Now Hear This!
Managing a Hearing Conservation Program (HCP)

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Learning Objectives

1. Describe the 7 Components of a Hearing Conservation Program
2. Review basic principles of noise and noise-related hearing loss
3. Know how to interpret an audiogram
4. Understand the hearing difficulties of, and hearing solutions for, the hearing-impaired worker
Outline

1. Overview of Hearing Conservation Program (HCP)
2. Brief review of general hearing & noise concepts
3. Audiometric testing
4. Hearing Impaired Worker
5. Keys to successful HCP
Hearing Conservation Program
OSHA Mini-history of Hearing Regulations

• 1969 Walsh-Healey Public Contracts Act
• OSHA revised regulation in 1983
• OSHA implemented policies and interpretations
Hearing Regulations

Regulations vary:

– Mining Safety Health Administration (MSHA)
– OSHA Exemptions - e.g. oil and gas well drilling
– State hearing loss Statutes
Components of HCP

1. Employer and program administrator
2. Employee
3. Noise measurement and control
4. Audiometric testing
5. Hearing protectors
6. Education
7. Record keeping and Program evaluation
Employer

• CEO/managers/supervisors
• Must have commitment from the top
• Promote a Culture of Safety
  – Provide equipment and staffing, especially a program administrator (the “champion”)
  – Lead by example - wearing hearing protectors (HP) when in noisy environment
  – Enforcement
Employees

Motivation and Buy in:

• Involvement in Planning of HCP
• Involvement of workers’ unions
• Education
• Feedback and Response
Noise Measurement and Control

Noise engineer and/or industrial hygienist

• Noise control plan
  – Remove or modify sources of noise - *most effective means to prevent hearing loss*
  – Administrative measures to control noise exposure

• Sound measurements
  – To identify and evaluate sources of excessive noise
  – To determine which employees need to be in HCP
  – To measure background noise levels in audiometer room
Hierarchy of Health & Safety Controls

1. Eliminate or Substitute
2. Engineer
3. Warnings
4. Training, Procedures, and Administrative Controls
5. Personal Protective Equipment
Audiometric Testing

• How you know if the HCP is effective
• Audiometric technician
  – Performs audiogram
  – Screens for problem audiograms
  – Education
  – Oversight of accuracy and quality of testing
• Professional supervisor
  – Audiologist, otologist or other clinician
  – Deals with problem audiogram interpretation
Hearing Protectors (HP)

- Worker acceptance is key
- Factors influencing use of HP
  - Convenience & availability & comfort
  - Belief that device will prevent hearing loss
  - Adequate noise reduction without impairment of ability to hear important sounds
  - Compatibility with other personal protective devices
Education

• Managers/supervisors
• Employees
  – OSHA mandated annually and if significant change in hearing (Standard Threshold Shift)
  – Review audiogram – “Teachable moment”

Inquiring Ears Want to Know
http://www.cdc.gov/niosh/mining/pubs/pubreference/outputid2573.htm
This sheet explains your audiogram (hearing test) and gives some basic information about protecting your hearing. Keep it so you can refer to it later.

What is an audiogram?
- An audiogram is often called a “hearing test,” but there’s no pass or fail
- It is a written record of your hearing levels
- A series of audiograms can track changes in hearing over time
- Your hearing threshold levels (the quietest sounds you can hear) are measured in decibels (dB) at different frequencies from low (500 Hz) to high (8000 Hz)

Why should I get audiograms?
- To measure your hearing ability
- To identify hearing problems
- To monitor success at maintaining your hearing
- To see if noise exposure is affecting your hearing

Do I have normal hearing?
Compare your hearing threshold levels to this scale:
- 10 – 25 dB Normal hearing
- 26 – 40 dB Mild loss
- 41 – 55 dB Moderate loss
- 56 – 70 dB Moderate/severe loss
- 71 – 90 dB Severe loss
- 91 – 100 dB Profound loss

Sample audiogram results

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Left Ear Thresholds</th>
<th>Right Ear Thresholds</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 Hz</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>1000 Hz</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>2000 Hz</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>4000 Hz</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>8000 Hz</td>
<td>15</td>
<td>30</td>
</tr>
</tbody>
</table>

Normal hearing threshold levels
(20 dB or less, positive numbers are especially good)

Worse than normal levels
(more than 25 dB)

Audiograms test a range of sounds from low to high frequency (pitch). The test frequencies, measured in Hertz (Hz), usually range from 500 Hz (around the middle of a piano’s scale) up to 6000 or 8000 Hz (a little above the highest note a piano can play).
Record Keeping

• Microprocessor audiometers with software
  – do calculations
  – store data and retain records
  – provide reports

• OSHA regulation (and more)
  – *Retain all audiometric test records at least for duration of employment*
Program Evaluation

• NIOSH –Hearing Conservation Program Evaluation Checklist
  – http://www.cdc.gov/niosh/topics/noise/solutions/hearingchecklist.html

• NIOSH Criteria Document recommends:
  Annual incidence of no more than 3% of workers showing significant threshold shift
  (15dB twice, same ear, same frequency)
At-Work Solutions for Noise

Hearing Conservation Program Evaluation Checklist

Training and Education

Failures or deficiencies in hearing conservation programs (hearing loss prevention programs) can often be traced to inadequacies in the training and education of noise-exposed employees and those who conduct elements of the program.

