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

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AudiologyOnline.com Expert Seminar Series on Noise-Induced Hearing Loss, 2013:

- Frank Wartinger, Au.D.

"Tinnitus Assessment in Young Musicians" Wed, July 17: 12-1pm EST

- Christopher Spankovich, Au.D., Ph.D., M.P.H.

"Food for Though: Nutrition and Noise" Wed, July 24: 12-1pm EST

- Colleen G. LePrell, Ph.D., CIH

"Otoprotective Agents for Prevention of Acquired Hearing Loss in Humans" Wed, July 31: 12-1pm EST

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?

Firearm Type	Peak Sound Level (dB SPL)
Small Rifle	140-145
Medium Rifle	157-160
Large Rifle	160-174
Shotgun	152-166
Small Pistol	150-157
Large Pistol	158-174

Provided by Michael Stewart, Ph.D. of Central Michigan University and presented on July 3, 2008 on Audiology Online

Bamboozle Road Show, June 2010

Bamboozle Road Show, June 2010

Sound Exposures: Bamboozle Road Show, June 2010

Leq* (dBA)	105
Time (hrs)	4
Noise dose**	5000%

Table 1. Total audience exposure

Leq* (dBA)	99
Time (hrs)	7
Noise dose**	2198%

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" = 85 dBA for 8-hr Leq, 3dB exchange rate

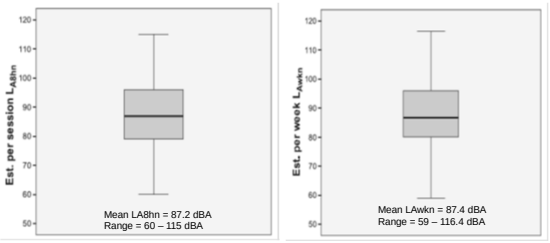
Audiology Today MayJune 2011: pp 30-40

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
90 dBA | 8 hrs	85 dBA | 8 hrs	80 dBA | 8 hrs
95 dBA | 4 hrs	88 dBA | 4 hrs	83 dBA | 4 hrs
100 dBA | 2 hrs	91 dBA | 2 hrs	86 dBA | 2 hrs
105 dBA | 1 hr	94 dBA | 1 hr	89 dBA | 1 hr

LIBERAL ⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯⋯→ CONSERVATIVE

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

Levey, Levey & Fligor (2011)

PLD Use, NYC Campus and Union Square

Ethnicity/Race	% Exceeds Max Daily Noise Dose	% Exceeds Max Weekly Noise Dose
African	60%	60%
African American	86%*	86%**
Asian	60%	60%
Caribbean	69%	46%
Hispanic	65%	61%
White	37%	34%

*p = 0.004; **p = 0.002

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

PLD Use, NYC Campus and Union Square

Age	% Exceeds Max Daily Noise Dose	% Exceeds Max Weekly Noise Dose
18-24 years	68%*	65%**
25-56 years	48%	41%

*p = 0.015; **p = 0.004

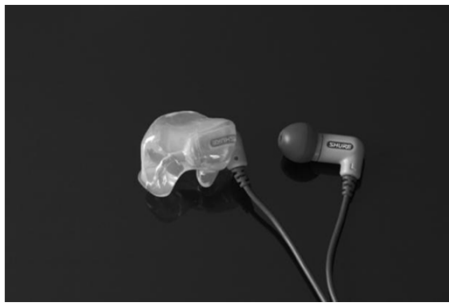
Non-significant: Education, gender, NIHL-risk awareness, campus vs. Union Square, mode of transit, device-type, or music genre

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



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"Acceptable"

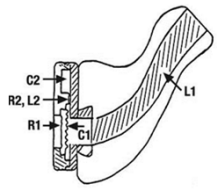
Audiologist motivation:

- 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?



Schematic side view of the ER-15

C = compliance
L = inductance
R = resistance

Musicians Earplugs™ schematic design.
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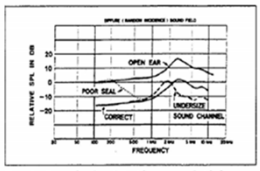


Figure 8. Expected eardrum SPL with ear open and with three constructions of ER-15 earmold.

