria for complex noise (Zhang et al., 2020).

2. Towards the implementation and evaluation of effective interventions to prevent the auditory effects of noise.

While many workplaces comply with legal or obligatory requirements and implement recommended hearing loss prevention interventions, noise-induced hearing loss remains one of the most common occupational conditions. A gap exists in research to evaluate the effectiveness of recommended actions. NIOSH has addressed this gap using two different approaches:

- 2.1. By conducting research, including broad systematic reviews, on the effectiveness of interventions to prevent occupational noise-induced hearing loss;
- 2.2. By creating an award program, the Safe-In-Sound Excellence in Hearing Loss Prevention Award™ (<https://www.safeinsound.us/>) to identify and honor excellent real-world examples of noise control and other hearing loss prevention practices and innovations which have demonstrated effectiveness.

3. Towards the expansion of science communication efforts to reach the general public. Public health agencies have traditionally enjoyed the respect and trust of the community, but the proliferation and widespread availability of information is changing the landscape. The public demands greater transparency, responsiveness, and accountability, and organizations must respond with authenticity and engagement in order to maintain the public's confidence. Social media channels have emerged as an effective platform for public health communication, and health communication specialists are integral to framing and delivering appropriate messages. However, scientists cannot remain disconnected from this process. NIOSH has been a pioneer in the use of social media platforms, including a multicomponent strategy to expand noise content into Wikipedia. While NIOSH has dedicated communications personnel who manage much of its social media presence, some hearing scientists personally direct their own online efforts.

## RESULTS

1. Towards identification and characterization, particularly related to chemical exposures and non-Gaussian noise.

Existing evidence has prompted the proposal of new guidelines and standards on hearing loss prevention in the US and abroad. In 2018, the Occupational Safety and Health Administration and National Institute for Occupational Safety and Health jointly published the Safety and Health Information Bulletin [\*Preventing Hearing Loss Caused by Chemical \(Ototoxicity\) and Noise Exposure\*](#). Since 2019, the American Conference of Governmental Industrial Hygienists' Threshold Limit Values® publication includes an ototoxicity notation to alert the occupational health community. NIOSH is an active contributor to the International Ototoxicity Management Group (<https://www.ncrar.research.va.gov/ClinicianResources/IOMG.asp>), leading the subgroup on occupational and environmental exposures. Work to identify and characterize damage risk criteria for complex noise is ongoing.

2. Towards the implementation and evaluation of effective interventions to prevent the auditory effects of noise:
  - 2.1. The effectiveness of interventions to prevent occupational noise-induced hearing loss has been examined by Cochrane Systematic Reviews. The first review was published in 2009 (Verbeek et al., 2009). Because this is a dynamic area of research, the review was updated in 2012 and 2017 (Tikka et al., 2017). Several noise control studies showed a reduction in noise levels, but when only machinery noise levels are measured, it remains unclear how much the worker's exposure has been reduced. A few studies found evidence that training in the correct insertion of earplugs resulted in better noise reduction, at least in the short term. While examining the need to update this broad review it became clear that research on the effectiveness of interventions to control for the risk of workplace noise was focused on hearing protection fit-testing technologies. A new Cochrane Review on that specific intervention is nearly complete (Morata et al, 2021). Systematic reviews highlight the need for more intervention effectiveness research in the field.
  - 2.2. The Safe-in-Sound award process has resulted in high quality field data related to noise exposure monitoring and successful noise control outcomes. Award winners implemented innovative interventions which reduced noise levels such that fewer workers needed to be enrolled in hearing conservation programs, or even led to the elimination of the need for a hearing conservation programs altogether (Meinke and Morata, 2012). In an effort to more widely disseminate the practicality, feasibility, and significant individual worker impacts of noise control in the workplace, a few strategies and examples of outcomes have been made available at [www.safeinsound.us](http://www.safeinsound.us).

3. Towards the expansion of science communication efforts to reach the general public. NIOSH hearing loss prevention scientists have been successful in achieving public engagement through outreach on social media platforms such as a science blog (<https://blogs.cdc.gov/niosh-science-blog/>), Instagram, Twitter (@NIOSHNoise), and Facebook. Targeted efforts to expand hearing loss prevention content on Wikipedia has resulted in millions of views of relevant pages related to hearing and acoustics (Morata and Chadha, 2019). These activities have identified new and effective approaches that may be beneficial to the scientific community.

