Journal of
The Association of Hearing Instrument Practitioners of Ontario

Signal

Summer/2013 • Edition 98

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Diplacusis: The Strange World of People with Double Hearing

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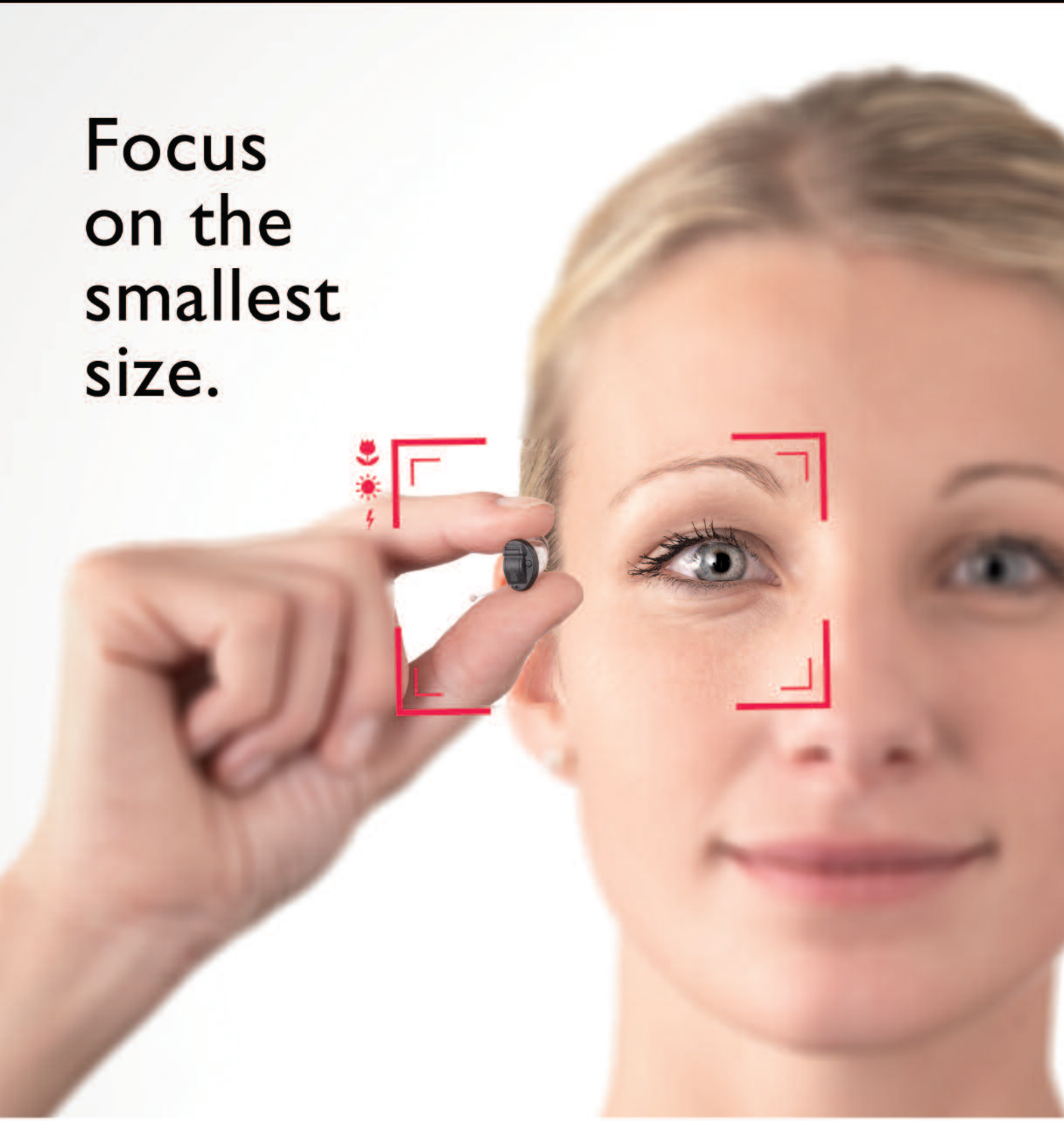

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Symposium 2013 AHIP Members in Pictures

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The mission of the Association of Hearing Instrument Practitioners of Ontario is to represent and guide its members in their practice which include, the testing, selecting and fitting, and dispensing hearing instruments and associated devices in the best interest of the hard of hearing, and may include the removal of cerumen from the external ear canal. Membership is available to hearing instrument practitioners or to those who have an interest in the hearing instrument profession.

Signal is the official journal of AHIP, the professional association of Hearing Instrument Practitioners of Ontario, incorporated in 1988 for the purpose of ensuring quality care for the hard of hearing. *Signal* presents technical and trade information to assist hearing instrument practitioners to better serve the hard of hearing.

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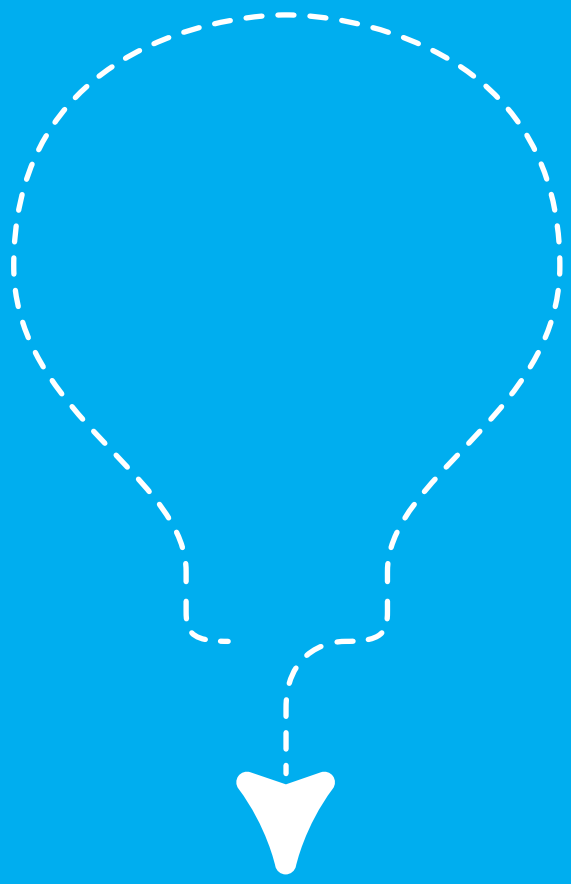
Summer 2013 • Edition 98

contents

SYMPOSIUM 2013 IN PICTURES

FEATURES



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Dear Members,

I would like to take this opportunity to thank you for your support and confidence in electing me as president. As well, I would like to specifically thank Vivienne Saba-Gesa for her dedication and commitment as president over the past two terms. Also, congratulations to the newly elected AHIP Board of Directors whom I will rely on for their support and expertise. You have my assurance that the strong AHIP tradition of protecting the rights of the Ontario hard of hearing as well as protecting the rights and interests of our profession will continue.

Wasting no time, your AHIP Executive and Board are already settling into their new positions and committees as outlined in your membership mailing of May 30, 2013. As president, in addition to regular association business priority will be given to government and professional relations as well as education and quality assurance.

Please enjoy this edition of the Signal which looks back on the wonderful experience of Symposium 2013. It was certainly beyond compare with record attendance, exceptional education and amazing entertainment. Please make a special effort to thank all the manufacturers for their support for without it Symposium would not be possible.

