Hearing Loss Prevention: What’s 5 dB among friends?

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The Problem of Noise Exposure:

- USA:
  - 10 - 20 million workers exposed to hazardous noise at work
  - 9 million more at risk due to ototoxic agent exposures
- EU:
  - 28% of workers exposed to hazardous noise at least 25% of time
- Canada:
  - 35% of workers exposed to hazardous noise at work
- Australia:
  - 1 million workers exposed to hazardous noise at work
- Asia:
  - > 50% of projected disabling hearing loss attributed to developing Asian countries
- Worldwide:
  - > 4 million disability adjusted life years (DALYs) attributed to NIHL
Comparison of NIOSH (1998) and ISO excess risk estimates

<table>
<thead>
<tr>
<th>Level (dBA)</th>
<th>ISO</th>
<th>NIOSH</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>17%</td>
<td>25%</td>
</tr>
<tr>
<td>85</td>
<td>6%</td>
<td>8%</td>
</tr>
<tr>
<td>80</td>
<td>1%</td>
<td>1%</td>
</tr>
</tbody>
</table>

ISO – International Organization for Standardization
NIOSH – National Institute for Occupational Safety and Health

## Occupational Medicine Model of Prevention

<table>
<thead>
<tr>
<th>Stages</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary:</strong></td>
<td>Prevent occurrence of disease, remove hazard: <em>noise control</em></td>
</tr>
<tr>
<td><strong>Secondary:</strong></td>
<td>Early intervention, test hearing: <em>intervene if TTS</em></td>
</tr>
<tr>
<td><strong>Tertiary:</strong></td>
<td>Treat and rehabilitate, intervention failed: <em>ALDs</em></td>
</tr>
</tbody>
</table>

### An ounce of prevention is worth a pound of compliance.

*Tip the scale toward prevention*
Audiologist's Role in Hearing Loss Prevention

Compliance vs. Prevention

Hearing Loss Prevention Program

- Recordkeeping
- Effectiveness Assessment

Each HCP component should integrate good record keeping practices and evaluation of HCP effectiveness.

The TEAM

- HLPP Coordinator
- Occupational Health Nurse
- Certified Occupational Hearing Conservationist
- Professional Supervisor
- Corporate and facility management
- Facility trainers, team leaders
- Employees

BTW: coming soon is a CAOHC online noise survey tutorial

The POLICY

The MESSAGE

Noise Measurement

Noise Control

Education

The TEAM

LWells@ AssociatesInAcoustics.com
Role of the Professional Supervisor

- Establish & Supervise Audiometric Testing
- Review of Audiograms
- Determination of Work Relatedness
- Follow-up of Work Relatedness
- Management of the Audiometric Database

The POLICY

- Compliance:
  - Comparison of the U.S. regulations
  - www.e-a-r.com/pdf/hearingcons/HCRegComparison0407081.xls
- “Best Practices” Recommendations by NIOSH
  - www.cdc.gov/niosh/98-126.html
- Your company’s HLPP policy?
  - Examine each HLPP element
  - Is policy appropriate?
  - Implement changes
  - Re-evaluate in one year
## OSHA Compliance | Prevention
--- | ---
**PEL or OEL & Exchange Rate** | 90 dBA TWA/5 dB | 85 dBA L<sub>Aeq,8</sub> /3dB
**Noise Control** | Enforcement at 100 dBA TWA | Buy Quiet Program
**Noise Measurement** | Update when exposure changes | Update every 2 years; personal noise monitoring
**HPD** | Mandatory at 90 dBA TWA No requirement for Dual HPD | Mandatory at 85 L<sub>Aeq,8</sub> /3dB Attenuation check

## OSHA Compliance | Prevention
--- | ---
**Baseline Hearing Test** | Within 6 months (12 months if mobile) | Within 30 days of noise exposure
**Annual Hearing Test** | For employees ≥ 85 dBA TWA | For employees ≥ 85 L<sub>Aeq,8</sub>
**Training** | Annual, specified content | Expanded content, within 30 days of noise exposure
**Evaluation** | Provide effective HCP | Annual review of HLP
The MESSAGE

• Hearing is valuable

Determination of Work Relatedness

WHO DONE IT?

♦ Facts: Regulations
♦ CLUEs
♦ Evidence aka Records
Case by Case Review

As specified in 1904.5 Record Keeping Rule

– If one or more events/exposures in the workplace caused or contributed to the shift in hearing or “significantly aggravated” a pre-existing hearing loss, then the STS is recordable

– The event or exposure need only be one of the discernable causes, it need not be the only cause.