1. Has training been conducted at least once a year?
2. Was the training provided by a qualified instructor?
3. Was the success of each training program evaluated?
4. Is the content revised periodically?
5. Are managers and supervisors directly involved?
6. Are posters, regulations, handouts, and employee newsletters used as supplements?
7. Are personal counseling sessions conducted for employees having problems with hearing protection devices or showing hearing threshold shifts?
Hearing & Noise Concepts
Noise

Noise = sound level

Sound is a wave of air pressure with two important characteristics

1. Amplitude or pressure of the waves
2. Frequency or rate of oscillating waves
Hearing Concepts

- **Amplitude** is measured in Decibels (dB) logarithmic scale.
- **Frequency** is measured in cycles per second or Hertz (Hz).
Hearing Concepts

• Human ear can perceive an extremely large range of pressures
• Sound pressures measured in micropascals
• To simplify, the decibel scale was created
• When the decibel level goes up by 20 dB, the sound pressure in micropascals goes up ten times
Sound levels in microPascals

<table>
<thead>
<tr>
<th>Source of Sound/Noise</th>
<th>Approximate Sound Pressure in μPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Launching of the Space Shuttle</td>
<td>2,000,000,000</td>
</tr>
<tr>
<td>Full Symphony Orchestra</td>
<td>2,000,000</td>
</tr>
<tr>
<td>Diesel Freight Train at High Speed at 25 m</td>
<td>200,000</td>
</tr>
<tr>
<td>Normal Conversation</td>
<td>20,000</td>
</tr>
<tr>
<td>Soft Whispering at 2 m in Library</td>
<td>2,000</td>
</tr>
<tr>
<td>Unoccupied Broadcast Studio</td>
<td>200</td>
</tr>
<tr>
<td>Softest Sound Human can Hear</td>
<td>20</td>
</tr>
</tbody>
</table>
Emerging concept

• Lifetime Sound Exposure
• Using units of Pascal-squared-seconds or PASQUES
• Could add sound exposure linearly - like adding calories
• Worker could determine if they had reached limit beyond which hearing loss is probable
“A” filtering dB(A)

• Human sensitivity to sound is greatest between 1000 and 5000 Hz
  – Noise exposure in this range causes more injury than other Hz

• *Occupational* noise is a weighted algorithm
  – noise in the range of the highest sensitivity is assigned a relatively greater Decibel value “dB(A)”

• Occupational noise is measured, studied and regulated with “A-filtering”
Duration of Noise Exposure

• Risk of hearing loss is related to both loudness \textit{and} duration.

• Both factors contribute to cumulative exposure

• Time-Weighted Average (TWA)
  – Averaging all the noise fluctuations in an 8-hr day
OSHA PEL and Action Level

Permissible Exposure Limit (PEL)
TWA 90dB(A) in 8-hr day

Action Level
TWA 85dB(A) for 8-hr day
employee should be placed in HCP
Exchanges rates

• Exchange rate: The relationship between allowable exposure times and specific noise levels
• 5-dB exchange rate – an increase of 5dB(A) is equivalent to doubling of exposure duration

<table>
<thead>
<tr>
<th>Noise Level</th>
<th>Exposure Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>90 dB</td>
<td>8 hr</td>
</tr>
<tr>
<td>95 dB</td>
<td>4 hr</td>
</tr>
<tr>
<td>100 dB</td>
<td>2hr</td>
</tr>
</tbody>
</table>
Hearing Loss

• Threshold of hearing
  – Different for each person
• Temporary Threshold Shift (TTS)
  – Short term hearing loss
• Permanent Threshold Shift (PTS)
  – Permanent hearing loss
  – New threshold for person
• Standard Threshold Shift (STS)
  – OSHA-defined threshold change
Audiometric Testing
OSHA Requirements

• OSHA requirements for audiometric testing

• http://www.osha.gov/SLTC/noisehearingconservation/index.html
OSHA Standards (and more)
Supervisor of Audiometric Testing

• Must be licensed or certified audiologist, otolaryngologist or other physician
• Person responsible for conduct of audiometric testing
• Determine if STS is present and if it is an OSHA recordable shift
• Reviewer of problem audiograms
• Determine if occupational or non-occupational hearing loss
Standard Threshold Shift (STS)

Definition:
Average shift from a previous baseline audiogram of ≥ 10 db for the frequencies of 2k, 3k, 4kHz

<table>
<thead>
<tr>
<th></th>
<th>2k Hz</th>
<th>3k Hz</th>
<th>4k Hz</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>15</td>
<td>20</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>Annual</td>
<td>25</td>
<td>35</td>
<td>35</td>
<td>31.7</td>
</tr>
<tr>
<td>Threshold Shift</td>
<td>10</td>
<td>15</td>
<td>10</td>
<td>11.7</td>
</tr>
</tbody>
</table>
STS Actions

