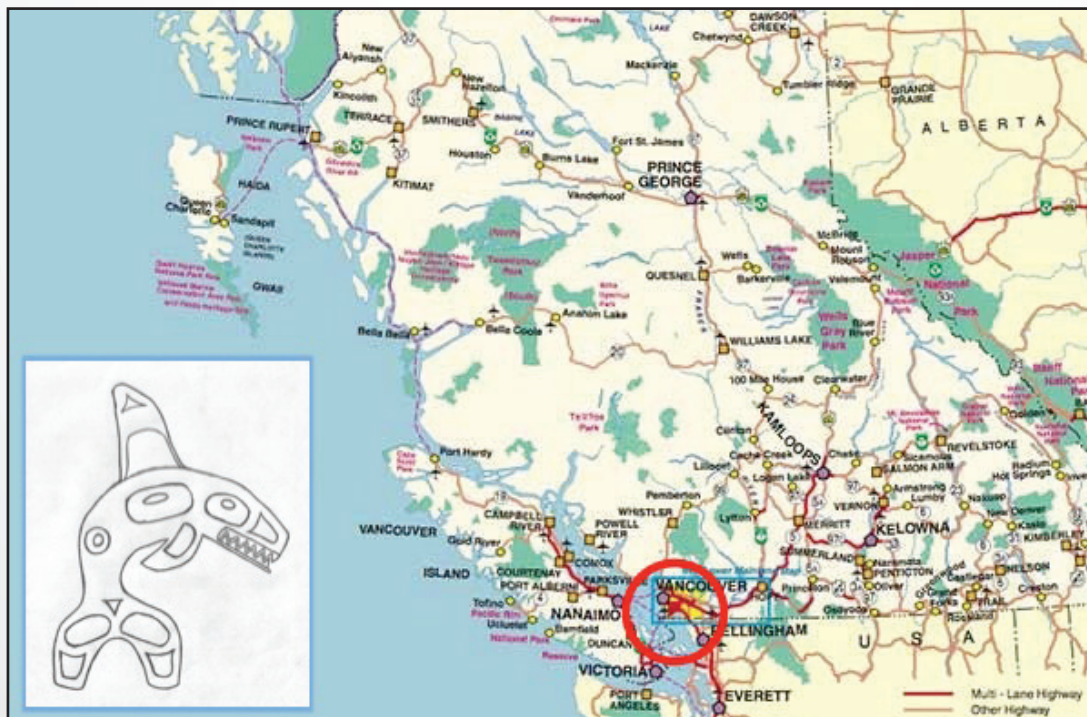


Canadian Hearing Report

Revue canadienne d'audition

VOL. 11 NO. 3 2016



VANCOUVER HOSTS THE WORLD CONGRESS OF AUDIOLOGY

HEAR 4U FOUNDATION

IN CONVERSATION WITH MARKE HAMBLEY

Publications Agreement Number 40025049 | ISSN1718 1860

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Hello again! By the time you are reading this, we have completed about 50 % of our annual tour around the sun since we last met. A half a year?

Yup, this issue is a little larger than usual, as it combines the contents of what would normally be the 3^d and 4th issues of *Canadian Hearing Report*.

As editor, I am pleased to note two letters in response to an interview we had with Abram Bailey AuD, who heads up Hearing Tracker, an online directory of thousands of hearing health care providers. You may recall that interview in the first issue of 2016. One question I had asked him was what he thought of the recent renaissance in North America of loop systems for churches and other public places. Abram replied that compliance with wireless streaming protocols might just trump (ouch!) older T-Coil technology. Now if you dredge your turbulent memories further, you might also conjure up the first issue of 2015, where we focussed on loop systems that work with hearing aids T-Coils. OK, scene being now set with these two bookmarks, we can now introduce two heartfelt letters concerning loop systems and T-Coils. One is from Juliette Sterns AuD, who is a Wisconsin-based audiologist who has been one of the foremost proponents of loop systems. Another is from a hard-of-hearing person himself, one Lee Ramsell, vice president of the Canadian Hard of Hearing Association's Edmonton Branch. All good stuff and good points made all around. I wish we had more letters of discussion like these.