I am looking forward to a very positive and productive term. Have a great summer!

Maggie Arzani H.I.D.
AHIP President

Dear Members,

Congratulations to new AHIP President Maggie Arzani, AHIP and all the newly elected executive and board members. I would also like to extend sincere appreciation to Past-President Vivienne Saba-Gesa, for her personal commitment to excellence in serving the profession with integrity and vision.

I am very much looking forward to once again, with the AHIP president, attending and representing AHIP at the International Hearing Society Convention. The convention will be held on September 11–15, 2013 in Washington D.C. Events which will be attended included the Chapter Leaders Convention, Licensing Board Convention and the Annual General Meeting. Within these meetings a number of international topics will be discussed including internet sales, social media, membership issues, continuing education and the International Licensing Exam to name a few. We will also have an opportunity to attend educational seminars which may give us some good ideas for future AHIP Symposium speakers.

Wishing all a safe and happy summer!

Respectfully Submitted,

Joanne Sproule
Executive Director

Greetings Members,

Thanks for showing your confidence in me at the AGM. Not only for attending not one but two nights of AHIPster shows but also for allowing me to move into the position of vice-president. Everything about symposium was great but I personally loved Serena Ryder's show during the AHIP gala. The symposium chairs booked her long before she won all those Juno's so good on them. I promptly bought her latest CD and have just about worn it out. My 4 year old asks for "fall to pieces" every time we get in the car. It has to be played at least 3 times in a row and yes he belts it out with me.

We have a really interesting article on diplacusis. I found this one thanks to a friend of mine who asked me for advice. She is from England and emailed me in a British version of panic. She is a piano tuner and she found that when she placed her tuning fork to one ear it was off by a whole semi-tone while the other ear was still accurate. As you can imagine, this is not a development a piano tuner would be comfortable with. Fortunately her case was temporary, caused by a blocked eustachian tube. She is once again perfectly pitched bilaterally.

To help ensure that you are getting the maximum out of your AHIP health care benefits, John Niekraszewicz has provided us with updates and tips. And to round it all off, we have Did You Hear and Part II of our practice management article. The member interview took another hiatus. I know it is popular but we were hard up for space this time. I will be sure to include one in the next edition. Don't hesitate to nominate yourself or a friend.

Lisa Simmonds Taylor, BA, H.I.S.
AHIP Vice-President, Editor-in-Chief

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Compiled by Lisa Simmonds Taylor and Chris Arnold

Scientists Find Mechanism that Causes Noise-Induced Tinnitus and Drug that Can Prevent It

An epilepsy drug shows promise in an animal model at preventing tinnitus from developing after exposure to loud noise, according to a new study by researchers at the University of Pittsburgh School of Medicine. The findings, reported this week in the early online version of the *Proceedings of the National Academy of Sciences*, reveal for the first time the reason the chronic and sometimes debilitating condition occurs.

An estimated 5 to 15 percent of Americans hear whistling, clicking, roaring and other phantom sounds of tinnitus, which typically is induced by exposure to very loud noise, said senior investigator Thanos Tzounopoulos, Ph.D., associate professor and member of the auditory research group in the Department of Otolaryngology, Pitt School of Medicine.

"There is no cure for it, and current therapies such as hearing aids don't provide relief for many patients," he said. "We hope that by identifying the underlying cause, we can develop effective interventions."

The team focused on an area of the brain that is home to an important auditory center called the dorsal cochlear nucleus (DCN). From previous research in a mouse model, they knew that tinnitus is associated with hyperactivity of DCN cells – they fire impulses even when there is no actual sound to perceive. For the new experiments, they took a close look at the biophysical properties of tiny channels, called KCNQ channels, through which potassium ions travel in and out of the cell.

"We found that mice with tinnitus have hyperactive DCN cells because of a reduction in KCNQ potassium channel activity," Dr. Tzounopoulos said. "These KCNQ channels act as effective "brakes" that reduce excitability or activity of neuronal cells."

Seven days after noise exposure, the team determined whether the mice had developed tinnitus by conducting startle experiments, in which a continuous, 70 dB tone is played for a period, then stopped briefly and then resumed before being interrupted with a much louder pulse. Mice with normal hearing perceive the gap in sounds and are aware something had changed, so they are less startled by the loud pulse than mice with tinnitus, which hear phantom noise that masks the moment of silence in between the background tones.

The researchers found that mice that were treated with retigabine immediately after noise exposure did not develop tinnitus. Consistent with previous studies, 50 percent of noise-exposed mice that were not treated with the drug exhibited behavioral signs of the condition.

"This is an important finding that links the biophysical properties of a potassium channel with the perception of a phantom sound," Dr. Tzounopoulos said. "Tinnitus is a channelopathy, and these KCNQ channels represent a novel target for developing drugs that block the induction of tinnitus in humans."

http://www.sciencedaily.com/releases/2013/05/130527153701.htm

Loud Portable Music Players May Hurt Ability to Clearly Discriminate Sounds

Growing numbers of people enjoy listening to music on portable music players or cell phones, and many tend to turn up the volume, especially in noisy surroundings. In a study published March 2, 2011 in the open-access journal *PLoS ONE,* researchers explore the potential effects of this behaviour on hearing.

The study was a collaboration between Drs. Hidehiko Okamoto and Ryusuke Kakigi from the National Institute for Physiological Sciences, Japan, and Drs. Christo Pantev and Henning Teismann from the University of Muenster. The researchers demonstrated that listening to loud music through earphones for extended periods in noisy surroundings can cause neurophysiological changes related to clear discrimination of sounds, even if the hearing threshold is normal.

This auditory abnormality concerns “the vividness of sounds” and cannot be recognized by the usual hearing test in which subjects are examined using a series of individual tones in a silent environment. These results may support a future auditory assessment plan for long-term portable music player users.

The research group examined the brain's response to sound using the biomagnetism measurement device MEG (magneto-encephalography), which makes it possible to measure the brain activity without any subject's behavioral response. They recorded the brain responses of two groups of 13 young adults; one group had regularly listened to music at full blast, and the other group had not. Subjects listened to a sound of a specific frequency contained in background noises while watching a movie.

The inability to dissociate a sound from background noises was considerably more pronounced in the habitual portable music player users. This difficulty cannot be detected with the current standard hearing test, which yielded the same results in both groups.

According to Dr. Okamoto, "It can be said that listening to music at high volumes burdens the nerves of the brain and auditory system and can cause a decline in the ability to discriminate sounds, even if the usual hearing test results are normal and the subject is unaware of any changes." He also claims, "It would be better to suppress environmental noises by using devices such as noise cancellers instead of turning up the volume when enjoying a mobile music player in a noisy place."

http://www.healthyhearing.com/content/news/Hearing-loss/Causes/47740-Listen-music-hearing-damage

More Studies Confirm Hearing Loss Related To Medication

Sturgeon Bay, Wisconsin Chiropractor and Naturopath, Dr. J G Moellendorf, DC, ND, LCP, notes that while aspirin has been known for decades to cause ringing in the ears, stomach ulcers, and kidney problems, doctors are concerned that aspirin and other analgesics (pain relievers) are causing loss of sight and hearing.