- Employee must be notified in writing within 21 days
- Employer must retrain the employee and evaluate employee’s hearing protection
- Change to new baseline, if STS persistent
- Decide if OSHA recordable
- Refer if needed
OSHA Recordable Shift

If STS present and if average hearing loss at 2k, 3k, 4k Hz is \( \geq 25 \text{dB} \) in either ear.
Baseline audiogram

• Within 6 months of hire, or within 1 year if using mobile van
• 14-hour period without loud noise exposure, before performing baseline test
  – hearing protection can be substituted
• Notify employees to avoid high non-occupational noise levels before baseline
Annual audiogram

• Done anytime, preferably at end of shift
• Compare to baseline for Standard Threshold shift (STS)
• If STS present
  – Per OSHA option to retest within 30 days
  – NIOSH suggests immediate retest, if same schedule for 30 day reconfirmation
Noise Induced Hearing Loss

1. History of loud noise exposure over months to years
2. Gradual onset
3. Sensorineural hearing loss
4. Bilateral loss with typical “notch” at 4000Hz
Noise induced hearing loss
Is it work-related?

• Workplace noise exposure
• Non-occupational factors
  – Noisy hobbies or sports
  – Other jobs
  – Medical problems (e.g. infections, chronic disease, tumors, Meniere’s disease, etc.)
  – Ototoxins (Medications, Chemicals, Metals)
  – Head or ear trauma
  – Family history of hearing loss
Presbycusis

• Not a disease...just life.
• Generally seen after age 60
• Loss greatest at very highest frequencies
• Optional age correction when determining STS
Presbycusis
When to refer

Asymmetric hearing loss
Sudden or fluctuating hearing loss
Ear pain or drainage (work-related if caused by hearing protectors)
Dizziness
Severe persistent tinnitus
Feeling of fullness or discomfort in ears in previous 12 month?
Foreign body or cerumen in ear canal
*Inconsistent results
*Employees with hearing aids
*Uncertain of diagnosis

(*work-related*)
Hearing Impaired Worker
Hearing Impaired Worker

• ~28 million Americans have some hearing loss
• Hearing loss present in 1/3 of people >60yr
• Special concerns for Hearing Impaired Worker
  – Hearing verbal instructions
  – Hearing sound of machinery or alarms
  – Communication with coworkers
  – Identifying direction of sound source
Hearing protectors for Hearing Impaired Worker

• Conventional hearing protectors may lower the volume of speech below the threshold of audibility

• Especially for middle to higher frequency consonant sounds
Speech discrimination
Hearing protectors for Hearing Impaired Workers

1. Active Hearing Protectors
2. Passive Hearing Protectors
3. Earmuffs with Communication Features
Hearing Aids are **not** effective Hearing Protection
Keys to Successful HCP
Keys to Success

• Commitment, communication and integration at all levels
• Dedicated program administrator (The Champion)
• Educate employees at time of testing
• Stop noise at its source
• Remember: Goal is hearing loss prevention... not detection
Web References

• US Dept of Labor Noise and Hearing
  (To find standards, regulations, consensus statements and much more)

• OSHA Technical Manual for Noise and Hearing Conservation

• Inquiring Ears Want to Know
  http://www.cdc.gov/niosh/mining/pubs/pubreference/outputid2573.htm

• US Dept of Labor: Hearing Conservation for the Hearing-Impaired Worker

• US Dept of Labor: Innovative workplace safety accommodations for hearing-impaired workers
  http://www.osha.gov/dts/shib/shib072205.html

• My I-Pod can Destroy My Hearing?? Say What?? Colorado School of Public Health (Student project). You Tube video (2010).
  http://www.youtube.com/watch?v=KbFV41Gw51s
References

• Drott, ES and Bruce RD. (Summer/Fall 2010) A Different Look at Noise Exposure and Hearing Loss. CAOHC Update 22; 2:1


Question 1:

1. There is a hierarchy of health and safety controls. What is the most effective means of preventing hearing loss in the workplace?

A. Hearing Protectors  
B. I-Pods  
C. Administrative Controls  
D. Enforcement  
E. Removal of noise sources
Question 2:

2. Which of the following best describes a “Standard Threshold Shift”?

A. Average shift from a previous baseline audiogram of $\geq 10$ db for the frequencies of 2k, 3k, 4kHz
B. Median shift from a previous baseline audiogram of $\geq 10$ db for the frequencies of 2k, 3k, 4kHz
C. Average shift from a previous baseline audiogram of $\geq 10$ db for the frequencies of 6k, 7k, 8kHz
D. None of the above
Question 3

3. Hearing-impaired workers face special challenges on the job. Which of the following statements about the use of hearing aids by hearing-impaired workers is correct?

A. Hearing aids effectively block noise
B. Hearing-impaired workers should avoid using hearing aids on the job
C. Hearing-impaired workers who need hearing aids should wear hearing aids and appropriate hearing protectors on the job.
D. Hearing-impaired workers should avoid using hearing protectors on the job