You'll note the BC oriented cover. Well, why not? There's 3 articles in this issue that focus completely on goings on west of the Rockies. One is an in-

depth interview with Marke Hambley, NBC-HIS. I am proud to have known this remarkable person for the past 20 plus years, having first met him when I worked at Unitron in the 1990s. At that time, he was Unitron's biggest Canadian customer. Readers will note no bio or introduction at the beginning of the interview, as the interview itself lays out his truly amazing contributions – so far – to the hearing health care profession. I say "so far" because the guy just doesn't seem to quit. And, to think that it all began as an outreach to remote centres from here in Victoria BC. Planes, trains, and automobiles? Well this one at least does involve planes. Have a read. His story is a true testament to his will and drive to succeed, and should be read by all Canadians in the hearing retail sector!

Another BC-based article is by Paul Mick MD, an Ear, Nose and Throat physician now working in Kelowna BC, who heads up the Hear4U Foundation, a new charity first introduced in the Better Speech & Hearing month of May 2016. As he has an additional Master's degree in Public Health from Harvard, Paul is well equipped to address the problems of accessibility and affordability of hearing health care and hearing aids. It is heartening to hear his concerns and his answer to this very real difficulty to so many Canadians who have low incomes. His well-sourced and cited article highlights the endeavours of the Hear4U Foundation, and I am sure I am not alone in hoping this can serve as an example whose torch can be taken and carried by other provinces!

Then of course, there is the World Congress of Audiology (WCA) to be held in Vancouver BC, on September 18th-21st! Rose Simpson, a veteran writer for Andrew John Publishing contacted Joanne Charlebois, CEO of Speech-Language and Audiology Canada (SAC), for more details of the conference. Both SAC and the Canadian Academy of Audiology are handling

the conference. Her article includes the layout of the conference, the pre-conference workshops, the keynote speakers, roundtable sessions, etc. We'll let Rose tell the story, but the conference looks like a big one, with over 1000 attendees expected.

Our 4th article has absolutely nothing to do with BC per se, but it does discuss an issue that's been brewing and now bubbling over for the past couple of years. That's the topic of untreated hearing loss and cognitive decline in the elderly. Our Public Library of Science article titled "Hearing Loss and Cognition: The Role of Hearing Aids, Social Isolation and Depression," has a bunch of authors (8 to be exact), hailing mostly from the UK but also a few from the USA. They come to the striking conclusion that cognitive improvement with the use of hearing aids was not associated with the reduction of isolation and depression. Rather, they suggest that cognitive improvement resulted from simply increased audibility and increased "self-efficacy." This latter term from the psychologist Albert Bandura, refers to one's inner belief that he/she can indeed accomplish tasks in order to meet goals of interest. In and of itself, this could give rise to optimal cognitive performance.


Now, a word in closing; this is my last issue being editor with *Canadian Hearing Report*. It's been a good and fun 2 year run, but it's now time for me to exit stage left. Thanks to John Birkby, president of Andrew-John Publishing, and to Scott Bryant, managing editor, and to everyone else there who has helped me along the way. It's been a good thick slice!

Cheers! Ted

*Ted Venema, PhD,
Editor-in-Chief*



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1. <http://arthritis.ca/manage-arthritis/ease-of-use-program/home-and-garden-products>



Canadian Hearing Report

Revue canadienne d'audition

Vol. 11 No 3 • 2016

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Canadian Hearing Report is published six times annually by Andrew John Publishing Inc. with offices at 115 King Street West, Dundas, On, Canada L9H 1V1.

We welcome editorial submissions but cannot assume responsibility or commitment for unsolicited material. Any editorial material, including photographs that are accepted from an unsolicited contributor, will become the property of Andrew John Publishing Inc.

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Individual copies may be purchased for a price of \$19.95 Canadian. Bulk orders may be purchased at a discounted price with a minimum order of 25 copies. Please contact Ms. Brenda Robinson at (905) 628-4309 or brobinson@andrewjohnpublishing.com for more information and specific pricing.

