Acceptable Strategies for Prevention of Noise- and Music-Induced Hearing Loss

Presented by:
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Instructor, Otology and Laryngology, Harvard Medical School
Director of Diagnostic Audiology, Children's Hospital Boston

Moderated by:
Carolyn Smaka, Au.D., Editor-in-Chief, AudiologyOnline

Expert e-Seminar

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Director of Diagnostic Audiology, Children's Hospital Boston
brian.fligor@childrens.harvard.edu
<table>
<thead>
<tr>
<th>Date</th>
<th>Event Title</th>
<th>Speaker(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 17</td>
<td>Tinnitus Assessment in Young Musicians</td>
<td>Frank Wartinger, Au.D.</td>
</tr>
<tr>
<td>July 24</td>
<td>Food for Though: Nutrition and Noise</td>
<td>Christopher Spankovich, Au.D., Ph.D., M.P.H.</td>
</tr>
<tr>
<td>July 31</td>
<td>Otoprotective Agents for Prevention of Acquired Hearing Loss in Humans</td>
<td>Colleen G. LePrell, Ph.D., CIH</td>
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</tbody>
</table>

**Acknowledgements and Disclosures**

- I borrow material from Mead Killion, Ph.D., and the folks at Etymotic Research, with their permission.
- I use images provided by Sensaphonics Hearing Conservation, with their permission.
- I have no financial or non-financial interest in either company.
- Frank Wartinger, Au.D., is a former 4th-year extern in my program at Boston Children’s Hospital (and he tells very, very funny jokes).
- Christopher Spankovich, Au.D., Ph.D., M.P.H., is co-editing a book with me: *Classics in Audiology*.
- Colleen Le Prell, Ph.D., is fun to hang out with at conference (oh, and she’s brilliant).

**“Acceptable”**

*Merriam-Webster:*

1. Capable or worthy of being accepted
   *accepted* = generally approved or used

2a. Welcoming, pleasing
2b. Barely satisfactory or adequate (!)

*NHCA: Which is the best earplug? The one that you use!*
“Acceptable”

The best strategy for preventing NIHL is one that you can’t feel, doesn’t limit your freedom, makes things (music, etc) sound just as good or better than not employing the strategy, and is free!

Elements of Hearing Loss Prevention Program:
- Noise survey
- Engineering/administrative controls
- Audiometric monitoring
- Education and motivation
- Hearing Protection Devices

Why do I need a strategy?

<table>
<thead>
<tr>
<th>Firearm Type</th>
<th>Peak Sound Level (dB SPL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Rifle</td>
<td>140-145</td>
</tr>
<tr>
<td>Medium Rifle</td>
<td>157-160</td>
</tr>
<tr>
<td>Large Rifle</td>
<td>160-174</td>
</tr>
<tr>
<td>Shotgun</td>
<td>152-166</td>
</tr>
<tr>
<td>Small Pistol</td>
<td>150-157</td>
</tr>
<tr>
<td>Large Pistol</td>
<td>158-174</td>
</tr>
</tbody>
</table>

Bamboozle Road Show, June 2010
Sound Exposures: Bamboozle Road Show, June 2010

<table>
<thead>
<tr>
<th>Leq (dBA)</th>
<th>105</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time (hrs)</td>
<td>4</td>
</tr>
<tr>
<td>Noise dose</td>
<td>50dBPL</td>
</tr>
</tbody>
</table>

Table 1. Total audience exposure

<table>
<thead>
<tr>
<th>Leq (dBA)</th>
<th>99</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time (hrs)</td>
<td>7</td>
</tr>
<tr>
<td>Noise dose**</td>
<td>2188PL</td>
</tr>
</tbody>
</table>

Table 2. Total crew exposure (4 hours show + sound check and setup)

*Leq is the typical 5-minute equivalent continuous sound level in A-weighted decibels
** DRC for determining “noise dose” = 95 dBA for 8 hr Leq 30 dB exchange rate

Audiology Today MayJune 2011: pp 30-40

Damage Risk Criteria

- OSHA
  - 90 dBA, 8-hr TWA
  - 5 dB Exchange Rate (ER)
- NIOSH
  - 85 dBA TWA
  - 3 dB ER
- EPA / WHO
  - 80 dBA TWA
  - 3 dB ER
- LIBERAL