The *Journal of the American Medical Association* published "Long-Term Use of Aspirin and Age-Related Macular Degeneration" in December, 2012. Barbara Klein's research team at the University of Wisconsin followed residents of Beaver Dam, Wisconsin for 20 years. Participants taking aspirin at least twice weekly had a 71% increase in macular degeneration 10 years later.

The *Journal of the American Medical Association Internal Medicine* published "The Association of Aspirin Use With Age-Related Macular Degeneration" in February, 2013. The research team led by Gerald Liew at the University of Sydney (Australia) found that the incidence of macular degeneration was about 2.5 times greater at 5, 10, and 15 years among regular aspirin users compared to non-users. Knowing the damages it can cause to the eyes, doctors are concerned that aspirin may also damage hearing.

The research team led by Dr. Sharon Curhan at Boston's Department of Medicine at Brigham and Women's Hospital has studied the causes of hearing loss for over 25 years. A connection was found between analgesic use and hearing loss. They published their results as "Analgesic Use and the Risk of Hearing Loss in Women" in the September 2012 issue of *American Journal of Epidemiology*.

Prefacing their findings, the researchers note that over 36 million Americans have hearing loss. More than 50% of Americans over 60 years are affected; with 33% of those between 40 and 49 already have hearing loss. They are concerned that even mild hearing loss compromises the ability to understand speech with background noise or several people talking. They are apprehensive that untreated hearing loss can lead to social isolation, depression and a poorer quality of life.

Curhan's team followed 62,261 women between 31 and 48 years between 1995 and 2009. Among those using ibuprofen 2 to 3 times per week, there was a 13% increase in hearing loss compared to non-users. Those using ibuprofen 4 to 5 times weekly had a 21% increase of hearing loss, and those with a frequency of 6 or more times weekly had a 24% increase. Among those using acetaminophen, there were increases of 11%, 21%, and 8% respectively. Those consuming aspirin showed no significant increases in hearing loss.

http://www.healthyhearing.com/report/51361-More-studies-confirm-hearing-loss-related-to-medication

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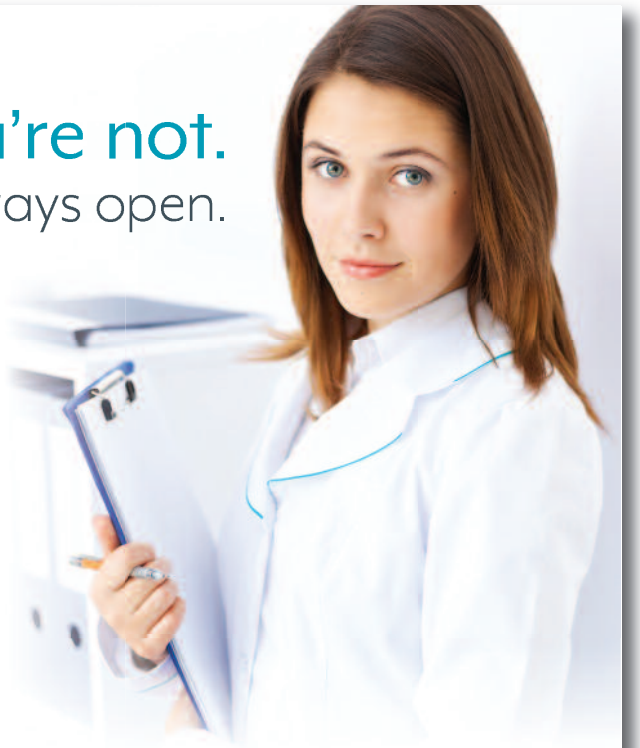

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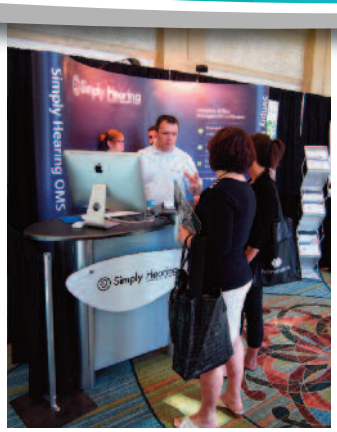
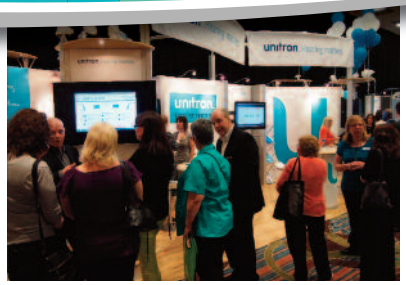
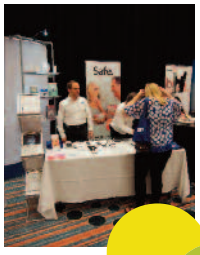
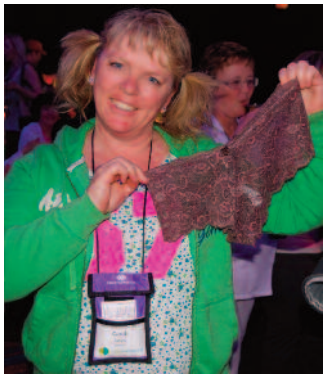






AHIP Members
at Symposium 2013



Part II:Analyzing the Practice for Success

By Robert M. Traynor EdD, MBA and Robert G. Glaser, PhD

About the Authors

Robert M. Traynor (far left) is CEO/Audiologist with Audiology Associates, Inc., Johnstown, Colorado

Robert G. Glaser is CEO/Audiologist with Audiology Associates of Dayton, Inc., Dayton, Ohio

Freeman et al describe two forms of financial analysis ratio comparisons, cross sectional and a time series analysis.[1] A cross sectional analysis, refers to the comparison of the practice's performance to that of an industry standard for similar practices in size, scope and geographical area. Though probably more appropriate recent years, is still difficult to determine an industry standard as there are not good data reported by private audiology practices as to their performance. Since performance comparisons between practices or to an industry standard are difficult to conduct, it is the time series analysis that becomes the most important. The time series comparison looks at the practice performance to itself, or over periods of time, usually month to month or year to year. Data, such as financial statements are compared from one period to another to determine if the practice's performance is better or worse. These time-series comparisons of financial statements and the data they contain are essential to making informed, data based management decisions about the practice and its operations.

Where is the Data?

Financial statements are full of numbers that, by themselves, simply present how the practice performed at a particular point in time and do not have too much significance in isolation. Since the financial statements alone do not provide information on the efficiency or profitability of the practice, they require analysis and a time series comparison to generate real information. When these numbers in the current statements are compared to financial statements conducted at other times (monthly or yearly) they come alive with informative data that paints a true picture of how success or failure has developed. Financial statements with the correct calculations and comparisons can reveal a wealth of information to the stockholders (or the practice owner) about earnings over time, soaring or stagnated sales, and even the practice's capability to pay back a loan to the bank. Within the same practice comparing financial statement totals to others taken at the some point in time is very helpful, for example, comparing the first quarter 2004 with the first quarter or 2005 or the whole year of 2004 with 2005, or last year at this time to this year at this time. Marshall et al. indicate that these calculations assist in the determination of a practice's financial position and the result of their operations by reporting on liquidity, activity, and debt and profitability analysis of income statements.[2] It is the calculation of various ratios for balance sheets and income statements that facilitate the comparison of one practice with another, no matter what the size of the operation. Although there are many of these and a wise practice manager should consult with their accountant as to those that are the most beneficial for the practice, these relatively simple measures can be calculated and tracked. The data can then be transferred to a spreadsheet and reviewed over time

to demonstrate the health of practice, for obtaining loans or supplier credit, reviewing success and failure for management decisions, to set budgets, or simply general information.

