Basic Information on Hearing Health

Information and Recommendations for Faculty and Staff in Schools of Music

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Part I. Hearing Health Facts and Concepts

Hearing Health: The Basic Issue

Hearing health is important for everyone. It is critical for music professionals.

Certain types of hearing loss, such as those caused by genetic factors, infections, or head trauma are often unavoidable and sometimes only temporary.

One particular type of hearing loss is often permanent: hearing loss due to noise exposure.

Scientifically, this is referred to as noise-induced hearing loss or NIHL.

The hearing system can be injured not only by a loud blast or explosion but also by prolonged exposure to high decibel levels of sound.

Music of any type and source at high volume that exceeds daily exposure levels and time periods is dangerous. Over time, NIHL can be the result.

Preventative measures need to be taken by individual musicians and by institutions where musicians study and work.

Preventative measures include but are not limited to information, applications of information in decision-making and culture building, and acoustically appropriate performance and rehearsal spaces.

The issue is serious. NIHL is widespread. Statistics vary, but 50 percent of musicians may have problems with hearing loss to some degree.

The danger of noise-induced hearing loss is calculated on the basis of scientific evidence expressed mathematically and in other scientific languages. Individual perceptions about loudness may provide useful indications; however, such perceptions are not a substitute for assessments based on scientific measurement and evidence-based data.

Purpose of this Web Resource

This web resource is focused on hearing health and hearing loss, preventative measures, and how schools and departments of music can work appropriately and comprehensively with associated issues.

This information is to be used in service of a goal in individual institutions to provide conditions that support hearing health.

The first essential is information about hearing health, hearing loss, and preventative action.

Charting an effective course to promote and provide the best environment for hearing health means working with many issues and forces beyond providing information for students, faculty, and administrators.

To be successful, a comprehensive hearing health program needs to be sustained from year to year.

This resource provides the basis for instructional efforts to provide information and develop a plan for supporting hearing health with a particular focus on minimizing conditions that could contribute to noise-induced hearing loss.

Basic Facts

Music, Noise, and Loudness Levels

Music is not noise, at least not to musicians.

So why are we talking about **Noise-Induced Hearing Loss** in a music setting?

How are music, noise, and hearing health connected?

Authoritative information about hearing health comes from medical research and practice. Both are based in science where "noise" is a general term for sound.

Music is one kind of sound among thousands of others.

Do not be confused or offended by terms. Remember the fundamental point.

A sound that is too loud, or too loud for too long, is dangerous to hearing health, no matter what kind of sound it is or whether the sound is called noise, music, or something else.

Sounds below threshold danger levels produce no risk, no matter how long the exposure time.

Music itself is not the issue. Loudness and its duration are the issues, for music and for all other sound sources.

Decisions about music play an important part in hearing health, but hearing health can be affected by far more sound sources than music. Loud sounds from all sources contribute 24/7 to the daily exposure level.

Musicians are responsible for their art form, and for supporting the well-being of other musicians.

Cultivating the most positive personal and professional relationship between music and hearing health is part of that responsibility.

Like so many issues in music itself, optimum effectiveness depends on balanced applications of knowledge and skill in varying circumstances by thousands of individual student, professional, and amateur musicians day after day.

Noise-Induced Permanent Hearing Loss

The Path of Hearing

Sound enters the outer ear in the form of sound waves. These waves travel through the bones of the middle ear. When they arrive in the inner ear, they are converted into electrical signals which travel via neural passages to the brain. It is then that sound is “heard.”

Middle Ear Damage

Occasionally, the intensity of a very loud impulse noise, like an explosion, can perforate the eardrum or dislodge the miniature bones of the middle ear, causing a conductive hearing loss. In many cases, this damage can be repaired with microsurgery. But such loud noise levels are also likely to send excessive sound levels into the inner ear, where permanent sensorineural hearing damage occurs.

Inner Ear Damage

After a sound passes through the middle ear, it enters the inner ear, also known as the cochlea. Inside the cochlea are tiny hair cells that help transmit sound waves to the brain. Loud noises cause damage to the hair cells, impairing their ability to send neural impulses to the brain.