## CONCLUSION

Over the past decades, international efforts directed at raising awareness of noise as a hazard, reducing the risk of occupational hearing loss, improving the use of hearing protection, and advancing measurement and control technologies have generated measurable results. Yet, noise remains a prevalent workplace exposure and remains the number one modifiable risk factor associated with acquired hearing loss. NIOSH continues to work towards preventing the effects of noise and ototoxicants at work, and providing resources to assist safety and health professionals in their hearing loss prevention efforts.

## REFERENCES

Johnson AC, Morata TC. 142. Occupational exposure to chemicals and hearing impairment. The Nordic Expert Group for Criteria Documentation of Health Risks from Chemicals. Nordic Expert Group. Gothenburg. Arbete och Hälsa 2010, 44(4): 177 pp. Available at <https://gupea.ub.gu.se/handle/2077/23240>

Fuente A, Qiu W, Zhang M, et al. Use of the kurtosis statistic in an evaluation of the effects of noise and solvent exposures on the hearing thresholds of workers: An exploratory study. *J Acoust Soc Am*. 2018 Mar; 143(3):1704. Available at [Use of the kurtosis statistic in an evaluation of the effects of noise and solvent exposures on the hearing thresholds of workers: An exploratory study: The Journal of the Acoustical Society of America: Vol 143, No 3 \(scitation.org\)](#).

Zhang M, Xie H, Zhou J, Sun X, et al. New Metrics Needed in the Evaluation of Hearing Hazard Associated With Industrial Noise Exposure. *Ear Hear*. 2021 Mar/Apr;42(2):290-300. Available at [New Metrics Needed in the Evaluation of Hearing Hazard Assoc... : Ear and Hearing \(lww.com\)](#).

OSHA-NIOSH [Morata TC, Schnapp K, Hatch M]. 2018. Preventing Hearing Loss Caused by Chemical (Ototoxicity) and Noise Exposure Safety and Health Information Bulletin (SHIB), Occupational Safety and Health Administration and the National Institute for Occupational Safety and Health. SHIB 03-08-2018. DHHS (NIOSH) Publication No. 2018-124. Available at <https://doi.org/10.26616/NIOSH PUB2018124>

Verbeek JH, Kateman E, Morata TC, Dreschler W, Sorgdrager B. Interventions to prevent occupational noise induced hearing loss. *Cochrane Database of Systematic Reviews* 2009, Issue 3. Art. No.: CD006396. Available at [Interventions to prevent hearing loss caused by noise at work | Cochrane](#).

Tikka C, Verbeek JH, Kateman E, et al. Interventions to prevent occupational noise-induced hearing loss. *Cochrane Database of Systematic Reviews* 2017, Issue 7. Art. No.: CD006396. Available at [http://www.cochrane.org/CD006396/OCCHEALTH\\_interventions-prevent-hearing-loss-caused-noise-work](http://www.cochrane.org/CD006396/OCCHEALTH_interventions-prevent-hearing-loss-caused-noise-work)

Morata TC, Gong W, Tikka C, Samelli A, Verbeek JH. Effects of hearing protection field attenuation estimation systems and associated training on the level of noise attenuation in workers exposed to noise (Protocol). *Cochrane Database of Systematic Reviews* 2021, Issue 10. Art. No.: CD015066. Available at [Effects of hearing protection field attenuation estimation systems and associated training on the level of noise attenuation in workers exposed to noise - Morata, TC - 2021 | Cochrane Library](#).

Meinke DK, Morata TC. Awarding and promoting excellence in hearing loss prevention. *Int J Audiol*. 2012 Feb;51 Suppl 1:S63-70. <https://doi.org/10.3109/14992027.2011.633569>

Morata, TC, Chadha S. Make Quality Hearing Health Information Available to All. *The Hearing Journal*: May 2019 - Volume 72 - Issue 5 -p 6. Available at [https://journals.lww.com/thehearingjournal/FullText/2019/05000/Make\\_Quality\\_Hearing\\_Health\\_Information\\_Available.2.aspx](https://journals.lww.com/thehearingjournal/FullText/2019/05000/Make_Quality_Hearing_Health_Information_Available.2.aspx)

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