The Calculations

Financial statements provide information regarding the capability of the practice to meet obligations to suppliers, employee salaries, product returns, loans, leases, and other expenses. Managers use liquidity, activity, and leverage ratios to analyze the balance sheet to demonstrate the strengths and weaknesses of the practice. Liquidity ratios are used to measure the short-term ability of practice to generate cash to pay currently maturing obligations while activity ratios measure how effectively the organization is using its assets, analyzing how quickly some assets can be turned into cash. Debt or leverage ratios reflect the long term solvency or overall liquidity of the practice and are of interest to the investors and/or the bankers that have loaned money.

Liquidity Ratios

A common liquidity ratio is the Current Ratio (CR). The CR is sometimes called a Working Capital Ratio as it is a calculation of how many times the practice's current assets cover its current liabilities and specifically looks at if the practice has sufficient resources to meet current liabilities. Put another way, the Current Ratio asks the questions, can the practice pay its bills or not? The Current Ratio is figured on the Balance Sheet as follows:

$$\text{Current Ratio} = \frac{\text{Current Assets}}{\text{Current Liabilities}}$$

If the result of a CR calculation is less than 1, the practice will not be able to meet its current liabilities and if the CR is 2 or more, the practice can pay its bills and have money left over. Usually bankers and practice managers like to see this ratio at least between 1 and 2. Since the CR calculation includes prepaid expenses (such as insurance, etc.) and the inventory, in some situations it may offer a cloudy view of the real picture. Particularly these days when audiology practices may have a stock of open fit or RITE hearing instruments, many audiology practices now have some inventory. Thus, a very common modification of the CR is the Quick Ratio (QR), commonly known as the Acid Test Ratio (ATR). The ATR evaluates the practice's liquidity without considering the inventory and prepaid expenses and, in doing so, often presents a more accurate indication of the liquidity of an audiology practice. The ATR is figured from the information on the balance sheet as follows:

$$\text{Acid Test Ratio} = \frac{\text{Cash + Marketable Securities + Accounts Receivable}}{\text{Current Liabilities}}$$

As with the CR, Acid Test Ratio values less than 1 demonstrate that the practice has serious difficulty meeting everyday expenses.

Just as plans are made to meet personal obligations in tough times, wise practice managers keep an emergency fund in the case that business drops off or ceases. These can be from natural disasters, major construction projects proximal to the clinic, or simply a downturn in the economy. In accounting, emergency funds are called Defensive Assets (DA) or those assets that can be turned into cash within three months or less, such as cash (savings), marketable securities, or accounts receivable. A calculation that determines the amount of Defensive Assets (RA) necessary to ward off disaster is the Defensive Interval Measure (DIM). To figure the DIM, it is first necessary to know the Projected Daily Operating Expenses (PDOE) or how much it costs to keep the practice open each day. To find the PDOE, simply look at the income statement and determine the cost of goods sold in a year (listed as the selling and administrative expenses) in a year and other ordinary cash expenses for the year then divide by 365:

$$\text{Projected Daily Operating Expenses} = \frac{\text{Total yearly Expenses}}{365}$$

Once the daily operating expenses (PDOE) are known, the DIM is found by dividing the DA by the PDOE:

$$\text{Defensive Interval Measure} = \frac{\text{Defensive Assets}}{\text{Projected Daily Operating Expenses}}$$

The DIM calculation gives the manager of the practice knowledge of the length of time the business could survive if revenue was substantially reduced or absent as present.

Activity Ratios

Activity Ratios are calculations that allow the practice manager to review how efficiently the practice uses its assets to generate cash. Although there are a number of Activity Ratios that can present the efficiency of the practice, the Accounts Receivable Turnover Ratio (ART), The Inventory Turnover Ratio (ITR), and the Total Assets Turnover Ratio (TAT) are useful to managers.

It is a good policy for all patients to pay when products and/or services are delivered and most practices have a sign to that effect in the waiting room, collecting as much revenue as possible on the date of delivery. Reality is, however, that insurance companies pay slowly; sometimes 60-120 days after the services are rendered and may often not even pay the first time the claim is submitted. Some patients need time to pay for goods and services require credit to facilitate the sales of hearing aids, batteries, and other goods or services. Although credit given to patients is another topic, the receivable account should be closely monitored to determine how much is due to the practice and how long, on the average, it takes to collect for these credit sales. The Accounts Receivable Turnover Ratio (ART) looks at how many times the receivable account is turned into cash each year. To obtain the ART ratio it is necessary to first find the average amount that is due the practice from the receivable account at any one time or the Average Accounts Receivable (AAR) balance. This is obtained by adding the accounts receivable balance at the end of last year and balance of the accounts receivable at the end of the current year and dividing it by 2:

$$\text{Average Accounts Receivable} = \frac{\text{AR (Year 1)} + \text{AR (Year 2)}}{2}$$

Once the AAR is computed, the time it takes to convert this account into cash or the ART ratio is conducted by taking the Net Sales (Income Statement) and dividing by the average accounts receivable balance:

$$\text{Accounts Receivable Turnover Ratio} = \frac{\text{Net Sales}}{\text{Average Accounts Receivable}}$$

Once known, the ART present the manager with how long it takes, on the average, to collect the amounts that in the accounts receivable, thus, the higher the ratio the better. For example, if the ART ratio is = 5.3, the practice turns over the accounts receivable 5.3 times per year or every 2.26 months. To obtain more detail, the calculation of the number of days it takes to turn the accounts receivable can be obtained by simply dividing the average accounts receivable into 365.

As indicated earlier, audiology practices are now stocking more inventory than ever before and it is beneficial to understand how fast the inventory sold so that stock can be ordered routinely. The Inventory Turnover Ratio (ITR) is the calculation that measures how fast the inventory is sold, or "turned." To arrive at the ITR it is necessary to obtain the average value of the inventory in the practice. The Average Inventory (AI) is found by reviewing the balance sheet and taking the beginning inventory for the year and the ending inventory of the previous year and dividing by 2.

$$\text{Average Inventory} = \frac{\text{Beginning Inventory} + \text{Ending Inventory}}{2}$$

Once the AI is known, the ITR can be computed by dividing the cost of the goods sold (Income Statement) by the average inventory. If the ITR was 5.9 this indicates that the inventory will turn almost 6 times each year. As with other activity ratios, the turning of the inventory can be further delineated to reflect how long it takes the inventory to sell out in days by simply dividing 365 by the ITR.

$$\text{Inventory Turnover Ratio} = \frac{\text{Cost of Goods Sold}}{\text{Average Inventory}}$$

In this example, if the inventory turns about 6 times per year then it takes about 61 days for the inventory to sell out. These data assist the manager in taking advantage of discounts for more efficient ordering of products, free demonstration product offers and insures that there is always a sufficient supply of products on hand for sale.

The Total Assets Turnover ratio presents how many times the practice assets turns over per year and is an indication of how efficiently assets are turned into cash. The TAT calculation looks at the sales for goods and services (income statement) and divides

by the total assets (balance sheet) to arrive at how many times the practices' assets turnover per year.

$$\text{Total Assets Turnover Ratio} = \frac{\text{Sales}}{\text{Total Assets}}$$

Of course, the higher the ratio the better as this is an indication that the assets turn over more times per year, suggestive of an efficient practice that uses it assets efficiently to generate cash.