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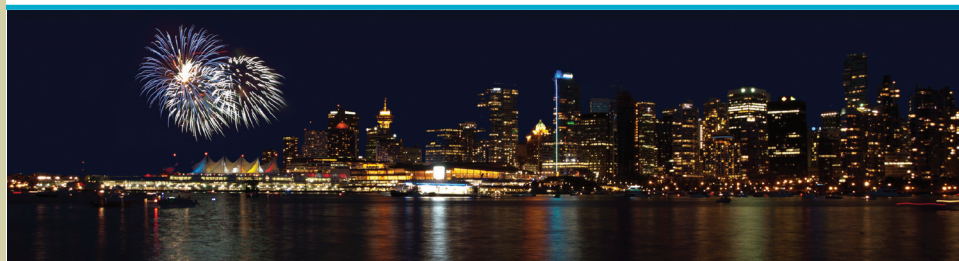
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Publications Agreement Number 40025049 • ISSN 1718 1860

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Andrew John Publishing Inc. 115 King Street West,
Dundas, ON, Canada L9H 1V1



| LETTER TO THE EDITOR

Dear CHR Editor,

I would like to respond to comments made by Dr. Abraham Bailey in a recent *CHR*, on behalf of the Edmonton Branch of CHHA. Full disclosure: I am a hearing aid user, an active CHHA member, a hearing loop advocate, a Western Canadian manufacturer's rep that distributes a variety of electronic products and systems including all types of Assistive Listening Devices (ALD). I provide engineering support for the design of loop systems and provide training to ensure that the proper ALD system is specified and installed correctly.

While it is true that hearing loops very similarly to when they were first engineered in 1936, they are about as antiquated as a bicycle.... except you don't have to peddle. No matter where you travel in the world one can take the bicycle and use it, no matter where you are; the same is true for a person with a tcoil-equipped hearing aid. And loops are simple to use, just a press of a button. In a loop the audio is picked up on base band without the issue of frequency allocations or digital wireless protocols, if a venue is looped, just a press of a button and the user is connected to the system. There are no drop outs, no loss is signal and the hearing aid remains connected until the user selects a different program of the hearing aid.

Try doing that with Bluetooth, an FM system, or tour guide system. Perhaps at some point in time there will be an international standard, perhaps the world will agree to use either 110 volt or 220 volt systems with either 50 Hz or 60 Hz. The world might agree to

use the same standards for frequency allocations of all radio transmissions.... perhaps. Even if that were to happen, that won't occur overnight

As for Dr. Bailey's comment about loops being sensitive to EMI, that is true of all electronic devices and when the IEC60118-4 standard is met, EMI issues are not relevant. A growing number of companies across Western Canada have been trained in the installation of loop systems. They work to ensure that the hearing loops meet the requirements of the IEC60118-4 Induction Loop Standard and they will not install loops in areas where this standard cannot be met.

Hearing care providers will benefit when they educate their clients and help promote universal and easy to use hearing loops. Most users, myself included, know that hearing aids are only effective up to a distance of 1.5 meters and as that distance increases, speech intelligibility reduces exponentially. We really have trouble hearing in airports, train platforms, churches, ticket counters, taxi cabs, or pharmacies, and loops can greatly help there. And they do that with a simple push of a button. That is impressive for an antiquated system. Loops overcome the shortcomings of hearing aids and makes users happier with their devices, I know I am. Hearing loops offer barrier-free hearing similar to what ramps do for people in wheelchairs.

The Edmonton Branch of The Canadian Hard of Hearing Association and been working hard at getting Edmonton looped for the past few years and we are having an impact. Our city libraries are being looped, a number of recreation

and senior run centres are being looped, the Walterdale Theatre is looped, and this summer the Citadel Theatre will have two of their theaters looped. Two local hearing aid centres have installed loop systems (Accent Hearing and the Audiology Clinic of Northern Alberta) for easy demonstrations, and we hope to see many more next year.

We disagree with Dr. Bailey's comment that these loop systems are a little too late, It is never too late to hear! And we believe that if he had to use hearing aids in every day life to communicate he would wholeheartedly agree with us.

While at some point in time hearing loops may go the way of the VCR, that is not just around the corner. And, until the world agrees on a world-wide universal standard for wireless devices, loops are going to be around for some time to come.