Severity of Loss

The severity of an individual’s noise-induced hearing loss depends on the severity of this damage to the hair cells of the inner ear.

Severity of damage to these hair cells is normally related to the length and frequency of exposure to loud sounds over long periods of time.

It is important to understand that hair cells do not regenerate and that once hair cells are damaged, they cannot be repaired.

Noise-induced hearing loss is permanent and painless and initially reduces hearing sensitivity for high frequency sounds. If additional noise exposures continue, the damage progresses to greater hearing loss for sounds that are important for speech understanding, as well as music perception.

Noise-Induced Temporary Hearing Loss

Sometimes, after continuous, prolonged exposure to loud noise, an individuam82t/TT0 1 Tf-6.043 -1.6c -0.(f)1(o)5D[

Noise Levels and Risk

Prolonged exposure to any noise or sound over 85 decibels can cause hearing loss. A decibel, defined by Merriam-Webster as "a unit for expressing the relative intensity of sounds on a scale from 0 for the average least perceptible sound to about 130 for the average pain level" is abbreviated "dB."

The longer one's exposure to a loud noise, the greater the potential for hearing loss.

The closer a person is to the source of a loud noise, the greater the risk for damage to the hearing mechanisms.

Consider these common sounds and their corresponding decibel levels:

30 dB – A Whisper

50 dB – Moderate Rain

60 dB – The Average Conversation

70 dB – Passing Freeway Traffic

80 dB – Alarm Clock

90 dB – Blender, Food Processer, Blow-Dryer; The Subway

100 dB - MP3 Players at Full Volume; Lawnmower, Snowblower

110 dB – s0.002 Tc -0.01 i-24.0226-8.46d226

Exposure Times and Risk

Two U.S. federal agencies that institute policies and enforce regulations related to on-the-job hearing health are the Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH), a branch of the Centers for Disease Control and Prevention (CDC). By and large, the NIOSH standards are stricter, and they recommend shorter exposure times to sound environments with elevated decibel levels.

Recommended Maximum Daily Exposure Times to Instances of Continuous Noise at Various Decibel Levels*

Decibel Level	NIOSH	OSHA
85 dB	**8 hours**	**16 hours**
88 dB	**4 hours**	**10.6 hours**
91 dB	**2 hours**	**7 hours**
94 dB	**1 hour**	**4.6 hours**
97 dB	**30 minutes**	**3 hours**
100 dB	**15 minutes**	**2 hours**
110 dB	**2 minutes**	**30 minutes**
120 dB (close-range)	**almost immediate**	**almost immediate**

***NIOSH and OSHA maintain that the risk for hearing loss is increased when continuous exposure time exceeds these recommended maximums.**

While both OSHA and NIOSH standards are normally applied to industrial facilities where workers face constant and continuous exposure to high sound levels, these recommendations may be applied more broadly to settings beyond the industrial workplace, such as the rehearsal room or the concert hall.

Note 1: OSHA regulations apply to many, many aspects of health and safety at work places of all kinds, including academic institutions.

Note 2: For an application of the above chart to MP3 players, see Basic Protection for Musicians.

Note 3: For more detail regarding the time/intensity relationship or the 3 dB exchange rate, see http://www.cdc.gov/niosh/docs/98-126/chap3.html.

Musicians and Risk of Noise-Induced Hearing Loss

Two facts are clear:

- Acute hearing and aural perception are essential for musicians.
- Noise-induced hearing loss is preventable.

Two conclusions are obvious:

- Musicians have basic hearing health responsibilities.
- Sound-level management is a critically important addition to the musician's portfolio of essential disciplines.

Constant attention is necessary because in most instances hearing loss is a gradual process that initially affects a person's ability to hear very high pitched sounds.

Problems with pitch perception and tinnitus may accompany such initial-stage hearing loss, and these may be career-ending for a musician.

Even if debilitating problems do not occur initially, career activity becomes increasingly difficult, and finally impossible as hearing loss proceeds to more advanced stages.

What do these facts and conclusions mean for musicians and for schools and departments of music?

In many cases, musicians are exposed to elevated levels of sound when they rehearse and perform. But such exposure alone does not equal automatic risk of hearing loss. There are many factors involved in benchmarking and determining the risk of exposure.