Leverage or Debt Ratios

There are two beneficial ratios that provide the practice manager with information as to the debt of the practice. The Debt to Assets Ratio (DAR) and the Times Interest Earned (TIE) ratio present the capability of the practice to support debt for the addition of equipment, to open another location, or other activities.

The DAR presents how much liability the practice has for every dollar of assets and offers creditors information about the ability of the practice to withstand losses. Specifically, the creditors are interested in how much of a loss the practice can sustain without impairing its capability to repay loans with interest. The DAR is simply the Total Liabilities divided by the Total Assets (balance sheet):

$$\text{Debt to Assets Ratio} = \frac{\text{Total Liabilities}}{\text{Total Assets}}$$

A desirable DAR is a low number since the higher the number indicates that the practice is more dependent on borrowed money to sustain itself. If the DAR is high it suggests that small changes in cash flow may cause serious difficulties in the capability to repay their debt.

The Times Interest Earned (TIE) ratio is an indication of how many times the practice earns the amount of interest that it is charged on the money that it has borrowed. The TIE is computed by taking the practices' earnings before interest and taxes and dividing it by the interest charged (income statement).

$$\text{Times Interest Earned Ratio} = \frac{\text{Earning Before Interest and Taxes}}{\text{Interest Charges}}$$

In an audiology practice the TIE should be somewhere between three and five as it indicates that the earnings are at least three to five times greater than the interest payments. A TIE ratio that is less than 1 indicates that the practice cannot pay its interest commitments.

Sometimes the ratios that often tell the most about a practice are the profitability ratios that are conducted on the income statement. These profitability ratios are clues to how well the company performed and looks at if the company's net income is adequate, the rate of return achieved and profit margin as a percentage of sales. Useful ratios that reflect performance of the practice considered are the Profit Margin on Sales (PMOS) and the Asset Turnover Ratio (ATR) calculated from information presented in both the income statement and the balance sheet.

The Profit Margin on Sales (PMOS) presents the profit margin achieved after all expenses are subtracted and presents how much of every dollar of sales are profit. To compute the PMOS, net profit (income statement) is divided by sales (income statement).

$$\text{Profit Margin on Sales} = \frac{\text{Net Profit}}{\text{Sales}}$$

PMOS results are presented in a percentage that reflects the amount of each dollar that is profit. For example, if the calculation yields 20% then $0.20 cents of every dollar collected is profit. These values can be tracked to determine if there are changes in profitability that require attention.

Summary

Although ratios can be very helpful in the evaluation of a practice, Glaser and Traynor offer some cautions on the use of ratio analysis.[3] They indicate that the best information about a company's health is determined from comparison and analysis of a group of ratios, not a single ratio and that these comparisons need to be made from like times of the year to arrive at accurate data on the practice's performance. Additionally, they also indicate that these ratios may be distorted somewhat due to the

reimbursement policies of insurance companies.

This has been a basic orientation to the use of ratio analysis to evaluate the audiology practice. There are many other ratios that can unlock specific performance information that are not presented in this discussion. The development of a set ratio assessment calculations to track various components of your particular practice should be developed with the help of a certified public accountant or other trained business professional. Once set up these calculations can be tracked over time using a spreadsheet to facilitate a basis for decisions based actual practice performance.

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Introducing Evan Jasper Laidman!

Evan Jasper Laidman was born Thursday April 25 at 8 pounds 2 ounces. A beautiful healthy baby. AHIP Director Scott Laidman and his wife Kelly are doing well too.

Dennis Papillon

On May 26, 2013, after 77 years of an earthly life well and happily lived, Dennis Leo Papillon has, peacefully and with great faith, moved on to the next stage of his existence.

With his best friend and wife of 54 years, Lucille (Hahn) Papillon, Dennis created lasting memories and a great love, sharing unforgettable times together. Their family, wonderful daughters and sons-in-law Michelle and Mark Gaboury, Lisa and Craig Webster, Andrea and James Cleary, and cherished son Stephen Papillon, have been truly blessed with such a caring Dad and role model.

Dennis was successfully self-employed as a Hearing Aid Specialist, founding Dominion Hearing Aid Company. He later shared this profession with son Stephen, passing on his love of this fulfilling work.

Please visit www.henrywalser.com for Dennis' memorial.

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Diplacusis – The Strange World of People with Double Hearing

By Neil Bauman, PhD

Question: A musician explained, "I suddenly began experiencing a strange phenomenon with my hearing. I now hear music through my right ear at the correct pitch, while, at the same time, I hear the same music a semitone higher in my left ear. This is frustrating and scary. I can no longer perform my music. A major part of my life has suddenly been snatched from me. Have you ever heard of this before? Am I going crazy? What can I do to correct this condition?"

Another person related, "I've suddenly begun to experience a rather disturbing auditory phenomenon. Sounds as heard by my right ear are pitched a bit lower than the same sounds as heard by my left ear. This gives music a very frightening and eerie chorus effect that is becoming more and more disconcerting. What causes it? Does it ever go away?"

Answer: I have written about people who hear music off-pitch either certain notes, or all notes. (See "When You Hear Music in the Wrong Key including all the comments [http://hearingloss help.com/weblog/when-you-hear-music-in-the-wrong -key.php].) In most cases, these people heard the same music off-pitch with both ears. This alone was disconcerting and destroyed their enjoyment of music.

However, it is even more frustrating when you hear the same notes at different pitches in each ear and you don't know which ear to believe. For example, your left ear may hear a note as F while your right ear may hear the same note as F# (F sharp).

Rest assured, when this happens you are not going crazy, but something definitely has messed up the pitch perception between your ears. This condition is known as diplacusis (dip-lah-KOO-sis).

What is Diplacusis?

Diplacusis is a disconcerting condition, especially for musicians, because you hear the same note at two different pitches – often at the correct pitch in one ear and either higher (sharp) or lower (flat) in the other ear. This makes playing, singing or listening to music sound sour (sharp or flat depending on the direction of the frequency shift). This can be devastating to a musician who has previously had perfect pitch.

The dictionary defines diplacusis as "abnormal perception of sound either in time or in pitch, such that one sound is heard as two." This fancy name comes from two Greek words "diplous" – double, and "akousis" – hearing. Thus, diplacusis is really double hearing or hearing double.[1]

Diplacusis occurs when your ears have a significant difference in frequency selectivity. This results in clashing interpretations (dissonance) of the tones you hear.

Fortunately, although many people hear tones at different pitches in each of their ears, this difference is normally slight. In fact, when the difference in pitch is less than about one semitone (halftone), the average person typically does not notice it. This difference in pitch normally escapes our notice because the slightly different pitches of sound from our two ears merge in our conscious perception such that we only hear one pitch of sound.[2]

Musicians, however, because of their musical training, may be considerably more sensitive to these slight pitch differences. As a result, they may be aware of, and bothered by, smaller pitch differences than even a semi-tone.

Kinds of Diplacusis

Diplacusis or "double hearing" comes in various "flavors."

Diplacusis binauralis (by-nar-RAL-is) is where you hear the same sound differently in each of your ears. For example, you may hear a different pitch of sound in each ear, or the timing may be different in each ear.

