Canadian Hearing Report

Revue canadienne d'audition

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Managing Quality at the Point of Sale

Explaination of OSHA and NIOSH Safe-Exposure Limits and the Importance of Noise Dosimetry

Peer Reviewed

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I'd like to welcome you, once again to another issue of *Canadian Hearing Report*, so let's get right to it.

The wonderful Gael Hannan starts us off by encouraging people with hearing loss to get out and meat others like themselves. Connecting with other people with hearing loss can be powerful and life-changing experience.

Next up is the return of our New on the Shelves feature. In this issue we profile Jerry Northern and Marion Downs' *Hearing in Children*, 6th Edition and *Sandin's Textbook of Hearing Aid Amplification* edited by Michael J. Metz.

The feature articles in this issue are really worth checking out as well. Brian Taylor tell us that, in an elective medical field, like hearing aid dispensing and audiology, patients have a choice as to where to spend their hard earned dollars, and very often their view of a quality health care experience is much broader than simply getting the hearing problem solved. Issues such as wait time, a friendly interaction with the staff, and a feeling of not being rushed can all contribute to the perception of a quality experience with the practice.

Last, but certainly not least, Patty Niquette from Etymotic Research tells us while noise-induced hearing loss (NIHL) and the associated disorders of tinnitus, hyperacusis, and diplacusis are all irreversible, the keys to prevention are in understanding the risks and consistently acting to minimize the risks.

Scott Bryant Managing Editor

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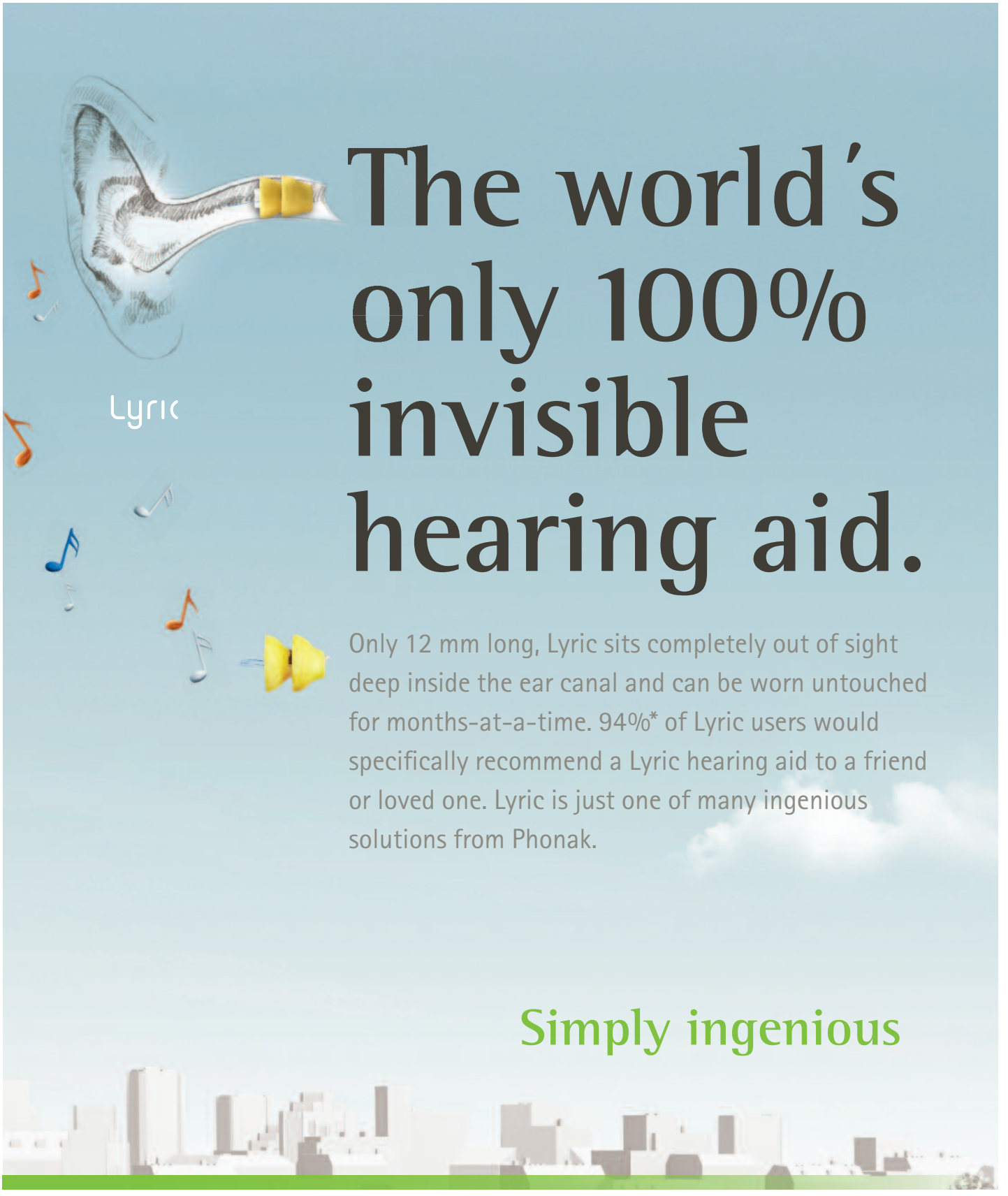

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contents

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TWO WAYS TO SHOW PATIENTS THEIR HEARING AIDS ARE HELPING

By Bob Martin

If you are an audiologist, it is easy to delude yourself into thinking that people will listen to you and accept what you are saying. You spent a lot of time and energy going to graduate school, and you have a license to practice Audiology. So, because you are a trusting individual, you believe other people will listen to you, and trust you. Sadly, this is often not the case.

One of the great weaknesses of any profession, including ours, is that our professional training does not give us a "real world" orientation. Audiology students in a typical graduate school do not learn much about the realities of life and business. All too often, new graduates enter practice without a good understanding of the basic human nature of the patients they will be caring for.

People have their own "judgment systems" that are strongly influenced by their age, culture, and individual differences. If you become adept at relating to a wide range of people and if you learn how to sell and fit hearing aids, you will become successful. If you don't, you won't. Like a lot of audiologists, my greatest weakness is not in technology, it is in salesmanship.

SOME TIPS FOR THE NEXT GENERATION

Speaking as a veteran audiologist, let me offer some fatherly advice to young audiologists.

Every time you see a patient, use some type of demonstration that starkly contrasts the difference between aided and unaided hearing. From the patient's perspective, this demonstration needs to be black and white. It should leave them saying to themselves, "I hear with these hearing aids. I cannot hear without them."

EFFECTIVE DEMONSTRATIONS

Here are a couple of ways to make this demonstration successful.

Study the patient's audiogram. If the speech-reception thresholds (SRTs) are above 40 dB and the thresholds for 1000-6000 Hz are above 50 or 60 dB, patients will have trouble hearing the noise they make when they rub their hands together.

The demonstration goes like this: Fit the aids; adjust the volume to a comfortable level; remove the aids. You should also try the hearing aids on your own ears, or measure their output in a test box to make sure you have substantial amplification. Don't start the demonstration until you're sure everything is working correctly.

Then, put a hearing aid on the patient's ear and tell them to rub their hands together. They should be able to hear this noise easily with their aided ear. Tell the patient, "Keep rubbing," and then reach over and remove the hearing aid. If you do this correctly, it will be a dramatic demonstration to the patient that the hearing aid enables them to hear sound that is inaudible to them unaided.