Recording Criteria Reference:

Determined by physician or other licensed healthcare provider (audiologist)

Permanency: Line-out or erasure is permitted if STS is not persistent

– True hearing change and not caused by age correction

– Would require baseline revision again

Recording Criteria Reference:
# Audiologist's Role in Hearing Loss Prevention

**Hearing Threshold Range**

<table>
<thead>
<tr>
<th>dBHL</th>
<th>Normal Child</th>
<th>Normal Adult</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
<th>Profound</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-15</td>
<td>0-25</td>
<td>30-40</td>
<td>45-70</td>
<td>75-90</td>
<td>&gt;90</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>kHz</th>
<th>0.5</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>6</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Left</em></td>
<td>20</td>
<td>15</td>
<td>20</td>
<td>10</td>
<td>35</td>
<td>25</td>
<td>10</td>
</tr>
<tr>
<td><em>Right</em></td>
<td>10</td>
<td>05</td>
<td>20</td>
<td>30</td>
<td>45</td>
<td>40</td>
<td>05</td>
</tr>
</tbody>
</table>

Larger dB number = louder signal = worse hearing

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## Review of Audiograms

**Standard Threshold Shift:**

The definition of STS has never changed under OSHA. It is the point at which the employer has mandatory intervention due to hearing decrease.

STS =

Average change of 10 dB or more between the current test and baseline test at 2000, 3000, 4000 Hz in either ear.

- Age corrections are allowed
- Baselines must be kept for each ear separately
**Male Employee**  
**Age at Baseline:** 40 yrs  
**Age at Current:** 43 yrs  
**Left ear:** No STS  
**Right ear:** STS  
**Age corrections applied.**

<table>
<thead>
<tr>
<th>Patient Information</th>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency (Hz)</strong></td>
<td>500</td>
<td>1k</td>
</tr>
<tr>
<td>Current</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Baseline</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Shift</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>STS</td>
<td>6.7</td>
<td>25.0</td>
</tr>
<tr>
<td>Age Corrected Shift</td>
<td>-1</td>
<td>3</td>
</tr>
</tbody>
</table>

**Review of Audiograms**

**Recordable Hearing Loss:**  
Definition has changed over time.  
Permanent hearing loss of sufficient magnitude to record on the injury and illness log.

OSHA: STS which results in hearing loss of ≥25 dBA average at 2, 3, and 4 kHz, and is related to occupational noise exposure.

\[
\text{OSHA: } 20 + 30 + 45 = 32 \text{ dB HL}
\]
Audiologist's Role in Hearing Loss Prevention

Baseline: AI = 1.00
OSHA STS: AI = .83
MSHA Recordable STS: AI = .41

Killion & Mueller, Page 10
1/2010 Hearing Journal

CLUES:

- Audiometric data
- Noise exposure
  - Other environmental exposure
- Hearing Protection
- Medical history
**CLUE: AUDIOMETRIC DATA**

**Q:** Has hearing loss been established?

- Must have *reliable* audiometric data to identify hearing loss and hearing shifts.
- Reduce audiometric variability introduced in testing.

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**CLUE: AUDIOMETRIC DATA**

**Q:** consistent with NIHL?

- Sensory type
- *Typically* bilateral and symmetrical
- Characteristic noise notch 3, 4, or 6 kHz
- Gradually progressive, unless acoustic trauma
- Temporary followed by permanent
- Tinnitus

*Graphic by Sharon Kujawa, PhD*
Diagnostic audiology evaluation includes *air and bone conduction* thresholds to determine type of hearing loss.
Individual susceptibility to NIHL loss varies greatly.

CRACK THE CASE:

<table>
<thead>
<tr>
<th></th>
<th>LEFT EAR</th>
<th></th>
<th>RIGHT EAR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kHz</td>
<td>0.5 1 2 3 4 6 8</td>
<td>0.5 1 2 3 4 6 8</td>
</tr>
<tr>
<td>1/13/02</td>
<td></td>
<td>15 00 10 15 10 25 15</td>
<td>10 00 10 15 15 15 15 30</td>
</tr>
<tr>
<td>1/30/03</td>
<td></td>
<td>20 20 25 35 35 15 20</td>
<td>45 50 75 60 60 80 80</td>
</tr>
<tr>
<td>5/02/03</td>
<td></td>
<td>20 25 20 25 25 25 30</td>
<td>10 10 15 20 25 10 00</td>
</tr>
</tbody>
</table>

Female
DOB: 04/01/47
Audiologist's Role in Hearing Loss Prevention

CLUE: NOISE EXPOSURE

Q: Commensurate with occupational noise exposure?

- Over the tenure of employment
  - Job history, noise exposure data
- Area measurements, noise dosimetry
  - Consider noise control efforts
  - Extended work shifts > 8 hours
- Other environmental exposures
  - solvents, heavy metals, tobacco smoke