Respectfully,
Lee Ramsell, Vice President,
The Canadian Hard of Hearing
Association, Edmonton Branch
leeram@shaw.ca



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Dear Editor of the Canadian Hearing Report,

Kudos for featuring Abram Baily and his Hearing Tracker initiative in the Spring issue of the *Canadian Hearing Report* (2016;11:5–7). I believe that the Hearing Tracker initiative is one that every hearing health care professional should get behind. HearingTracker.com gives consumers a way to find hearing care providers who practice ethically and consistently provide a high standard of holistic care.

Abram Bailey's response to the recent renaissance in North America of (hearing) loop systems ("might be too little too late"), surprised me. I know him to be a well-informed and consumer-oriented audiologist and I hold him in high regard. For those who missed it, Dr. Bailey and I recently sponsored a petition on Change.org entitled Stop the FCC from Removing the Telecoil Compatibility Requirement from HAC Phones. With Dr. Bailey's blessing, I would like to respond to the comments he made about looping technology in *CHR*, which he agrees poorly convey and oversimplify his position on the issue.

While I agree with Dr. Bailey that it would be great if a new wireless streaming "comply with rigorous wireless streaming protocols." The truth is those do not exist at this time.

Hearing aid engineers advise that while a universally compatible Bluetooth-like transmitter system (with one-to-many wide area capability) is technically feasible but not practical in the foreseeable future. The hurdles of frequency spectrum allocation (not all countries have the same frequency authorizations), arriving at a mutually

agreeable technology among the hearing aid and PSAP manufacturers, and the need for people with hearing aids to buy new compatible hearing aids in order to listen, is likely 10–15 years out.

After being questioned, Dr. Bailey agreed with my timeframe estimate, citing a comment made by wireless technology guru Nick Hunn, who is currently working on a Bluetooth solution for wide-area direct audio access. He regrets the damage his comment in *CHR* may have caused in discouraging your readers from advocating for hearing loops or educating their clients on the benefits of telecoils.

Our clients deserve to hear today and tomorrow. Not 10 years from now. If audiologists take this kind of attitude towards hearing loops, it will mean that many people with hearing loss will live their life out without experiencing the incredible benefits hearing loops can offer in houses of worship, meeting rooms, retirement centres, and theaters, the very places where hearing aids are simply unable to deliver. That hearing aids do not deliver in many public situations was demonstrated in a survey published in the *Hearing Review* of 866 people, each of whom rated the performance of their hearing aids or cochlear implants using a 10-point scale. The average response was 4.9 using hearing devices (i.e. a non-looped setting) and a remarkable 8.7 in a looped environment.

In regard to Dr. Bailey's "antiquated telecoil" technology being "subject to interference" comment, Bluetooth is subject to interference as well. The IEC60118-4 induction hearing loop standard addresses the interference issue head-on as loop installers are trained to test for this electromagnetic interference,

which exists in a facility whether or not a hearing loop is installed. And, in order to meet the IEC standard, installers will verify that the magnetic speech signal-to-electromagnetic noise ratio is 37dB or greater. That is a signal to noise ratio we can all dream of for our hearing aid using clients. I have personally listened in hundreds of hearing loops, and love the way they help me, a person with beginning hearing loss at 6 and 8 kHz, hear and can attest that interference is rarely a problem.

For information about IEC 60118-4 see www.univox.eu/p/FSM_Certificate_GbA5V4.pdf

Hearing loop advocates are not for hearing loops per se, they are for a technology that is relatively low cost, worldwide universal, non-proprietary, directly compatible with the majority of hearing aids and PSAPS without a gateway device or remote control, and useful in a variety of large area listening situations. Loop advocates and installers are in effect "paving the way" for a future technology, that will make it easier to convince places that jumped on hearing loop systems, to update their venue with the latest and greatest universal "Green - or Yellowtooth" transmitter technology.

At the moment, BT wireless streaming technology – though useful in many one-on-one situations – is no-where near ready for the large area listening system stage and won't be for years to come. My husband is still waiting for his jetpack.