SHOW IMPROVED WORD UNDERSTANDING

Here's another idea. The Tennessee Tonality Words are "test words," which are grouped by pitch into five tonal groups: Low-pitch (L), Low-Mid (L-M), Mid (M), Mid-High (MH), and High (H).

I use these words to do another type of black-and-white demonstration that shows patients how well they hear words with the hearing aids and how poorly they understand without them.

I ask patients to repeat the words I say. I speak in a normal voice, but cover my mouth so patients can't read my lips. I adjust the hearing aid to a comfortable level, then remove it. Standing three feet away from the patient, I start uttering some high-pitched words: "itch, teach, ship, beach…" After saying two or three words, I ask the patient to repeat them. If the patient does so correctly, I increase the distance between us and repeat the test.

At some point the patient will no longer be able to hear and repeat the words. For this example, suppose the patient can no longer repeat what I say from 12 feet away. I turn to the family members and ask them, "Can you hear the words?" They usually say, "Yes, easily."

I then put the hearing aid back in the patient's ear and ask them to repeat the same words, which I say standing at the same place where the patient was unable to hear me unaided.

If I have set up this demonstration correctly, the patient will be able to hear all the words with the hearing aid, and none of the words without it. I emphasize the difference by asking the family, "Are the hearing aids working?" At this point, the patient's family members become a very important part of the demonstration, because they typically become excited and are overjoyed that their husband or father will be able to hear.

Demonstrations like these do more than show patients the benefit of the hearing aids. They also keep us honest. If for any reason the fitting is not working correctly, the demonstration will fail. That tells us that something is not working properly and that we need to put extra effort into fine-tuning the fitting.

Canadian Hearing Report 2014;9(3):7.

Unitron Celebrates 50 Years: Technology Changes but Relationships Remain a Constant in Company's History

The Unitron Corporate and Canada team

June 4th, 2014 - Kitchener, ON, Canada – Unitron is proudly celebrating 50 years of building strong relationships with hearing health care professionals and delivering great products and services to support them with their patients.

Founded in 1964 in Newfoundland, Canada, by partners Fred Stork, Rolf Strothmann, and Rolf Dohmer, Unitron became the first Canadian manufacturer of hearing aid technology. Unitron is now one of the fastest growing hearing instrument companies in the world, with global and Canadian headquarters located in Waterloo Region, Canada's '"Silicon Valley."'. Today, Unitron delivers hearing instruments in 70 countries through 20 international offices and a network of distribution partners. Throughout its history, Unitron has thrived and grown, always guided by the belief that this business is built on the strength of personal relationships, and that its products are really opportunities to make life better for people with hearing loss.

A History of Innovating to Make Life Better

Since Unitron's founding, its product development has focused on products and features that offer real benefits to the people who use them. In the 1960s through mid-1980s – the analog years – Unitron became a leader in power BTEs for people with severe to profound hearing losses. By the 1990s, programmable hearing aids and fitting software were changing the face of the industry: Unitron was there with user-friendly, intuitive fitting software advancements that made fittings more streamlined and helped improve first-fit acceptance. The digital revolution followed next and was an industry game changer. Unitron first introduced Unison, the product that made digital technology accessible to all, and today the Company continues to develop signature features to specifically address speech preservation and intelligibility, including the award-winning AntiShock™, SmartFocus™, and most recently SpeechZone™ 2.

Relationships Remain a Constant

While innovation has always been a vital part of Unitron's product history, the Company has also remained steadfast in its belief that relationships are the foundation of its business and its customers' success. Explains Unitron President, Jan Metzdorff, "Since our earliest days, Unitron has understood that this business is personal. That was true 50 years ago and it holds today. The relationships we have established with hearing healthcare professionals, and how we support them in forming strong relationships with their patients has never been more important."

Another constant in the Unitron story is people. Continues Metzdorff, "Our local and global teams have always worked tirelessly to support our hearing health care professional customers, while moving us forward as a thriving global

Unitron President Jan Metzdorff holding Moxi Kiss RIC *(left)*; Unitron founding partner Rolf Dohmer holding a 205A BTE from 1966 *(right)*.

organization. Their skill, innovation and compassion, and the great connections they have forged with our customers, have proudly made us the Unitron we are today."

Unitron will mark its 50th year with local events that celebrate the "'favourite'" sounds of the past 50 years.

About Unitron

Unitron is a global company that understands the hearing healthcare business is built on strong, personal relationships. The Unitron team works closely with hearing healthcare professionals to improve the lives of people with hearing loss. A member of the Sonova Group, Unitron has a proven track record of developing hearing innovations that provide natural sound with exceptional speech understanding. Headquartered in Canada, Unitron distributes its full line of hearing instruments to customers in over 70 countries. For more information, please visit unitron.com.

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Have You Met Someone Else Like You?

By Gael Hannan
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About the Author
Gael Hannan is a writer, actor, and public speaker who grew up with a progressive hearing loss that is now severe-to-profound. She is a director on the national board of the Canadian Hard of Hearing Association (CHHA) and an advocate whose work includes speechreading instruction, hearing awareness, workshops for youth with hearing loss, and work on hearing access committees.

Gael is a sought-after speaker for her humorous and insightful performances about hearing loss. Unheard Voices and EarRage! are ground-breaking solo shows that illuminate the profound impact of hearing loss on a person's life and relationships, and which Gael has presented to appreciative audiences around Canada, the United States and New Zealand. A DVD/video version of Unheard Voices is now available. She has received several awards for her work, including the Consumer Advocacy Award from the Canadian Association of Speech Language Pathologists and Audiologists.

While the relationship between people with hearing loss and their hearing care professional (HCP) can be complicated, as we work to improve standards and models of service, the individual connection is a no-brainer: as a hard of hearing person, I depend on my hearing care professional to fit me with technology to help me hear.

But an equally important connection is between peers, the people with hearing loss. While I've been going to HCPs my entire life, it wasn't until I met other people who had the same issues as me, that I finally *understood* my hearing loss and learned how to deal with it successfully using strategies that go beyond amplification.

The author Cheryl Strayed says in her book *Tiny Beautiful Things*: "The healing power of even the most microscopic exchange with someone who knows in a flash precisely what you're talking about because they experienced that thing too, cannot be overestimated." I can't say it any better than that.

Growing up, I knew no other people with hearing loss, except my great-grandmother who lived to be 99. All I learned from her is that if you have hearing loss, you'll have a voice like a foghorn and you'll say inappropriate things and the family will laugh at you.

At the age of 41, I met my peers for the first time. It was like falling in love – not only with this new world of hearing loss awareness, but with myself. My new confidence and *identity* as a successful person with hearing loss made me happier with myself.

Connecting with other people with hearing loss can be powerful. My friend Myrtle Barrett, president of the Canadian Hard of Hearing Association, often tells this story, which mirrored her own experience of connecting with others.

> I was in a lineup at Tim Hortons, picking up supper after a long day. I gave the girl my order – and I kept on telling her, because she didn't understand me. Finally I asked, "What am I doing wrong!"
>
> Her eyes filled up. She turned red and said, "It's not you, I have a hearing loss!" A co-worker helped her get my order, and I decided to eat in – because I needed to talk to her.

When she wasn't busy, I apologized for my impatience and asked if she would like to talk when she finished work. I told her I was deaf. Her face lit up. She was only 16 years old and we talked for a long time. Her boss didn't know, and she was afraid to lose her job. I gave her some suggestions about workplace accommodations and about our local support group. She joined the youth group and became a great advocate. Most importantly, she became empowered and successful – all because of a chance meeting with someone who was just like her.