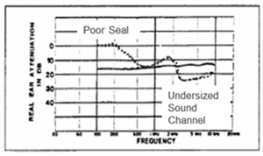
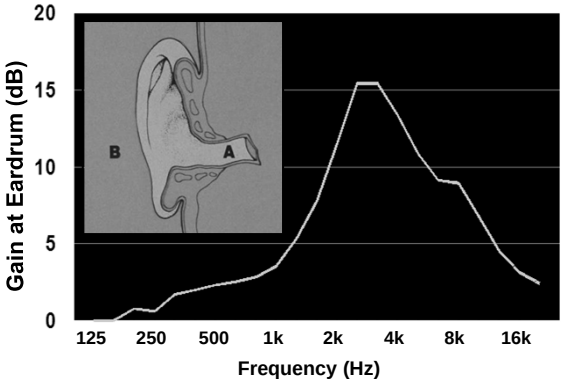


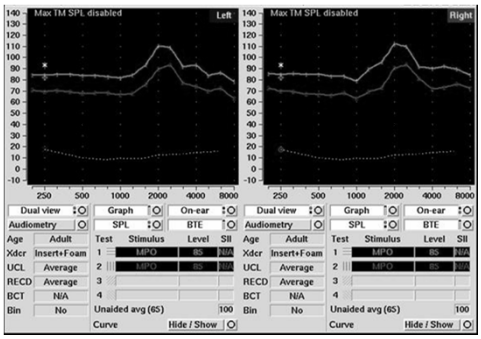
Figure 9. Calculated ER-15 performance vs. earmold construction: (—) correct (3.5 mm) sound channel, well-sealed; (. . .) poor seal, equivalent to 0.028" vent hole; (- - -) undersized sound channel (2-mm dia.).

Killion, DeVilbiss and Stewart 1988

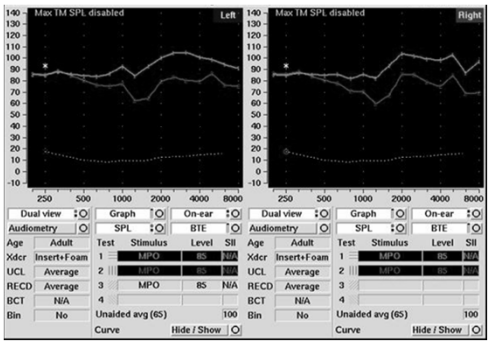
Transfer Function of the Open Ear



MIRE Verification of Flat Attenuation



Verification of Flat Attenuation



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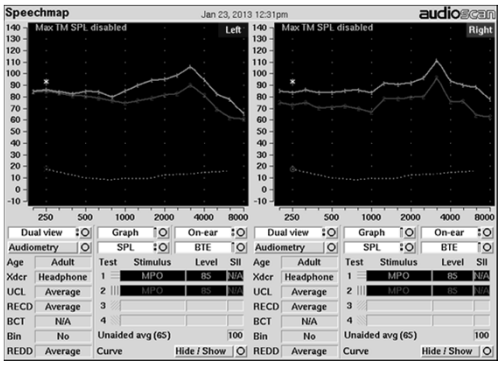
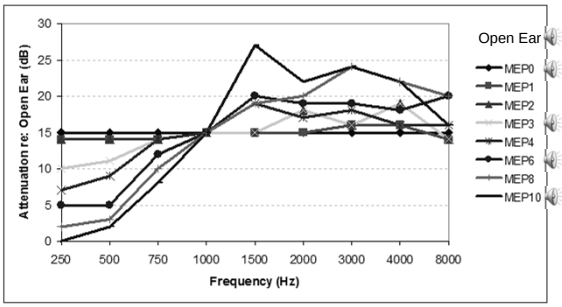


An experiment toward “acceptable”



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

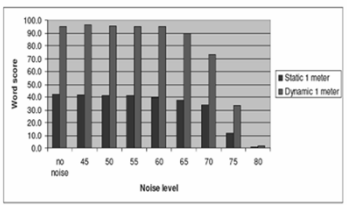
- First-responders
- Military
- Resource extraction (mining, drilling, etc)
- Vocalists

Noise-Induced Hearing Loss

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

Noise-Induced Hearing Loss

Active HPD-Communication Device



http://www.myavaa.org/documents/JDVAC-2011-Presentations/Erman_JDVAC2011.pdf

Need for Communication-HPD

Vocalists on stage: "More Me!" factor

3D Active Ambient in-ear monitors

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"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!