<table>
<thead>
<tr>
<th>90 dBA</th>
<th>8 hrs</th>
<th>85 dBA</th>
<th>8 hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>95 dBA</td>
<td>4 hrs</td>
<td>88 dBA</td>
<td>4 hrs</td>
</tr>
<tr>
<td>100 dBA</td>
<td>2 hrs</td>
<td>91 dBA</td>
<td>2 hrs</td>
</tr>
<tr>
<td>105 dBA</td>
<td>1 hr</td>
<td>94 dBA</td>
<td>1 hr</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CONSERVATIVE</th>
<th>80 dBA</th>
<th>8 hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>83 dBA</td>
<td>4 hrs</td>
<td></td>
</tr>
<tr>
<td>86 dBA</td>
<td>2 hrs</td>
<td></td>
</tr>
<tr>
<td>89 dBA</td>
<td>1 hr</td>
<td></td>
</tr>
</tbody>
</table>
Portable Listening Device (PLD) Use

Box-and-whisker plots showing equivalent continuous 8-hr and 40-hr levels (Leq) for median, interquartile range, and maximum and minimum

Mean LA8hn = 87.2 dBA
Range = 60 – 115 dBA

Mean LAwkn = 87.4 dBA
Range = 59 – 116.4 dBA

Levey, Levey & Fligor (2011)

PLD Use, NYC Campus and Union Square

<table>
<thead>
<tr>
<th>Ethnicity/Race</th>
<th>% Exceeds Max Daily Noise Dose</th>
<th>% Exceeds Max Weekly Noise Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>African</td>
<td>60%</td>
<td>60%</td>
</tr>
<tr>
<td>African American</td>
<td>86%*</td>
<td>86%**</td>
</tr>
<tr>
<td>Asian</td>
<td>60%</td>
<td>60%</td>
</tr>
<tr>
<td>Caribbean</td>
<td>69%</td>
<td>40%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>65%</td>
<td>61%</td>
</tr>
<tr>
<td>White</td>
<td>37%</td>
<td>34%</td>
</tr>
</tbody>
</table>

*p = 0.004; **p = 0.002

Levey, Fligor, Cutler & Harushima, (Noise and Health, in press)

PLD Use, NYC Campus and Union Square

<table>
<thead>
<tr>
<th>Age</th>
<th>% Exceeds Max Daily Noise Dose</th>
<th>% Exceeds Max Weekly Noise Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-24 years</td>
<td>68%*</td>
<td>65%**</td>
</tr>
<tr>
<td>25-56 years</td>
<td>48%</td>
<td>41%</td>
</tr>
</tbody>
</table>

*p = 0.015; **p = 0.004

Non-significant: Education, gender, NIHL-risk awareness, campus vs. Union Square, mode of transit, device-type, or music genre

Significant Factor: Social identity?

Levey, Fligor, Cutler & Harushima, (Noise and Health, in press)
Acceptable strategy with PLD?
Sound isolation and comfort: custom vs. non-custom

“Acceptable”
Audiologist motivation:
- Prevent all hearing loss and have a grateful patient! (Who will refer more patients)

Patient motivation:
- Avoid suffering the negative consequences of hearing loss
- Achieve the same pleasure/performance in my activity as I do without following the HLPP
- Any devices are comfortable enough to use for the duration of my activity
- The cost is in line with the value
- Limit occlusion effect (and other detrimental consequences)
- Don’t look silly
- Others?

Live music: are flat frequency attenuators more acceptable HPD?
Musicians Earplugs™ schematic design. © Copyright Etymotic Research Inc. Used with permission.

Killion, DeVibiss and Stewart 1988

Transfer Function of the Open Ear

MIRE Verification of Flat Attenuation
Verification of Flat Attenuation

MIRE Verification of Flat Attenuation

An experiment toward “acceptable”
Noise-Induced Hearing Loss
Need for Level-dependent HPD

Firearms noise exposure
- #1 cause of recreational NIHL
- Target shooting vs. live game hunting
- Environment: open field vs. turkey blind
- Caliber of firearm

Communication critical occupations
- First-responders
- Military
- Resource extraction (mining, drilling, etc)
- Vocalists

Level-dependent HPD:
Active, passive, non-custom, custom

Active HPD-Communication Device

Need for Communication-HPD

Vocalists on stage: “More Me!” factor

3D Active Ambient in-ear monitors

Used with permission by Sensaphonics

“Acceptable”

Welcoming, pleasing

Capable or worthy of being [generally approved or used]

Barely satisfactory or adequate

Summary: “Acceptable”

✓ Not compromising goals of HLPP
✓ Finding the right trade-off between performance and comfort
  - tight seal, deep canal vs. shallow and loose
✓ Maintain communication and situational awareness
  - don’t over-protect
✓ Give the freedom to pursue passion (safely)
Do we have time!?

Thoughts? Questions?
Challenges?
--- All are welcome!

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