Most of my family, and the people in the social circle my husband and I share, do not have hearing loss. Well, apart from my elderly father and a couple of our friends are now hearing aid users, but they prefer not to talk about it, thank you very much! But I also live in a parallel universe where everyone has hearing loss and we love to talk about it and gather strength and ideas from each other. And yes, sometimes we gripe about those insensitive hearing people, and how can we get them to face us when they talk. In this parallel universe, we carry no shame about our hearing loss. There are no embarrassing moments – just laughable ones. Every moment spent in this hearing loss world empowers our sense of dignity in the real world, and helps us deal with our communication challenges.

This peer connection can be a lifeline for someone struggling with hearing loss. It can happen unexpectedly, as in Myrtle's story, or through a social media group, or through consumer hearing loss associations, such as the Canadian Hard of Hearing Association. Every person, if possible, should go to a live meeting, even if just once, to connect with other people who are walking, talking demonstrations of communication success. When I went to my first hearing loss conference, I did so with an unconscious desire to distance myself from the people I was going to meet. As Groucho Marx said,"I don't want to belong to any club that will accept people like me as a member." Deep down, I was thinking, "Do I really want to associate with a bunch of hard of hearing people? Other people will think I'm like them, disabled or something."

Two amazing, inspiring days later, I was a new person. After the closing banquet, a few of us celebrated at a pub – and there is nothing on this earth is louder than a dozen hard of hearing and oral deaf people having drinks. I was a bit embarrassed by the stares we were drawing from the other people in the pub.

And then it happened.

I thought, so what if we were loud? We had hearing loss, yes, and we were also smart, happy, and enlightened. It was a life-changing moment. Rocky Stone, founder of Self Help for Hard of Hearing People, once said, "You can't change the world. You can change yourself and improve your immediate area with the spirit of love and concern for other people."

If you have hearing loss, reach out. Someone is waiting to talk to you, because they have been through the same thing.

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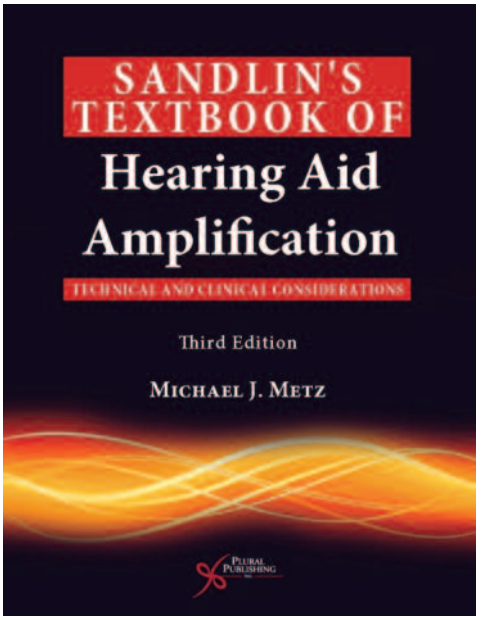

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SANDIN'S TEXTBOOK OF HEARING AID AMPLIFICATION: TECHNICAL AND CLINICAL CONSIDERATIONS, THIRD EDITION

Edited by: Michael J. Metz, PhD

ABOUT THE BOOK

The comprehensive *Sandlin's Textbook of Hearing Aid Amplification*, now in its third edition, provides the hearing health professional with an overview of the technological advances related to hearing aid devices. The authors give particular emphasis to the most current advances in clinical assessment techniques and hearing instrument technology, and provide a detailed analysis of the application of digital signal processing. Clinical insights into the psychology of hearing health are included to help professionals meet clients' emotional as well as acoustic needs. This is a valuable text for academic and clinical professionals involved in the selection and fitting of hearing aid devices for the acoustically impaired.

New to the third edition:

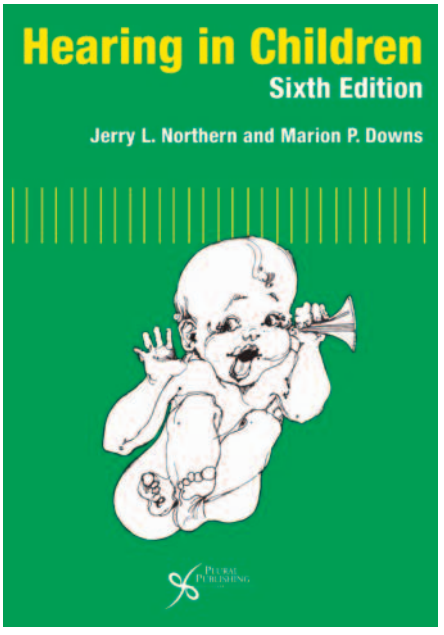
- Updated chapters on earmold and earshell acoustics; principles and applications of high-fidelity amplitude compression; and microphone technology
- Major revisions to chapters on digital signal processing; hearing aid selection, fitting, and verification; mathematical formulae for applying amplification; measures of validity and verification; and surgically-implanted hearing devices for unilateral hearing loss
- Discussion of distribution methods; considerations for treating children; elements of design and implementation of DSP circuits; the evolution from analog to digital hearing aids; and future consideration for the field

This text is regularly used by clinicians at the graduate level of training in the 70 to 90 universities offering graduate degrees in audiology. Furthermore, practicing clinicians in countries all over the world have included this recognized text in their professional libraries.

CONTENTS

5. The Many Faces of Compression
   Theodore H. Venema
6. Use of Directional Microphone Technology to Improve User Performance in Noise
   Yu-Hsiang Wu, Ruth A. Bentler
7. DSP Hearing Instruments
   Ingo Holuba, Henning Puder, *Therese M. Velde*
8. From Analog to Digital Hearing Aids
   Søren Westermann, Hanne Pernille Anderson, Lars Bækgaard, et al.
9. Technical Considerations for Sound Field Audiometry
   Gary Walker
10. Psychology of Individuals with Hearing Impairment
    Robert W. Sweetow, Julie Bier
11. Considerations for Selecting and Fitting of Amplification for Geriatric Adults
    Robert E. Novak
12. Hearing Technology for Children
    Jace Wolfe, Sara Neumann
13. Principles and Clinical Utility of Hearing Aid Fitting Formulas
    Phillip T. McCandless
14. Real Ear Measures
    George Frye
15. Making Hearing-Aid-Fitting Decisions
    Robert L. Martin
16. Inventories of Self-Assessment Measurements of Hearing Aid Outcomes
    Judy L. Huch
17. Assistive Technologies for the Hearing Impaired
    Joseph J. Smaldino, Brian M. Kreisman
18. Cochlear Implants
    Dawn Burton Koch, Mary Jo Osberger
19. Fitting Options for Adult Patients with Unilateral Hearing Loss
    Michael Valente, L. Maureen Valente
20. Future Considerations
    Michael J. Metz, Robert E. Sandlin

Appendix A: American Academy of Audiology Ethical Practice Guideline for Relationships with Industry



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HEARING IN CHILDREN, SIXTH EDITION

Jerry L. Northern, PhD
Marion Downs

ABOUT THE BOOK

In this completely updated sixth edition, *Hearing in Children* thoroughly examines the current knowledge of pediatric audiology, and provides a medical perspective on the identification, diagnosis, and management of hearing loss in children. This enduring text, written by two universally recognized pediatric audiologists, has been the chief pediatric hearing resource used worldwide by audiologists for nearly 40 years.