Noise monitoring records

<table>
<thead>
<tr>
<th>Date</th>
<th>Job Description</th>
<th>Noise Dosimetry Average (Of Multiple Samples) dBa, TWA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978-1979</td>
<td>Inspector packer/trainee for Operator</td>
<td>&lt; 80 &lt; 80</td>
</tr>
<tr>
<td>1979-1987</td>
<td>Operator: line start-up</td>
<td>91 – 99 94.9</td>
</tr>
<tr>
<td>1987-1991</td>
<td>Machine Chief</td>
<td>80 – 91 86.5</td>
</tr>
<tr>
<td>12/91–1/92</td>
<td>Servicer: drove clamp trucks</td>
<td>83 – 86 84.0</td>
</tr>
<tr>
<td>1/92-8/92</td>
<td>Machine Chief</td>
<td>80 – 91 86.5</td>
</tr>
<tr>
<td>8/92-11/92</td>
<td>Maintenance Production Utility</td>
<td>86 - 106 95.7</td>
</tr>
<tr>
<td>11/92-4/94</td>
<td>Packaging Attendant</td>
<td>76 - 96 86.9</td>
</tr>
<tr>
<td>5/94-11/94</td>
<td>Machine Chief</td>
<td>80 – 91 86.5</td>
</tr>
<tr>
<td>11/94-4/95</td>
<td>Servicer: drove clamp trucks</td>
<td>83 – 86 84.0</td>
</tr>
<tr>
<td>4/95-7/05</td>
<td>Machine Chief</td>
<td>80 – 91 86.5</td>
</tr>
<tr>
<td>7/05-7/06</td>
<td>Medical Leave of Absence</td>
<td>No Noise No Noise</td>
</tr>
</tbody>
</table>
Non-occupational noise exposure?

- Firearms
- Motorcycles
- Chain saws
- Power tools
- Loud music
- Race cars

Contribution of nonoccupational noise is difficult to quantify. Nonoccupational noise also tends to indicate other risk factors for hearing loss.

Extra documentation for shooters:
- Do you shoot right or left handed?
- What type of firearm/s do you use?
- Approx. how many rounds do you shoot annually?
- Do you wear hearing protection when target shooting? Hunting?
- What type of HPD?

Noise Navigator
http://www.e-a-r.com/pdf/hearingcons/Noise_Nav.xls
## Crack the Case:

<table>
<thead>
<tr>
<th>kHz</th>
<th>.5</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>.5</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>6</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/23/04</td>
<td>10</td>
<td>15</td>
<td>15</td>
<td>25</td>
<td>30</td>
<td>15</td>
<td>20</td>
<td>20</td>
<td>05</td>
<td>15</td>
<td>20</td>
<td>10</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>8/06/05</td>
<td>15</td>
<td>20</td>
<td>25</td>
<td>60</td>
<td>55</td>
<td>60</td>
<td>85</td>
<td>15</td>
<td>20</td>
<td>20</td>
<td>35</td>
<td>10</td>
<td>05</td>
<td>10</td>
</tr>
<tr>
<td>11/1/05</td>
<td>05</td>
<td>10</td>
<td>10</td>
<td>55</td>
<td>55</td>
<td>55</td>
<td>75</td>
<td>15</td>
<td>05</td>
<td>05</td>
<td>25</td>
<td>05</td>
<td>00</td>
<td>10</td>
</tr>
</tbody>
</table>

## CLUE: Hearing Protection

**Q:** Was hearing protection properly fitted and used?

- Are there quantifiable attenuation data?
- Is attenuation commensurate with noise exposure?
- Is hearing protection compatible with other PPE?
- Did employee comply with company policy?
- Are there training records?
- Was hearing protection worn before audiometric test?
Labeled vs. Field Values

NRR ÷ 2

Not Really Relevant?
Factors That Compromise Hearing Protector Performance

- Comfort
- Communication
- Use/wearing time
- Fit
- Compatibility
- Readjustment
- Deterioration
- Modification
### Crack the Case: Employee Info:

- **Gender:** Male
- **DOB:** 6/01/1976
- **Job:** Spunbound operator C
- **TWA:** 90 dBA
- **HPD:** Flange style
- **Nonocc noise:** Firearms, music
Audiologist's Role in Hearing Loss Prevention

HPD Attenuation Measurement

VeriPro™

E·R·fit

http://www.howardleight.com
http://www.e-a-r.com
CLUE: MEDICAL HISTORY

Q: Are symptoms claimed plausible?

- Tinnitus, ear disease, etc.
- Personal medical conditions
- Other environmental exposures

INVESTIGATION

- Standard HLPP protocol
- Diagnostic audiology evaluation
- Extended medical history
- Details non-occupational exposure
- Noise dosimetry at work
- Professional Reviewer interview of employee
- HPD fit check or audiology HPD attenuation measure
CRITICAL RECORDS

- Noise & chemical exposures over entire work history (TWA, $L_{Aeq,8}$),
- Other noisy jobs (past or 2nd job), military service,
- Non-occupational noise exposure and HPD use,
- HPD records: fitting, replacement, compliance,
- Training documentation,
- Annual audiograms, calibration/booth records,
- Employee feedback and follow-up actions,
- Referral results or opinions from audiologist, doctor.

CRACK THE CASE

LEFT EAR

RIGHT EAR

[Graphs showing hearing levels over time]
RESOURCES

- American Academy of Audiology: Position Statement on Preventing Noise-Induced Occupational Hearing Loss
  www.audiology.org

- American College of Occupational and Environmental Medicine: Position Statement

- Council for Accreditation in Occupational Hearing Conservation's Professional Supervisor Course
  http://www.caohc.org/professional_supervisor/course.php

  http://www.cdc.gov/niosh/topics/noise/research/noiseandchem/noiseandchem.html