For musicians, managing hearing health starts with understanding basic facts and avoiding the most obvious problematic situations.

An environment is risky when it is so loud that one must shout to be heard, especially if such loudness is sustained. A list of basics is provided on Noise Levels and Risk.

There is more, however. Like most other decisions in advanced music making, thoughtful judgments about what to do and what not to do for yourself and for others involve gaining in-depth knowledge and applying it with sophisticated understanding.

Research-derived metrics are a good example. Metrics are valuable. The NIOSH and OSHA standards provide an authoritative basis for comparisons and further calculations. Analytical

Any metric needs to be used with the understanding that in any rehearsal or performance, a number of variables are interacting at the same time and that these interactions are unique to specific settings and situations.

Four major variables are:

Sound-level variation. In some musical situations, decibel levels are essentially constant. However, in most, decibel levels rise and fall. A rock concert may constantly expose performers and audiences to dangerously high noise levels. A classical string quartet performance is usually characterized by fluctuations between soft and loud, with relatively few moments at peak volume.

Settings. Rehearsals and performances may take place in spaces that are right-sized and shaped for the size and volume levels of the individual performer or ensemble. Such spaces have adequate cubic volume. Other spaces may be too small, thus concentrating noise levels. Such spaces do not have adequate cubic volume. Some have proper acoustical treatment for their musical purposes. Others may not. Some settings feature electronic amplification; others do not. Placement of individual [sh)2c [hotb no5(of) tins[s)-2((dua)b1(i)-s)-2(n)2(o5(of-5(i)--3(1 Tc 0 Tw 10.0-)

Sound-level meter readings confirm the obvious. In an overall sense, groups of strings produce

Basic Information on Hearing Health:

Part II. Considerations for Faculty and Staff

Please find below a number of ways you can promote hearing health in your faculty or staff role.

Hearing Health in Music Classrooms, Studios, Rehearsals, and Other Spaces

- Help students understand the importance of hearing health and their responsibility for acting responsibly.

- As a teacher or conductor, you have a significant role in maintaining volume levels in the classroom that do not exceed reasonable levels, especially for long periods. If you are concerned about volume levels in your classroom or rehearsal space related to either room size or construction or to class enrollment, notify an administrator. Large ensembles may not always need to rehearse at full volume.

- Monitor sound levels in your classroom and rehearsal and performance spaces by utilizing available tools, such as a sound-level meter, especially if there is a reasonable chance that sound levels are high for long periods.

- Provide breaks for your students during rehearsal. This “quiet time” is beneficial to both their ability to concentrate and to their hearing health.

- If appropriate, speak with students and administrators about protective devices such as earplugs and sound shields.

- If you suspect that a student is having difficulty hearing (or if he or she reports such a difficulty), refer the student to t2(n)11-5(o tk)11w 2 Tc -0.002 Tw [(a8)-5(ct)6(t)-5(o t)6a .

- Apply carpet to the floors of problematic rehearsal rooms to help absorb sound.

- Place acoustical shields in front of the brass and percussion sections to protect the hearing of the musicians directly in front of these sections.

- Consider making performance-grade earplugs available to students, either on a complimentary basis or for purchase.

- Place treble brass musicians on risers. This way, higher frequency sound waves, such as those played by a trumpet player, will go over the heads of the musicians in the sections in front of them.

- Elevate loudspeakers to near ear level so that they provide musicians with better sound quality at lower levels of intensity.

- Place instrumental groups back from the lip or edge of the stage to achieve optimal acoustics in the audience.

Conclusion

As educators, you and your colleagues are tasked with preparing the next generation of musicians. Some may go on to play professionally, others may decide to teach, and still others will embrace music as a life-long hobby. Whatever their future aspirations, students' hearing health is vital to their success as musicians and to their overall happiness.

Hearing health is essential, too, for faculty and staff engaged in playing and teaching music.

Certain behaviors and exposure to certain sounds can, over time, damage hearing. It is important to understand and avoid those risk factors that can compromise hearing ability.

With this document, we hope we have been able to shed some light on a very important issue and perhaps inspired you to take steps in various aspects of your own work.