KEY FEATURES

- An expanded review of the medical aspects—early intervention, genetics, diseases and disorders, and treatments—of pediatric hearing loss as well as hearing and auditory disorders in infants, toddlers, and young children
- Practical descriptions of age-specific testing protocols and hearing screening technologies, and early hearing loss detection and intervention procedures
- Comprehensive coverage of amplification for children with hearing loss, including fitting and management issues in hearing aids, cochlear implants, and assistive listening devices
- Valuable information on the role of family-centered services related to all aspects of childhood deafness
- A revised appendix of hearing disorders that includes 90 syndromes and disorders associated with childhood deafness
- Nearly 500 new and current references

CONTENTS

Managing Quality at the Point of Sale

By Brian Taylor, AuD

As hearing care professionals we have been taught to provide the highest quality care to the best of our abilities. For most professionals this means providing an effective treatment solution (hearing aids) to a quantifiable problem (sensorineural hearing loss). From a medical perspective, this is a perfectly acceptable principle, and one that all of us must continue to strive to achieve. Unfortunately, in an elective medical field, like hearing aid dispensing and audiology, this narrow view of quality can be problematic. Patients have a choice as to where to spend their hard earned dollars, and very often their view of a quality health care experience is much broader than simply getting the hearing problem solved. Dimensions such as wait time, a friendly phone interaction with the receptionist, and a feeling of not being rushed with the doctor all contribute to the perception of a quality experience with the practice.

A broad view of quality is an important differentiator among practices. Not only are practices that compete on all aspects quality (not just achieving outstanding treatment results) able to command a significantly higher average selling price, practices that differentiate themselves on quality have another unique competitive advantage: they are able to generate more word-of-mouth referrals. In a low volume – high margin industry, like commercial hearing aid dispensing, a large number of practice promoters is vitally important to success. For these reasons managers need to have a passion for improving all dimensions of quality.

In the April, 2010 issue of the *Hearing Review* Sergei Kochkin and several co-authors suggested that a simple, common sense fitting approach that can enhance quality involves the following nine procedures[1]:

1. Physical evaluation of the ear and case history
2. Measurement of the patient's hearing loss
3. Selection of the most appropriate hearing aid technology
4. Assessment of the patient's expectations
5. Quality control measures using a hearing aid analyzer
6. Prescriptive fitting with the use of probe microphone measures to verify a reasonable match of the fitting target
7. Fine tuning of the instruments using patient-specific test measures, such as Loudness Discomfort Levels
8. Use of self report and laboratory measures of hearing aid outcome
9. Counseling and rehabilitative services

In a similar unpublished report, the Hearing Instrument Association (HIA), using scientifically-derived research data, created a Top 10 reasons for hearing aid delight.[2] This list highlights procedures and behaviours audiologists and their support staff can engage in with the patient in order to generate higher levels of satisfaction and loyalty. This list includes:

1. Hearing aids must provide benefit in multiple listening situations
2. Motivated patients seek out information, oftentimes on the Internet
3. Office, including the reception area must look professional
4. Many patients desire a high tech, engaging pre-fitting and fitting process
5. Comprehensive counseling processes, including aural rehabilitation services
6. Providers that make a confident treatment recommendation based on evidence
7. Use of a live hearing aid demonstration during the pre-fitting process
8. Use of verification and validation to ensure the hearing aids are performing up to specification and benefitting the patient in everyday listening
9. A strong relationship between the patient and provider, which is formed through periodic face-to-face office visits
10. A dedicated hearing care professional that engenders trust

The key to unlocking the value of your practice to patients and prospects is understanding how to bring these two lists to life. This article provides five actionable ideas they can use to leverage the findings from these timely HIA and

THR studies.

DEVELOP A CUSTOMIZED LEAD-GENERATING WEBSITE

The fastest growing segment of Internet users are people over the age of 70, which is approximately the same age as the average age of initial hearing aid use. Numerous studies, cited in the HIA report[2] have suggested that many people go to the Internet to find information about an ailment or condition before they seek a personal consultation with a medical professional. For this reason alone, it's imperative to have a presence online. There are some anecdotal reports suggesting that practitioners with a website receive one to two new prospects per month via the Internet channel.

In addition to being a lead generator, a customized website can be used to educate existing patients. For example, several short instructional videos can be added to your site. These videos reinforce your message about acclimatization and orientation to hearing aids and better communication. By posting instructional video on your website, you foster a deeper relationship with patients.

UNDERSTAND MELU AND USE IT TO DISPENSE HEARING AIDS AT A HIGHER PRICE POINT

Most clinicians have heard about or even use the Client Oriented Scale of Improvement.[3] The results of the pre-fitting COSI is often used to begin a conversation with the patient about the need for premium products with advanced features. What many clinicians fail to realize, however, is that there is a direct and systematic relationship between overall satisfaction and the number of listening situations effectively addressed with amplification. Leveraging the findings of MELU and overall satisfaction from several MarkeTrak studies,[4,5] clinicians can build a case for the need for premium technology for many patients.

One of the significant findings from the MarkeTrak surveys is that the more listening situations you can satisfy with amplification, the higher the overall satisfaction of the patient, and the more willing the patient is to refer other prospective patients to your practice. These findings suggest that professionals target 10 or more unique listening situations for improvement during the pre-fitting communication assessment. Importantly, the relationship between overall satisfaction and the need for premium products and advanced features for improved communication in multiple listening environments can be used as a vehicle for discussing the need for telecoils, Bluetooth gateway devices, remote controls, along with a myriad of other advanced features found only in premium and business class product lines.

USE COMPUTER-BASED TESTING DURING THE PRE-FIT APPOINTMENT

Based on the HIA Top 10 reasons for hearing aid delight study, promoters of your practice are captivated when tests are conducted that have the perception of being high tech. Video otoscopy serves as an excellent example. From the vantage point of the professional there is little value in conducting otoscopy with a video camera. However, viewed through the lens of a patient, the ability to see a high resolution image of the ear canal adds a tremendous amount of value.

Another example is the use of speech-in-noise testing. In order to save time, most professionals continue to rely on live voice testing when conducting routine tests, like MCL, UCL and word recognition.[6] Not only are recorded tests more accurate but, according to the HIA report, they have the perception of being high tech. This unquestionable adds value to the patient's clinical experience and contributes to their perception of quality. Tests such as the Quick SIN[7] (Etymotic Research) and the Acceptable Noise Level test[8] (Frye Electronics) should replace more traditional tests like MCL and speech audiometry in quiet with live voice whenever possible.

PAY ATTENTION TO CLINIC WORKFLOW

There are a finite number of hours in the day and your ability to manage your appointment is imperative to success. Clinic workflow and time spent with each patient is one important way to gauge the efficiency of your practice. For each "touch point" that your practice engages the patient, it's important to have some idea how much time is needed to optimize satisfaction.

The amount of time spent is also indicated for each "touch point." Although there is no data outlining the optimal amount of time for each point of contact, Sergei Kochkin's data suggested that satisfaction was maximized when 2 to 3 hours of collective time was spend face-to-face with a patient over several office visits.

MEASURING SEVEN DIMENSIONS OF QUALITY

As previously stated, patients' perception of quality go well beyond the professional's ability to solve their problem. Their perception of quality is wide-ranging and many times takes into consideration things the professional easily overlooks. In order to stay focused on all dimensions of quality from the patients' perspective, you can rely on measuring quality along seven dimensions.