Juliëtte Sterkens, AuD
Hearing Loss Association of America
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World Congress of Audiology: Canadian Audiologists Welcome the World

By Rose Simpson



From September 18--21, 2006, Canada will play host to the World Congress of Audiology (WCA2016) at the Sheraton Hotel in Vancouver. It is an event that is more than six years in the making and will showcase the work of Canadian audiologists and researchers on the world stage.

The Congress is a joint effort by Canada's two national audiology associations – the Canadian Academy of Audiology (CAA) and Speech-Language and Audiology Canada (SAC). It has been more than 20 years since Canada has been chosen to host the congress.

It will feature more than 130 speakers from around the world and is expected to attract more than 1,000 registrants, 60% of whom will come from Canada's audiology and speech pathology community.

"We have a diverse speaker list and we have built a wide-ranging international program," says Joanne Charlebois, the chief executive officer of SAC. "We wanted to give Canadians the opportunity to hear speakers from around the world but also showcase some of our Canadian experts. I think we've struck a nice balance."

The program sessions will include pre-congress workshops, roundtable plenary sessions, featured concurrent sessions, contributed papers and sponsor symposia. Delegates will also have the opportunity to participate in a diverse scientific program which is designed to provide the latest in innovations and research from leading health-care professionals from around the world. The emphasis will be on relating research evidence to clinical practice.

The congress has also attracted international interest for its trade show which has been sold out for months.

Charlebois says the congress will also provide a unique opportunity for students who have been encouraged to actively participate in the program.

"We are so pleased that there is a very strong student registration," she says. "The universities have been very supportive and they have planned that week especially so students could attend. This is a terrific opportunity for students who are going into the audiology profession to hear from individuals they've been learning about in their classrooms. This year, those experts will be on Canadian soil and it's a chance for students to attend their sessions and interact with them."



Charlebois says the choice of Vancouver as the site for the congress has piqued the interest of international delegates.

"Vancouver is a very attractive location for congress delegates," she says. "We chose it strategically. The Canadian dollar also makes this a very attractive event for international participants in terms of registrations and accommodations."

The congress will have strong Canadian representation with more than 600 audiologists from across the country registered.

"I think this speaks volumes in terms of Canadian audiologists coming together with professionals from around the world."

KEYNOTE SPEAKERS:

The WCA 2016 congress will feature

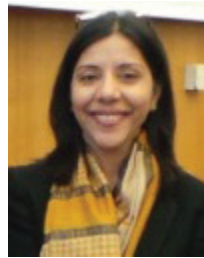


a number of renowned experts from Canada, and around the world. The opening keynote, *Communication in an Aging World:*

Get Ready will be delivered by Yves Joanette, a professor of Cognitive Neurosciences and Aging at the Faculty of Medicine at the Université de Montréal. He is currently the scientific director of the Institute of Aging of the Canadian Institutes of Health Research (CIHR). He is the scientific lead of the CIHR Dementia Research Strategy and also acts as a co-lead of other CIHR initiatives on eHealth and on Healthy and Productive Work.

WHO LECTURE

Dr. Shelly Chadha oversees WHO's



work on prevention of deafness and hearing loss including advocacy for prioritization of hearing care; technical support to countries for

development of hearing care strategies; and development of technical tools and guidance. She will deliver the WHO lecture which will explain the WHO program, discuss WHO initiatives such as World Hearing Day which are designed to arouse public interest in the global movement to make hearing care accessible to all.

GLORIG LECTURE

Professor Harvey Dillon, director of



research at the National Acoustic Laboratories in Sydney, Australia, will deliver the Glorig Lecture on *Listening in Noise*. His lecture will

discuss how binaural beamformer microphones can be used to improve listening in noise for people with sensorineural hearing loss, and how training in spatialized noise can be used to completely overcome the deficits experienced by children with spatial processing disorder. It will also discuss how adaptive speech-in-noise tests can be combined with adaptive tone-in-noise tests, and adaptive speech tests in quiet to remotely and automatically not only detect hearing problems, but also determine whether the problems arise from sensorineural loss, conductive loss, or auditory processing disorders/language disorders, even in children as young as four.

PRE-CONGRESS WORKSHOPS

The congress will kickoff with six workshops designed to appeal to a wide variety of interests. Prior to the full congress, registered delegates can also participate in two satellite workshops conducted by the University of British Columbia's School of Audiology and Speech Sciences on their campus.

