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health standards". The NIOSH criteria document regarding occupational noise exposure was originally published in 1972 and revised in 1998. Based on the best available knowledge at the time, each document provided the basis for a recommended standard to reduce the risk of developing permanent hearing loss from occupational noise exposure.

**Materials and Methods:** The 1998 criteria document identified several areas in which additional research was needed in order to clarify the risks associated various noise exposure scenarios as well as to develop appropriate recommendations to protect workers against the effects of these exposures. NIOSH and the scientific community have conducted research addressing these and other areas.

**Results:** Results indicate that some of the previous recommendations should be updated. Data point to three main topic areas in need of updated recommendations – hearing protector fit-testing, improved age adjustment tables, and assessment of complex noise exposures. Updates could be disseminated in a revised criteria document and/or through other communication channels.

**Conclusions:** This presentation will highlight the latest research and the three main topic areas that are under consideration, and provide an update on the current efforts taken by NIOSH scientists and external collaborators to update occupational noise exposure guidelines in the U.S.

#### Sp37-4

##### **Hearing outcome analyses in mice and humans with exposures to mixtures of metals with noise**

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**Introduction:** Evidence shows that metals such as lead and cadmium are ototoxic. However, metal ototoxicity in the presence of noise or concurrent exposures to multiple metals is not well understood. This research uses both a toxicological and epidemiological approach to explore metal ototoxicity in the context of (1) a mouse model and (2) in a cohort of young adults in an occupational setting.

**Materials and Methods:** In the toxicology study, CBA/CaJ mice were exposed to lead, cadmium, and noise to evaluate alterations in hearing. Mice were tested using ABR, DPOAE, and cochlear cell counts. In the epidemiological study, noise dosimetry, blood metal levels, and health history information was collected from electronic waste workers in Ghana then analysed with linear regression.

**Results:** Only noise exposures of 105 dB were associated with significant changes to ABR, cochlear cell counts and DPOAE in mice. In humans, sixty percent of electronic waste workers were found to have audiometric notches indicative of noise-induced hearing loss and this was supported by high levels of noise exposures.

**Conclusions:** While these studies did not provide evidence of lead and cadmium ototoxicity, more research is necessary to understand ototoxic properties of metals in real world settings with mixed exposures. Stronger study designs and more nuanced hearing tests may better capture metal ototoxicity. For risk assessments, thorough noise, chemical, and outcome measurements are needed. Metals, noise, and hearing are often ignored, however the importance of these on our lives and wellbeing should not be minimized.

#### Sp37-5

##### **Combined effects of low exposure levels of noise and solvents on hearing among printing workers**

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**Introduction:** There is no consensus on the approaches of clinical audiology to identify cases and provide hearing care to those who present hearing difficulties associated with combined exposure to noise and solvents.

**Objectives:** To assess temporary and permanent auditory effects associated with occupational co-exposure to low levels of solvents and noise.

**Methods:** Cross-sectional study with 25 printing industry workers simultaneously exposed to low noise (<80 dBA TWA) and low levels of solvents. The control group consisted of 29 industry workers without exposure to noise and/or solvents. Participants answered a questionnaire and underwent an auditory test battery. Auditory fatigue was also examined by measuring the acoustic reflex threshold before and after the workday.

**Results:** The exposed group had poorer thresholds bilaterally at 6kHz and 4kHz than the control group. Ipsilateral acoustic reflex thresholds were different between groups at the frequencies of 500 Hz and 1 kHz. Brainstem auditory evoked potential results showed differences in the III-V interpeak interval. EchoScan detected a significant difference ( $p=0.0317$ ) between the exposed ( $4.58\pm 6.8$ ) and the control ( $0\pm 4.62$ ) group.

**Conclusions:** Each hearing test indicated significant differences between groups. The temporary effect of the exposure was characterized by an increase of the threshold of the acoustic reflex. Measuring the shift in the acoustic reflex (EchoScan test) can identify work-related exposures that create auditory fatigue and help prevent hearing impairments possibly before they become permanent.

##### **Special Session 38 New realities for the health of working women in the new normal**

Chair: Igor Bello

###### **Session introduction**

The crisis unleashed by the COVID-19 pandemic has disrupted the world of work, asymmetrically affecting men and women. Women have had a special impact by having the highest participation in the prioritized sectors of the economy (health, education, food) and this has had an influence on further widening inequities between genders, and especially in terms of their health. In this session we will address some of these aspects from a sectorized and global perspective.

#### Sp38-1

##### **Warrior Women of the 21st Century: The Role of Female First Responders in the COVID-19 Crisis**

Claudia de Hoyos and Igor Bello