A subset of diplacusis binauralis is diplacusis dysharmonica (dis-har-MON-ih-ka) where only the pitch is different in each ear. Some authorities use the term Interaural Pitch Difference (IPD) rather than diplacusis, but they both refer to the same condition.[2]

Diplacusis echoica (eh-KOE-ih-ka), as its name implies, is where you hear the same sound repeated in the affected ear – thus you hear the original sound followed by an "echo" of the original sound.

Finally, there is diplacusis monauralis (moh-nar-RAL-is). This is where you hear a single sound as two different sounds in the same ear.[1]

In my experience, by far the most common "flavor" of diplacusis is diplacusis dysharmonica. This is the annoying condition that numbers of musicians experience and the kind of diplacusis we will discuss here.

What Causes Diplacusis?

Diplacusis involves a shift of pitch perception. This can happen when the hearing in one ear is damaged (unilateral hearing loss), or the hearing in one ear is damaged more than it is in the other ear (asymmetrical hearing loss). However, the degree of pitch distortion does not appear to bear any simple relationship to the degree of hearing loss.[3]

Incidentally, diplacusis was first observed way back in the 1880s in people with unilateral hearing loss.[2]

If one ear has normal hearing, and the other one has sensorineural hearing loss, you can have a lot of diplacusis. Bilateral sensorineural hearing loss results in less diplacusis but there are probably pitch distortions because both ears are likely messed up in the same way.[4]

In fact, there is a high degree of correlation between the occurrence of diplacusis and damage to the inner ear.[2] Diplacusis is typically experienced as a result of sensorineural hearing loss. Onset is usually spontaneous and can occur at the time of an acoustic trauma or in the midst of an ear infection. Sufferers may experience the effect permanently, or it may go away on its own.[4]

For people who have some degree of sensorineural (inner ear) hearing loss, here is a detailed account of how diplacusis may develop. First, we need a bit of background.

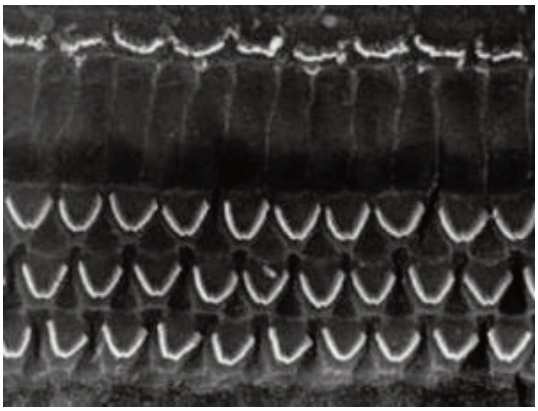

Figure 1. The top row of inner hair cells shows their slightly rounded stereocilia bundles. The bottom three rows of outer hair cells show their deep V-shaped stereocilia bundles.[5]

The cochlea in your inner ears contains four rows of hair cells. There is one row of inner hair cells and three rows of outer hair cells. On the top of each hair cell are bundles of minute hair-like projections called stereocilia (Figure 1.). These stereocilia sway (dance) in unison to received sound signals.

The job of the inner row of hair cells is to transmit the sound signals from the cochlea to the auditory nerve. As they sway, they open "ion-gates" that allow the sound signals to be transmitted to the auditory nerve.

If the row of inner hair cells die, you will not hear anything as there is no other way to transfer the sound signals from the cochlea to the auditory nerve. If sections of inner hair cells die or are severely damaged, you no long will hear the frequencies of sound to which those hair cells were tuned.

The outer three rows of hair cells (Figure 1.) have a different function. Their job is to filter and amplify the sounds we want to hear. If all of them were to die, we could still hear (that's the inner hair cells job), but sounds would be unregulated as to volume and all sounds would appear to run together.

Like the inner hair cells, "each set of outer hair cells and associated stereocilia (Figure 2) have a favorite frequency and 'dance' energetically when they receive it. This 'dance' amplifies the signal to the inner stereocilia, which react passively and signal the brain. An array of outer and inner stereocilia operate

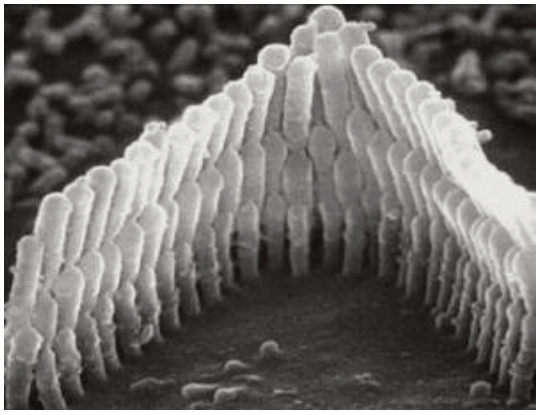

Figure 2. Close-up of a healthy stereocilia bundle perched on top of an outer hair cell.[5]

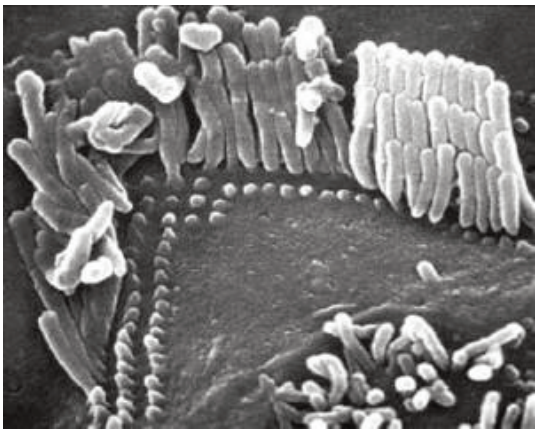

Figure 4. Close-up of a damaged stereocilia bundle perched on top of an outer hair cell. Notice that many of the stereocilia are missing or flopped over and deformed.5 (Compare with Fig. 2 left.)

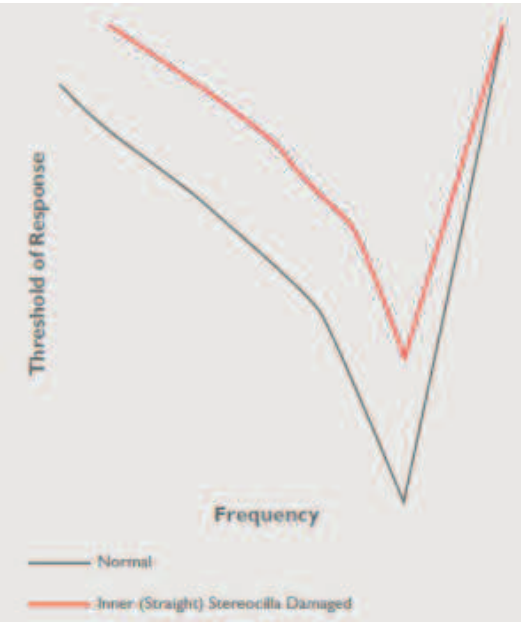

Figure 3. The black (bottom) line shows the normal operation of the sharply-tuned cochlear amplifier. When some inner hair cells die or are damaged only the volume is reduced (red [top] line) but the signal is still sharply defined.[5]