Wideband Tympanometry: The first will discuss Wideband Tympanometry which is gaining popularity around the world. The session will cover the general principles of absorbance/reflectance techniques and examine absorbance patterns in normal children and adults with various middle ear pathologies. Participants will have the opportunity to learn proper administration of WAI in real participants using all commercially available wideband acoustic immittance systems in the market.

Electrophysiological Measures of Hearing Thresholds:

This interactive workshop will provide a general introduction to the electrophysiological testing of infant and adult hearing. The workshop will include a demonstration of ABR and other electrophysiological recordings.

The WC 2016 has also scheduled six additional pre-congress workshops that will deal with a wide-range of subject matters including:

- Evidence-based practice in 2016, turning data and information into action;
- What's new in central auditory processing testing techniques and technology;
- Tapping the potential of "hearables;"
- The eligibility criteria for hearing aids and cochlear implants;



WORLD CONGRESS OF AUDIOLOGY: CANADIAN AUDIOLOGISTS WELCOME THE WORLD

- Incorporating screening for cognitive, vision and falls risks into practice; and
- Population and public health approaches to hearing care.

PROGRAM HIGHLIGHTS:

Over the three days, the Congress will feature a series of three roundtable sessions. The topics were chosen by delegates from the 2014 congress in Australia. They follow three general themes:

- **Auditory Neuroscience:** Beyond the ear and the audiogram. Delegates will hear from world experts who will share leading edge developments in the use of brain imaging in the assessment of auditory function; the relationship between imaging and function; and brain imaging advances that may relate to audiology.
- **Advancing Best Practices in Audiology.** The roundtable will provide an overview of the foundation of evidence-based practice along with examples of evidence and its application in a range of audiology contexts.
- **Hearing in the Context of a Global Health Priority.** World experts will discuss the importance of curating the best knowledge, experience and procedures to enable citizens with hearing problems to get the best social and solutions.

Following these sessions, delegates will be asked what themes they would like to explore for the next congress, which will be held in South Africa in 2018.

For more information about the WCA2016 Congress, please visit the website at:

[www. http://www.wca2016.ca](http://www.wca2016.ca).





The Hear 4U Foundation

Dr. Paul Mick



About the Author

Dr. Paul Mick is a neurotologist practicing in Kelowna, B.C. He completed a neurotology/skull base surgery fellowship at Sunnybrook Health Sciences Centre at the University of Toronto, an otolaryngology residency at the University of British Columbia and a Masters degree in public health at Harvard. His epidemiology research program focuses on identifying and preventing the health impacts of age-related hearing loss in older adults, and his work is published in many peer reviewed journals. Paul is a researcher with the Canadian Consortium of Neurodegeneration in Aging and has received awards for research and teaching. In his spare time he enjoys hanging out with his family, friends and dog in the great outdoors.

Unfortunately, access to hearing aids depends on income. Even the most basic single hearing aid costs hundreds of dollars, excluding batteries, and must be replaced approximately every 5 years. Across Canada, government subsidies are inconsistent. For example, Albertans under the age of 18 or over the age of 65 receive up to \$945.00 for 1 aid every 5 years, whereas in British Columbia universal coverage is only offered to children under the age of 5.

As a consequence, some people avoid hearing aids altogether. In a population-based survey of 2169 Americans who had hearing loss but did not use hearing aids, 76% of respondents described financial constraints as a barrier to hearing aid adoption. 64% could not afford hearing aids, 52% said they were too expensive to maintain, and 45% said they were not worth the expense (participants were allowed to choose multiple responses).¹ Unsurprisingly,

the median income of respondents who stated they couldn't afford hearing aids was lower than those who could. In the 55-64 year old age group, the median household income of those who could afford hearing aids was CAD\$89,501, while the median household income of those who could not was CAD\$38,600. Compounding the problem is the fact that hearing loss is more prevalent among low socio-economic groups. Lin et al., in a population-based study of American adults 70 years and older, demonstrated that hearing aid use among people with at least a moderate hearing loss (≥ 40 dB HL 0.5, 1, 2 and 4 kHz pure tone average in the better hearing ear) was only 40% and that low socio-economic status was a significant predictor of low hearing aid use.²

Systematic reviews of large numbers of studies show that hearing aids result in medium to large improvements in hearing-related quality of life and

significantly reduce the psychological, social and emotional effects of hearing loss.³ It is widely recognized that depriving people of hearing health care (i.e., diagnosis and evaluation, hearing aids, other assistive devices and auditory rehabilitation) may dramatically impair their ability to communicate, quality of life and health. Ensuring the accessibility and affordability of hearing health care services, however, has not been prioritized by health care policy makers.