7 Dimensions of Quality

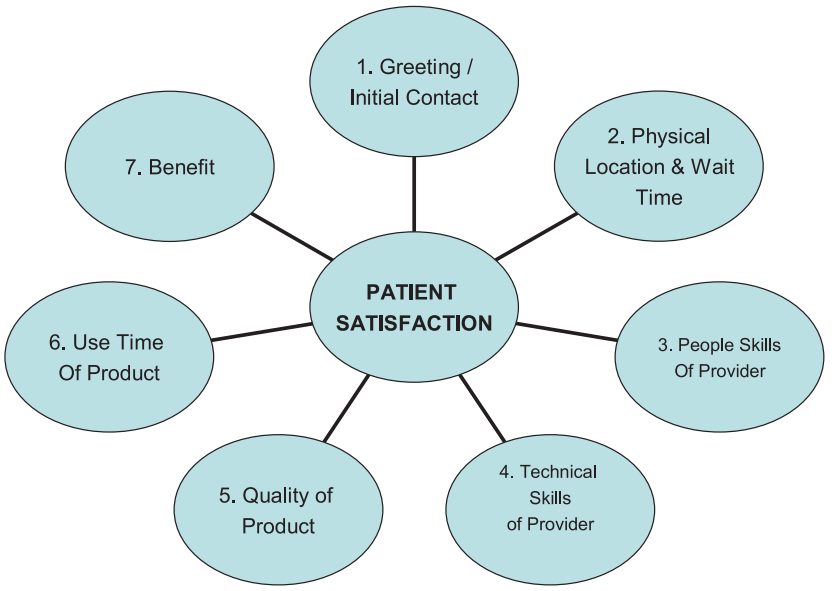

Figure 1. The seven dimensions of quality have a direct impact on patient satisfaction.

Patient Name	Date & Time	Appropriately Greeted	Wait Time	Notes

Figure 2. Sample tracking form used to measure the initial greeting and patient's first contact with the practice. An appropriate greeting can serve as a proxy measure of quality for the dimension of initial office contact.

Here are some helpful, easy-to-use tools that busy clinicians can use to measure quality. These seven dimensions represent the various phases of the patient's journey from initial contact with the office until initial use with hearing aids. By taking the time to measure these quality dimensions, hearing professionals can manage the entire process and begin to ensure that each patient is highly satisfied with all aspects of his or her experience.

WAIT TIME AND INITIAL GREETING OF THE PATIENT IN THE CLINIC

Woody Allen once said that 80% of success is simply showing up, and in any customer service business this is certainly true. Little things, like when the office manager answers the telephone with a friendly voice go a long way toward improving quality. Armed with this information, managers can train their front office staff to warmly greet every patient over the phone or when they arrive in the clinic. Communication experts agree that standing up, squarely facing the patient, smiling and offering a handshake are components of an ideal greeting, and the ability of front office staff to perform these behaviors can be tracked using a form like the one shown in Table 1.

APPEARANCE OF PHYSICAL LOCATION

The reception area or waiting room is one of the most easily overlooked aspects of a practice, but often the most important first impression for patients. It may seem obvious that when patients enter a practice location, they expect the facilities to reflect their perceptions of a professional business. Beyond the reception area, the entire physical location of the practice needs to be routinely inspected. A simple approach to measuring the quality of any physical location is to maintain a checklist that the office manager or front office professional marks daily with meticulous attention to detail. The physical location checklist is completed each morning by the office manager, and a written copy is shared with the owner or managing director. All

Date: Responsible Party:	
Restroom is clean and stocked	
Current, tatter-free reading material in reception area	
Floors, walls and windows are clean	
Furniture is clean and properly arranged	
Literature with practice brand is prominently displayed	
Well-lit areas (no burned out bulbs)	
No foul odors	
Equipment is orderly and dust-free	
Staff is properly groomed and wearing appropriate attire	
Deficient areas:	

Figure 3. Physical location checklist.

I felt the hearing professional really listened to me.	0 1 2 3 4 5 6 7 8 9 10
The hearing professional took the time to thoroughly test my hearing.	0 1 2 3 4 5 6 7 8 9 10
The hearing professional took the time to clearly explain my test results.	0 1 2 3 4 5 6 7 8 9 10
I was given reasonable treatment options.	0 1 2 3 4 5 6 7 8 9 10
The hearing professional solved my problem.	0 1 2 3 4 5 6 7 8 9 10

Figure 4. Five important components of relationship-building skills that can be measured on a comment card. 0 is highly dissatisfied and 10 is highly satisfied.

Standard	Clinical Tool/Procedure
Pre-Test Communication Assessment	❑ COSI ❑ COAT ❑ HHIA-E
Testing	❑ Audiogram ❑ Immittance Testing ❑ Speech Audiometry (Quiet and Noise)
Post-Test	❑ Reviewed Test Results ❑ Demonstrated New Technology ❑ Discussed Options ❑ Offered Recommendation

Figure 5. An example of a clinical protocol checklist. Once the hearing professional has been given guidance on how to conduct each procedure, she can begin to document that the protocol was followed by using the checklist.

deficient areas in need of upgrades or repair are recorded at the bottom of the form.

INTERPERSONAL COMMUNICATION SKILLS OF THE HEARING CARE PROFESSIONAL

An audiologist's effectiveness is largely determined by their ability to form strong relationships with patients. Any investment managers can make to improve the relationship building skills of their employees is likely to pay off in improved service delivery. Good listening skills, the ability to ask open-ended questions, and clear and concise explanations of test results are a few of the "people skills" needed to build effective relationships with patients and enhance patient satisfaction.

Interpersonal or relationship-building skills can be directly measured by patients. Using a comment card with five or six important components of interpersonal skills, like the one shown in Figure 4, patients can directly measure the effectiveness of this dimension of quality. Once you have collected a representative data sample (15 to 20 responses per month for the typical practice), you can begin the process of improving behaviours that have the largest impact on patient satisfaction.

TECHNICAL SKILLS OF THE SERVICE PROVIDER

The ability of a hearing professional to conduct a comprehensive hearing evaluation, as well as program, fit and troubleshoot hearing devices can be indirectly measured by assessing the professional's adherence to a clinical protocol. There is no shortage of clinical hearing aid selection and fitting protocols. The most current clinical hearing aid selection and fitting protocol sanctioned by the American Academy of

Patient Name: _____ Date: _____
Manufacturer and Style: _____ Model _____

- ❏ Physical fit is comfortable and without feedback.
- ❏ Patient can insert and remove devices.
- ❏ Patient can change battery and clean instruments.
- ❏ Initial usage of devices and expectations were discussed.
- ❏ Verification of target was conducted, results documented.
- ❏ Demonstrated special features to the patient.
- ❏ Areas of concern:

Figure 6. An example of a hearing aid checklist used to measure the quality of the initial fitting.

Audiology incorporates evidence-based practice standards.

Unlike interpersonal skills which patients can directly measure, a hearing professional's technical ability needs to be gauged indirectly by tracking their adherence to a clinical protocol. In Table 4 the essential standards for a pre-fitting hearing aid consultation appointment are outlined. Managers can track the execution of a protocol by requiring hearing professionals to place a completed checklist into each patient's chart notes at the end of the consultation.

PRODUCT QUALITY

Two cc coupler measures within the hearing aid test box are the standard method for ensuring that hearing aids are performing at a specific standard by the manufacturer, and they can be used by the hearing professional before the fitting to ensure that the hearing aid is functioning properly. Prior to the fitting the hearing professional must take the hearing aids from the packaging material, perform a listening check on them and, finally, conduct a routine electroacoustic analysis of the devices, using the correct 2 cc coupler.