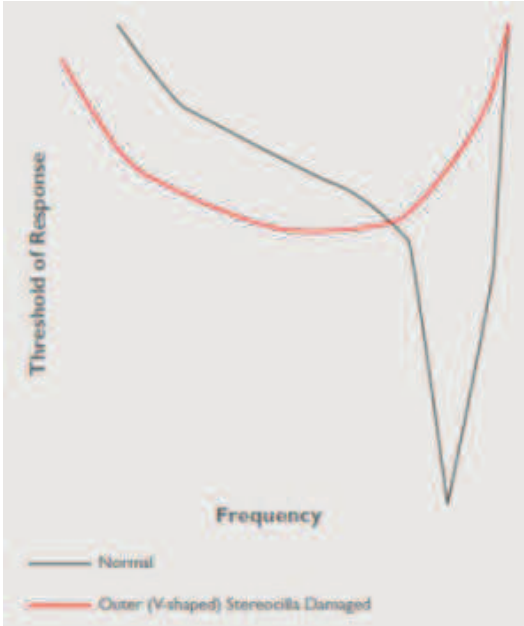

Figure 5. The black (bottom) line shows the normal operation of the sharply-tuned cochlear amplifier at one particular frequency. When some outer hair cells die or are severely damaged sound signals become softer and fuzzier (red [top] line) resulting in a shallow broad curve with no clear peak. Notice that the central frequency is also shifted slightly away from where it should be, thus giving a slightly different frequency of signal in the damaged ear resulting in diplacusis.[5]

together as a narrowband amplifier."[5]

Thus, when all is working properly, there is a sharply defined peak for a given sound (The black line in Fig 3.).

However, damage or death to some of the inner row of hair cells reduces sound sensitivity so you don't hear as well (the red line in Figure 3), but if there is no corresponding damage to the outer rows of hair cells, the signal peaks are still sharply defined.

In real life this seldom happens. What typically happens is that loud sounds first damage the outer hair cells rather than the inner hair cells. In fact, you could have 50% of the stereocilia on a region of the

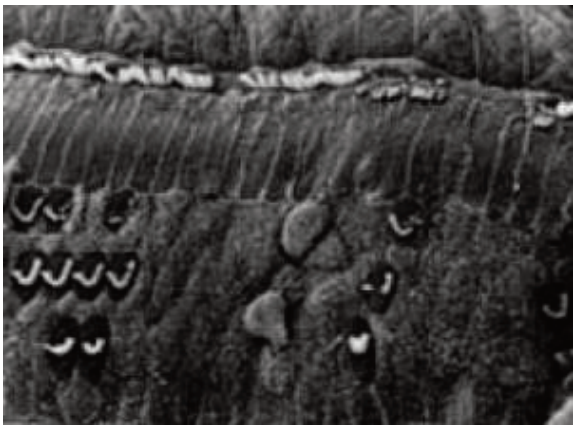

Figure 6. Missing and badly damaged hair cells. The inner row of hair cells is at the top and the 3 rows of outer hair cells are in the middle. Notice how most are dead and thus missing. Compare with Figure 1.[5]

outer hair cells damaged before you would see any change in hearing on an audiogram. A person could suffer damage to 75% of the outer hair cells before he would notice he had a hearing loss, but by that time you would expect some inner hair cells to be severely damaged too. Thus, the first consequence of noise damage is not hearing loss itself as you might expect, but fuzzy or blurred hearing.

The stereocilia on top of a hair cell may be damaged (Figure 4) and thus will not be able to do their "dance" properly. Since they do not "dance" effectively, there is less amplification of their favorite frequencies.

The result is that both the amplitude and the sharpness of the resulting signal is drastically changed. Compare the black line (healthy hair cells) in Figure 5 with the red line (damaged hair cells).

Not only is there less volume, and fuzzy hearing, something surprising also occurs. The frequency is shifted a bit. Notice that the lowest part of the red line and the peak of the black line no longer coincide.

Since the frequencies are slightly different, the result is that you now hear the same sound at two different frequencies. The fuzzy, shifted frequency in the your more damaged year and the normal or near normal sound in your undamaged or lesser-damaged ear. This is one possible explanation for diplacusis.

Another interesting phenomenon is that when your brain receives information from damaged sections of hair cells it struggles to determine whether it is intensity (volume) or frequency that has changed. Thus, for instance, it may seem that the music you are listening to has gone sharp during a crescendo.[5]

Loud sounds do not only damage or kill a single hair cell along with its stereocilia, but loud sounds also typically damage or kill neighboring hair cells as well.

Incidentally, if a cell is badly damaged, it programs itself to die through a process known as apoptosis. Since hair cells are a specialized kind of nerve cell, when they die your body does not replace them, thus leaving you with a permanent hearing loss.

Figure 6 shows the results of severe noise damage. Notice that most of the hair cells are missing and have been replaced by scar tissue. When this happens hearing becomes very faint and fuzzy. The result is that you will no longer hear much at all, and whatever you do hear will be so fuzzy that you will be not be able to distinguish small differences in pitch between your two ears and therefore you will never notice diplacusis.

Diplacusis can occur whether you have a temporary hearing loss or a permanent hearing loss. If you have a permanent hearing loss, your diplacusis may prove to be permanent as well[2] such as is the case with my wife. Diplacusis does not just occur in people with hearing loss, however. It is also found in some people with normal hearing. The main difference between diplacusis in people with hearing loss and in people with normal hearing is that in people with hearing loss there is a pronounced intra-ear frequency shift that typically exists in a fairly broad frequency region, while in people with normal hearing the intra-ear frequency shift rarely exceeds +/-2% and is distributed in a quasi-random manner such that the mean across frequencies essentially is zero.[2]

Apart from having a sensorineural hearing loss, a number of people seem to get diplacusis after they have had a cold or ear infection. This may be because of a viral attack on the inner ear, or because of a middle ear infection and/or blocked eustachian tube causing a conductive loss.

For example, one man explained, "I have had a cold for the past week or so. Last night I suddenly noticed that the pitch I hear in my right ear is a semitone higher than the same pitch in my left ear."

Another person explained, "I have had this happen to me several times over the years, always in conjunction with an ear infection. Fortunately, it never affected me longer than a few days."

Still another person explained, "I have had this happen twice in the past 15 years or so, and both times it was related to a bad cold and probable ear Infection. In my case the effects diminished gradually over several weeks, and finally disappeared."

Finally, a singer explained, "I woke up to an ear ache in the middle of the night a week ago and couldn't hear music properly the next morning. I went to my doctor, who said my eardrum was inflamed and that I had a sinus infection. He put me on azithromycin and steroids and now my cold/sinus infection seems to have mostly subsided, although I am still hearing about a quarter tone higher pitch in my left ear than my right."

Ménière's disease also seems to result in diplacusis in some people.[6] The amount of diplacusis seems to vary in degree with the amount of hearing loss, becoming more significant when the hearing decreases and less noticeable as hearing improves.[7]

How Common is Diplacusis?

Since hearing loss (inner ear damage) affects as many as 1 in 4 people, and since hearing loss is seldom identical in both ears, diplacusis is not as rare a phenomenon as you might think.[5] However, diplacusis appears to be more common – or at least more noticeable – among musicians since they have trained their ears to discern smaller differences in pitch than people in the general public.

One study of musicians revealed that 24% experienced tinnitus, 25% experienced hyperacusis, 12% experienced distortion in their hearing, and 5% experienced diplacusis in one of its forms. Of course, many of these musicians experienced two or more of the above symptoms at the same time.[5]

Cases of diplacusis on the order of 1 to 2% can be found in many people with normal hearing, especially those that are fatigued or have been exposed to loud noise.[6]

What Can I Do About My Diplacusis?