In addition to 2 cc coupler measures, hearing professionals can rely on a hearing aid fitting checklist list as a proxy measure of product quality. After the fitting has been completed, the clinician completes the checklists, noting anything unusual or problematic before placing the checklist into the patient's chart. Figure 6 is an example of a hearing aid fitting checklist.

The final three dimensions of quality can be systematically evaluated using traditional measures of hearing aid outcome. Two separate studies conducted by Humes and colleagues[9] using an assortment of more than 20 outcome measures identified three separate and distinct aspects of hearing aid outcome:

1. Aided and unaided speech recognition performance.
2. Self-reported hearing aid usage.
3. Subjective benefit and satisfaction.

Given these findings, both subjective and objective measures of outcome should be used to assess quality in clinical practice.

USE TIME OF THE DEVICES

There is a relationship between patient satisfaction and use time of hearing aids, as full time hearing aids users are more likely to report higher overall satisfaction scores compared to part time or non-users. In addition, lower rates of usage are reported for patients with negative attitude towards amplification,[10] and those who consider hearing aid use to be stigmatizing.

Hearing aid use rate can be measured either subjectively or objectively. Subjective measures of use time would be considered to be diaries or questionnaires that the patient completes. Research has found that subjective reports of usage are unreliable.[11] Fortunately, objective measures of usage can be obtained using data logging, which is found in many modern hearing aids. One of the advantages of data logging is that it objectively tracks the total number of hours of hearing aid use. Part time and non-users can be managed differently than full time users. For example, a patient with a low use rate, which has been objectively verified with data logging, might have a problem with annoyance from noise as measured on the acceptable noise level (ANL) test. The low use time combined with the high unaided ANL score might be an indication that the patient needs a more aggressive noise reduction strategy.

LABORATORY AND SELF REPORTS OF HEARING AID BENEFIT

Benefit is simply the difference between the unaided and aided condition. Hearing aid benefit can be measured in a number of different ways, including laboratory measures and self-reports or questionnaires. Considering the findings of Cox and Alexander[12] a workaday approach to measuring benefit would be to use some combination of laboratory and self-reports.

Laboratory measures of benefit complement probe microphone verification measures, as they can be

used to objectively demonstrate to the patient that certain features within the hearing aid are functioning properly. For example, the Quick SIN can be presented at a low intensity level (45 dB HL) in the unaided and aided condition. The difference between these two scores would be the aided benefit on a speech recognition task. When the QuickSIN is conducted at a low intensity level, it provides the patient with meaningful information on how improved audibility usually translates into improved speech intelligibility in noise. Taylor has written a useful article posted at www.audiologyonline that details how laboratory measures of outcome can be used in a busy clinic to cross check real ear verification measures and complement self-reports of benefit.[14]

Self-reports or questionnaires compliment laboratory measures of benefit because they ask the patient to rate their success with amplification in everyday listening, using some type of a scale. Dozens of self-reports have been created and validated, and they subjectively measure real world benefit. They also are an integral part of an evidence-based practice paradigm. Three of the most useful self-reports are reviewed below. Hearing professionals are encouraged to choose two of the three listed here and use them routinely to measure the user benefit and satisfaction dimensions of quality.

CLIENT ORIENTED SCALE OF IMPROVEMENT

The COSI is an open-ended scale in which a patient targets up to five listening situations (from a list of 16) for improvement with amplification. The goal of the COSI is for the patient to target specific listening situations and report the degree of benefit obtained compared to that expected for the population in similar listening situations. Many hearing aid manufacturers now include the COSI in their fitting software.

ABBREVIATED PROFILE OF HEARING AID BENEFIT (APHAB)

In an attempt to develop a more clinic-friendly measure of outcome, the APHAB was developed.[15] The goal of the APHAB is to quantify the disability caused by hearing loss, and the reduction of that disability achieved with hearing aids. The APHAB uses 24 items covering four subscales: ease of communication, reverberation, back-ground noise and aversiveness to sounds. The APHAB has been normed on 128 elderly adults with mild to moderate hearing loss. The APHAB can be downloaded from the University of Memphis Hearing Aid Research Lab (HARL) website.

INTERNATIONAL OUTCOME INVENTORY FOR HEARING AIDS (IOI-HA)

Consisting of seven questions on a five point rating scale, the goal of the IOI-HA is to assess benefit, satisfaction and quality of life changes associated with hearing aid use. The IOI-HA has been normed on 154 adults.[16] The IOI-HA was designed to be used with other self-report tools, like the APHAB. Available in several languages, it can be downloaded from the University of Memphis HARL website.

WHAT SELF-REPORT OUTCOME MEASURE SHOULD BE USED?

Due to the abundance of self-reports available to clinicians, it is difficult to know which ones work the best. When making this decision, it is important to examine exactly what dimension of real world outcome you are trying to capture in the most time-efficient manner. Cox and Alexander[14] examined the relationship between self-reports of outcome and personality. Analyses of the collection of outcome measures produced a set of three components that were interpreted as a Device component, a Success component, and an Acceptance component. Results suggest that personality is more closely linked to self-reports of hearing aid outcome than conventional laboratory measures, like the audiogram. Their findings suggests that both self-reports and laboratory-based of outcome are needed to accurately access hearing aid benefit.

Measuring each of the seven dimensions of quality, using a combination of direct and proxy measures, enables the professional to identify performance gaps and begin the process of eliminating them. Managing today's modern audiology practice requires judicious application of quality metrics that compliment traditional productivity measures.

It goes without saying that systematically measuring quality along seven patient centric dimensions is not an end in itself. Rather, the purpose of measuring is to gain deeper insight into how your practice creates a premium office experience and generates word of mouth referrals, which are proven generators of significant revenue and growth over a long period of time.[16] As professionals we know that what gets measured gets done. In an industry in which the most common metric for quality is a low return for credit rate, it time to broaden our scope and examine the entire patient experience and how it relates to quality in our practices.

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Noise Exposure: Explanation of OSHA and NIOSH Safe-Exposure Limits and the Importance of Noise Dosimetry

By Patricia A. Niquette, AuD

About the Author
Patty Niquette is an audiologist with Etymotic Research where she has the great privilege of working with Mead Killion and many other talented scientists, audiologists, and engineers in their shared mission of developing products to measure, improve and protect one of humankind's most precious senses: hearing.

INTRODUCTION

It's a noisy world, and hearing damage from loud sound affects millions of people. Noise-induced hearing loss (NIHL) and associated disorders of tinnitus, hyperacusis, and diplacusis are all irreversible. This is a tragedy, considering that these often debilitating conditions are preventable. The keys to prevention are in understanding the risks and consistently acting to minimize the risks.

NEW EVIDENCE FOR URGENCY

NIHL and associated disorders (which, for simplification, will be included in the acronym "NIHL") are caused by overexposure: listening to sound that's too loud, for too long. NIHL can occur from a single activity such as an explosion or a loud concert, but it usually occurs gradually over many years. Decades of data have shown that noise-related shifts in hearing appeared to be temporary, a phenomenon known as temporary threshold shift (TTS). With TTS, hearing thresholds typically recover to pre-noise exposure levels after a period of auditory quiet. Because of this recovery, many of us assumed that the structure and function of the auditory system was affected only temporarily by noise, returning to normal (or pre-exposure) levels after a period of quiet. We believed that permanent changes in auditory anatomy transpired only after repeated auditory insults occurring over many years. However, research on noise exposure in animal models by Kujawa and Liberman (2009) challenges these assumptions.

Kujawa and Liberman (2009) found that while outer hair cells do recover post-exposure (with a corresponding recovery of hearing thresholds and otoacoustic emissions [OAEs]) other changes in the basal region of the cochlea do not recover: there is dramatic degeneration of both pre- and post-synaptic elements of the inner hair cells and spiral ganglion cells. Not only is this damage undetectable using current test protocols (pure tone thresholds, OAEs and Auditory Brainstem Response [ABR]) but the loss of spiral ganglion cells is not seen until weeks or months post-exposure. Kujawa and Liberman suggest that noise-induced hearing damage has progressive consequences that may not manifest until much later. This damage may be expressed as difficulty hearing in noise and/or in associated auditory disorders (tinnitus, hyperacusis, etc.).

The implication of this research is that noise can produce subclinical damage that goes undetected, progresses unnoticed, and finally manifests itself long after the fact. We can't measure this subclinical damage using audiometric tests, including the "gold standard" for

Level, in dB A	85	88	90	92	94	95	100	105	110	115
OSHA PEL	16		8			4	2	1	0.5	0.25
NIOSH REL	8	4			1		0.25			

Figure 1. Duration (in hours) of allowable exposures based on OSHA and NIOSH criteria. PEL = Permissible Exposure Limit; REL = Recommended Exposure Limit. Noise exposure levels/times exceeding those shown in Figure 1 require the use of hearing protection.

testing NIHL: pure tone hearing thresholds. Data collected over many years from persons exposed to industrial noise shows that most NIHL develops over the first 10-15 years of noise exposure and then asymptotes (levels off). From a preventive standpoint, the sooner we identify hearing risk and minimize it, the better. We need to educate our young people and equip them to protect their hearing at an early age, ideally before damage occurs. To do this we must monitor noise exposures to assess risk and use hearing protection when necessary to reduce the risk of NIHL.

WHO GOVERNS NOISE EXPOSURE?

In the United States, concern with noise exposures began primarily in the workplace. Guidelines for occupational noise exposure were established by the Occupational Safety and Health Administration (OSHA, 1983) and the National Institute for Occupational Safety and Health (NIOSH, 1998). Both OSHA and NIOSH were created by the Occupational Safety and Health Act of 1970 (see www.cdc.gov/niosh/about.html).

OSHA is part of the U.S. Department of Labor and is responsible for developing and enforcing workplace safety and health regulations. The OSHA standard (29CFR1910.95) carries behind it the force of law and employers in the industrial sector are bound to comply with it. Those employed in mining, railroad, coast guard, military, and construction are bound by their own standards.

NIOSH is part of the Centers for Disease Control and Prevention (CDC) in the U.S. Department of Health and Human Services. NIOSH conducts research and provides information, education, training, and recommendations regarding occupational safety and health. As such, NIOSH is in a position to recommend standards and best practices, but it is not in a position to regulate or enforce standards.

LIMITING NOISE EXPOSURE: DAMAGE-RISK CRITERIA

How long and how loud can we listen to sound without risking hearing damage? Damage-risk criteria provide the basis for recommending noise exposure limits based on noise level and exposure time. OSHA and NIOSH criteria are shown in Figure 1.

OSHA permits exposures of 85 dBA for 16 hours per day, and uses a 5-dB time-intensity tradeoff: for every 5 dB increase in noise level, the allowable exposure time is reduced by half. For every 5 dB decrease in noise level, the allowable exposure time is doubled. All time/intensity values shown on the OSHA PEL line in Figure 1 are assumed to have equal risk to each other, that is, 16 hours at 85 dB carries the same auditory risk as 8 hours at 90 dB, 4 hours at 95 dB, 2 hours at 100 dB, and so on.

NIOSH recommends an exposure limit of 85 dBA for 8 hours per day, and uses a 3 dB time-intensity tradeoff: for every 3 dB increase in noise level, the allowable exposure time is reduced by half. For every 3 dB decrease in noise level, the allowable exposure time is doubled. The time/intensity values shown on the NIOSH REL line in Figure 1 are assumed to have equal risk to each other, that is, 8 hours at 85 dB carries the same auditory risk as 4 hours at 88 dB, 2 hours at 91 dB, and so on. The differences in OSHA criteria and NIOSH recommendations for exposure limits produce different outcomes: the more lenient OSHA values allow for higher exposures for longer durations and the more conservative NIOSH values recommend lower exposures for shorter durations. The NIOSH values are based on scientific studies relating noise exposure to hearing loss, and are more protective of hearing. It should be noted that both standards are based on the assumption that the noise occurs as part of a work environment, and both assume non-occupational quiet. That is, the limits are based on an 8-hour workday, five days per week over a 40-year working lifetime, and the time the individual is not at work (the other 16 hours in a day, as well as weekends) is assumed to be quiet. The standards do not account for noisy activities and hobbies (e.g., concerts, ATVs, snowmobiles, power tools, car races, live music, etc.) which mayincrease risk for NIHL.

ORIGIN OF DAMAGE-RISK CRITERIA

The NIOSH Recommended Exposure Limit (REL) is based on scientific data relating noise-induced permanent threshold shift (NIPTS) to the level and duration of noise exposures (NIOSH, 1998). In contrast, the OSHA

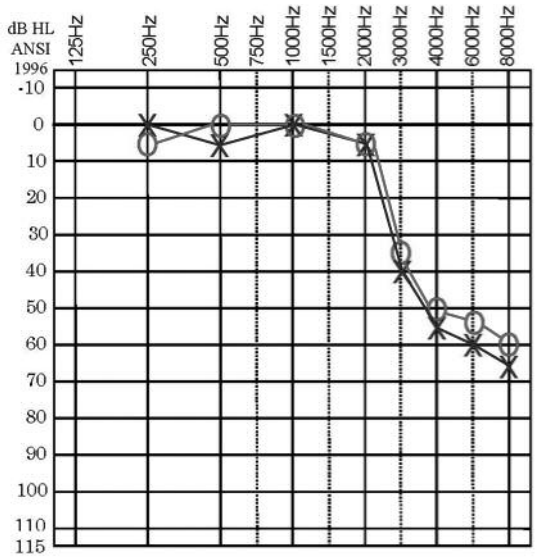

Figure 2. Audiogram of moderate high-frequency hearing loss that does not mee the definition of material hearing impairment under OSHA or NIOSH standards.

Exposure Level (8-hr time-weighted average)	Excess Risk
80 dB A	1%
85 dB A	8%
90 dB A	25%

Figure 3. Excess risk of developing material hearing impairment as a function of daily noise exposure (assuming a 5-day work week) over a 40-year working lifetime.

Permissible Exposure Limit (PEL) was the result of debate and compromises that are a part of enacting any legislation (OSHA, 1983). Neither guideline is completely protective in nature; both allow for some NIPTS based on their individual definitions of material hearing impairment and the percentage of the population for whom this risk is deemed acceptable. Additionally, standards are based on average risk (rather than individual susceptibility) so certain individuals may be at greater or lesser risk for developing NIHL.

Definition of Material Hearing Impairment

The time/intensity limits comprising the OSHA PELs and NIOSH RELs are in part based on each organization's definition of material hearing impairment and the excess risk of developing that impairment.

OSHA defines material hearing impairment as average hearing thresholds exceeding 25 dB HL at 1k, 2k and 3k Hz, bilaterally. NIOSH uses the same definition, except that thresholds at 4 kHz (where the effects of noise are usually seen first and/or worst) are included. The inclusion of 4k Hz is an improvement over the OSHA definition; however, the averaging of thresholds across frequencies and ears means that significant hearing loss can occur before either formula labels it as hearing impairment. The audiogram shown in Figure 2 reveals a mild to moderate high-frequency hearing loss, but this audiogram does not meet the definition of material hearing impairment under either the OSHA or NIOSH standards.