Since diplacusis is most often associated with some degree of hearing loss, if you have some condition that reduces your hearing such as wax in your ears, middle ear infections or clogged sinuses/clogged eustachian tubes, the obvious thing to do is to treat these conditions. As the "gunk" dissipates and your ears/sinuses clear, your hearing will improve and your diplacusis will likely fade away.

For some people, being properly fitted with hearing aids helps to reduce their diplacusis. Unfortunately, for others, nothing seems to work. You may be left to cope with your diplacusis as best you can. In any case, the good news is that you now understand what is likely going on with your ears, and that makes it easier to deal with.

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Your AHIP Health & Dental Plan Annual Enhancements

By John Niekraszewicz

Every year on May 1st, Manulife Financial comes out with enhancements for your AHIP Association Health and Dental Plan. For 2013, Manulife Financial has added the Preferred Vision Services (PVS) benefit. PVS is an enhancement in the form of discounts available from a network of preferred providers for vision and hearing products and services. So, next time you get a new pair of eyeglasses or contact lenses from an optician who is a PVS preferred provider, you will be entitled to an additional discount. You can find a list of all preferred vision and hearing providers at www.pvs.ca.

As a way to increase business, AHIP members may want to consider becoming a PVS preferred provider for hearing products and services. At the recent Symposium event, some AHIP members indicated to me that they were losing business from patients who also had the PVS benefit included in their health and dental plans. These AHIP members were interested in becoming a PVS preferred provider, but thought that the larger clinics would just undercut them by offering a better deal. But this is not the case. After reviewing the contract for becoming a preferred partner of PVS, the discount for all PVS preferred providers for hearing instruments is similar. The one clause of the contract that could be a cause for confusion concerns discounts on mail order hearing aid batteries. However, I have been told that if a clinic does not offer this service, then a modification to the contract can be made. This way a level playing field exists for clinics large and small, national and local.

Another way that AHIP members are gaining value from the AHIP Health and Dental Plan is by having employees maximizing the dental benefit. Because most employees are dealing face to face with patients on a daily basis, having clean teeth makes for healthy smiles which in turn leads to patient satisfaction and referrals. This means having teeth cleanings 2, 3, or even 4 times each year.

When you review your AHIP Health and Dental Plan benefits don't confuse the term "recall visit" with "teeth cleaning visit." It seems that the dental profession uses terminology that doesn't make sense to most of us. In this case, the term "recall visit" means an appointment for a patient who is returning for maintenance or follow up care by a

dentist. This means that only your dentist check-ups are covered by "recall visits" but not your teeth cleanings. You can get your teeth cleaned an often as you like and you will be reimbursed by Manulife Financial up to the anniversary year maximum that your AHIP Health and Dental Plan covers.

Health Service Navigator is also included with your AHIP Health and Dental Plan at no extra cost. This unique solution provides integrated health tips and tools, medical condition information, and resources on how to find your way through the Canadian health care system. Upon diagnosis of a serious illness or injury, you can receive an evaluation of your medical records by world-class specialists who confirm the initial diagnosis and recommend appropriate treatment options. This fast, yet in-depth review can reduce potentially serious complications from a misdiagnosis and help your local physician determine the proper course of action.

Providing Health Service Navigator to employees shows that you care. As a business owner it fulfills part of your obligation to take care of employees and can also help reduce costs incurred due to absenteeism. Also, the peace of mind obtained during a time of crisis can be priceless.

For those who like to travel, one prescription that is covered by your AHIP Health and Dental Plan is Twinrix. This is the vaccine designed to protect against hepatitis A and B. After speaking to nurse Sue, I'm glad that my wife and I started our vaccination. Being in the medical profession, nurse Sue told us some scary stories of how hepatitis B can be contracted quite easily without having to travel abroad. One example nurse Sue gave us was how fast food workers, who wear gloves, contaminate food by not disposing of the gloves each time they handle different foods. So, next time you are watching your food being prepared, observe how workers handle, or should I say, mishandle your food. Wearing gloves doesn't make bacteria disappear and eliminate cross-contamination.

Prevention from contracting hepatitis is smart from a health and financial standpoint. If you have a history of contracting hepatitis, your chances of qualifying for both critical illness and life insurance go down. And even if you do get accepted, your policy could be "rated." For example, a rating of 50% means you would have to pay 50% more than you would if your policy was normal and not rated. Your AHIP Health and Dental Plan intentionally does not include critical illness or life insurance. In addition to keeping the costs down and making your AHIP Health and Dental Plan premiums tax deductible for business owners, obtaining proper medically underwritten critical illness and life insurance should be done personally on an individual basis (see the Signal edition 96 article "Good and Bad Insurance").

As you can see, offering the AHIP Health and Dental Plan to your employees can be good for your business. Not only can it help improve business productivity, but many employees also believe that a health benefits plan is more satisfying than receiving a higher salary.

John Niekraszewicz (Nick-ra-shev-itch) BMath, FCSI, CFP, FMA is the Certified Financial Planner responsible for the AHIP Health & Dental Benefits Plan provided by JVK Life & Wealth Insurance Group. John is also the Principal of JVK Life & Wealth Advisory Group, a firm providing investment, retirement, tax & estate planning. John welcomes your questions and can be reached at john.niekraszewicz@jvkgroup.com or 1-800-767-5933.

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Classifieds

Hearing Aid Practitioner
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The Stanton Territorial Health Authority (STHA) is a 100 in-patient bed accredited facility in Yellowknife, and is a referral centre for approximately 37,000 regional residents of the Western Arctic and Nunavut (Kitikmeot Region). The STHA provides health care services to adults and children on an inpatient/outpatient and outreach basis in order to restore health with dignity.

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The salary ranges from at $36.82 per hour (approximately $71,799 per annum), plus a northern allowance of $3,450.00.

For more information on health and social services careers and practicing in the Northwest Territories please visit www.practicenorth.ca

A job offer is contingent upon a satisfactory criminal record check. The successful candidate will be required to obtain a medical clearance.
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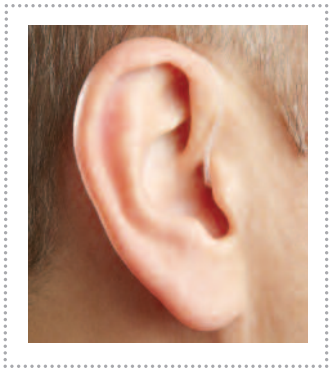
Xino's Multiflex Tinnitus Technology designed it to seamlessly integrate into most tinnitus treatment strategies. Xino Tinnitus provides custom relief to your patient's unique tinnitus experience.



GOOD THINGS COME IN SMALL PACKAGES.

www.starkeycanda.ca

Contact your Starkey Representative for more information.

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www.gnresound.ca/control

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Smart control anywhere
The new ReSound Control™ app turns any smartphone into a remote control. When used with the ReSound Unite™ Phone Clip+, the app gives your customers cutting-edge control of their wireless hearing instruments, phone conversations and streaming accessories – straight from the device they already carry with them.

It's connectivity options like these that take the experience of hearing to a whole new level. Market-leading. Empowering. Hassle-free.

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ReSound Unite™ Phone Clip+ is required for operation.

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