Both OSHA and NIOSH definitions include 1k and 2k Hz, where NIHL is not likely to be seen. This has the effect of "watering down" the average loss across frequencies. In the presence of normal low-to- mid frequency hearing, there must be moderate to moderately-severe high frequency hearing loss in both ears to produce a 3-frequency or 4-frequency average exceeding 25 dB. Significant hearing loss can occur before it is labeled as such by these definitions.

Excess Risk

Excess risk is defined as the percentage of people in a noise-exposed population who develop a material hearing impairment (as defined by OSHA or NIOSH) above and beyond the percentage of people in a non-noise-exposed population who develop a material hearing impairment. Excess risk is calculated based on the exposure level and assumes an 8-hour work day, 5 days per week, over a 40-year working lifetime. Figure 3 shows the excess risk of developing material hearing impairment for different exposure levels, based on the NIOSH definition of material hearing impairment.

As can be seen in Figure 3, a 90 dB exposure incurred 8 hours per work day over a working lifetime, results in 25% excess risk of developing material hearing impairment, while an 85 dB exposure results in 8% excess risk of developing material hearing impairment. While neither criterion protects all workers, the NIOSH limit of 85 dB is more protective and if followed, results in fewer workers sustaining material hearing impairment.

Individual Susceptibility

Individual susceptibility for NIPTS depends on genetic predisposition ("tough ears" vs. "tender ears"), environmental contaminants (e.g., chemicals and solvents), medications (e.g., chemotherapy or antibiotic agents that react synergistically with noise and exacerbate NIHL), medical conditions (e.g., diabetes, heart disease) and behaviors (e.g., smoking). Environment, health and lifestyle issues, combined with occupational and non-occupational noise, determine an individual's risk for developing NIHL. An individual could adhere to the limits of the more

OSHA (1983)

Level (dBA)	Duration	Dose %
90	8	100
95	4	100
100	2	100
105	1	100
110	30 min	100
115	15 min	100

NIOSH (1998)

Level (dBA)	Duration	Dose %
85	8	100
88	4	100
91	2	100
94	1	100
97	30 min	100
100	15 min	100

Figure 4. Equivalent unprotected noise exposures (level over time) that produce a 100% noise dose.

conservative NIOSH recommendations and still develop NIHL due to individual risk factors that can't be accounted for in standards.

In summary, both the OSHA and NIOSH limits seek to reduce risk for the average person, rather than to prevent NIHL for all individuals.

MEASURING NOISE EXPOSURES

To assess risk of NIHL we need to know the level and duration of noise exposures so we can compare them to the RELs. Noise can be measured using a sound level meter or a noise dosimeter.

A sound level meter measures sound level at a single point in time, which is useful when sound is steady-state with little variation in level. Sound level meters are inexpensive, widely available, and relatively simple to use. When sound exposures vary in level and duration it's difficult to accurately estimate exposure using a sound level meter, and a noise dosimeter should be used instead.

A noise dosimeter measures sound levels continuously over time and integrates them into a single value, the noise dose. A dosimeter provides a more accurate estimate of noise exposure when sound levels fluctuate and/or exposure durations vary, and can alert the user in real time to the need for hearing protection based on the accumulated noise dose. Noise dosimeters have traditionally been expensive and complicated to operate, limiting their use to special applications by highly trained individuals.

Etymotic Research, in collaboration with Greg Flamme, Ph.D., developed two low-cost personal noise dosimeters that are easy to operate and can be used for a wide variety of applications.

NOISE DOSE

Noise dose is expressed as a percentage of a predetermined maximum, defined by the standard you choose (e.g., OSHA or NIOSH). Dose is calculated based on the criterion level, threshold level and exchange rate. Criterion level is the sound level which, if continuously applied for 8 hours, would result in a 100% noise dose. Threshold level is the level below which the dosimeter produces no noise dose accumulation (values below that level are effectively considered to be zero). Exchange rate is based on the equal-energy hypothesis, which assumes that equal amounts of sound energy will produce equal amounts of hearing impairment.

OSHA uses a criterion level of 90 dB, a threshold level of 80 dB, and an exchange rate of 5 dB. An OSHA 100% noise dose is 90 dB for 8 hours, 95 dB for 4 hours, 100 dB for 2 hours, and so on (OSHA decreases the PEL to 85 dB for 8 hours if the employee has a documented threshold shift; see 29CFR 1910.95 for additional details).

NIOSH uses a criterion level of 85 dB, a threshold level of 75 dB, and an exchange rate of 3 dB. A NIOSH 100% noise dose is 85 dB for 8 hours, 88 dB for 4 hours, 91dB for 2 hours, and so on (see Figure 1).

Since OSHA and NIOSH define dose differently, the first rule of interpretation is to know which standard the dose calculation was based on. As illustrated previously, the NIOSH and OSHA allowable sound levels and times differ, so each define a 100% dosedifferently (see Figure 4).

The differences in the OSHA and NIOSH standards become noticeable at high noise levels: OSHA allows a 100 dB noise exposure for two hours, while NIOSH limits it to 15 minutes; OSHA allows a 115 dB noise exposure for 15 minutes, while NIOSH limits it to 28 seconds (not shown). These differences undoubtedly produce differences in risk for NIHL, with the OSHA criteria carrying higher risk. The exposure used by Kujawa and Liberman (2009) was 100 dB for 2 hours, which constitutes a 100% dose as defined by OSHA. This single exposure produced irreparable damage to IHC afferent nerve terminals and associated degeneration of the cochlear nerve.

An important point about noise dose is that it is cumulative; noise dose never decreases over time. While sound levels may go up and down over time, noise dose only increases or plateaus over time. This is because you can't remove

OSHA (1983)

Level (dBA)	Duration	Dose %
105	1	100
105	2	200
105	4	400
105	8	800
105	16	1600

NIOSH (1998)

Level (dBA)	Duration	Dose %
94	1	100
94	2	200
94	4	400
94	8	800
94	16	1600

Figure 5

the exposure once it has occurred, much the same way you can't undo sun exposure after the fact. When the combination of sound levels and duration exceed those shown in Figure 4, noise dose increases to values greater than 100% (see Figure 5).

A 200% noise dose is two times the allowable limit (equivalent to two days' worth of noise exposure); a 400% noise dose is four times the allowable limit (equivalent to four days' worth of noise exposure), and so on. Do exposures like this occur often enough for us to be concerned? Absolutely! Measurements taken during a drum line demonstration in the band room at a local high school, with only half of the drum line students resulted in a 1400% noise dose after only 45 minutes.

Using Dosimetry Results to Recommend Hearing Protection

The simplest way to use noise dosimetry results is to recommend use of hearing protection whenever noise dose exceeds 50%, particularly if that dose is reached early in the noise exposure period. Initiating protection at a 50% noise dose is more protective, especially for individuals with higher than average susceptibility to NIHL. This also recognizes the potential for exposure to noise throughout the day, rather than limiting potential exposure to the work day only.

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WARNING

Buying Hearing Aids from the Internet?

Serious Health Risks

In Ontario, a prescription is required by law prior to a hearing aid being dispensed.

- **Without obtaining the assistance of qualified hearing healthcare professionals,** you will not have obtained proper testing, selection, counseling and dispensing.
- Hearing Aids are a Class II Medical Device which must be approved by Health Canada to ensure they are safe and effective.
- Hearing aids over the internet may be counterfeit, cause serious infections, be recalled due to safety concerns or have missing parts.

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