Fortunately, there is some evidence that priorities are changing. Recently, the (U.S.) National Academy of Medicine convened a committee that published recommendations to improve the accessibility and affordability of hearing health care.⁴ Among other suggestions, the group recommended public health programs to improve access for underserved and vulnerable populations, implementation of innovative models of hearing health care, and increase

awareness of how to receive hearing services and financial support if needed. This work underscores efforts to shift the perception of age-related hearing loss from a lifestyle issue to a public health problem requiring community-based and health policy solutions as well as innovations in treatment that are delivered at the individual level.

The Hear4U Foundation is a recently established independent charity that aims to address the problem of hearing aid affordability and increase access to hearing aids among low income British Columbians. Our foundation has organized a hearing aid recycling program that provides refurbished hearing aids at little or no cost. The Hear4U program consists of a network of volunteer audiologists and hearing instrument providers from 53 clinics across British Columbia. Members of the public who want to donate their old devices can drop them off in Hear4U donation boxes located in the participating clinics. Only functioning behind the ear or receiver in the canal devices are accepted since they can be inexpensively adapted to new users, and other devices are discarded. After the devices are dropped into donation boxes, the volunteer clinicians test them for functionality, clean them, replace the domes and receivers with new ones, and store them in their clinic. Clients who are interested in receiving

a refurbished aid will call the office to arrange an appointment. Clinicians may ask them to review a list of responses to frequently asked questions about the benefits and limitations of the program. They are then assessed as per standard of care practices and offered a hearing aid if an appropriate device is available in the clinic. Each volunteer clinician has agreed to assess at least one Hear4U client per month, which equates to over 600 devices exchanged per year across the province.

Our organization also publicizes information about public and private financial assistance programs for brand new hearing aids. For example, the B.C. provincial government, in partnership with the Neil Squires Foundation, is offering one-time subsidies for hearing aids for individuals who work or volunteer via the “Technology at Work” program. Most consumers, however, are unaware of this opportunity. Information about qualification criteria, and how to access the program (and others) are listed on our website (<http://www.hear4u.ca/recipient/resources/>). People who are interested in a refurbished aid are instructed to review the list of subsidies beforehand to ensure that they do not miss the opportunity to receive a brand new device.

Hear4U is a new charity, unveiled in May 2016 during Better Hearing and

Speech Month, and has been well-received among our volunteer clinicians and the public. Many donations of high-quality used aids have already been received from people upgrading to new devices, or from children of recently-deceased parents who were hearing aid wearers. We hope that the program will be popular, sustainable and allow everyone with hearing loss to access sound and communication, regardless of income.

Anyone interested in finding out more about the Hear4U program, such as where to drop off donated hearing aids, which types of devices we are looking for, or how to receive a refurbished aid, should visit our website at hear4u.ca.

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In Conversation with MARKE HAMBLEY

By Ted Venema, PhD

Ted Venema (TV): You've had a long and rather interesting history in the hearing aid retail sector! I first met you in the mid-1990s when you were CEO of Island Acoustics. At that time I was working for Unitron and you were Unitron's biggest Canadian customer. Periodically, you'd invite me to come out West and speak to your audiologists and HIPs. This interview however, is about you, the man named Marke Hambley. You've been a huge influence upon the Canadian hearing health care scene. As such, I think it would be great for our readers to hear some of the milestones of the path you have taken over the years.

So Marke, you've told me bits and pieces of your story while crossing Georgia Strait on the ferry between Victoria and Vancouver...I recall it involves planes, trains, and automobiles. How did it all begin? You weren't always in the hearing aid sector, right?

Marke Hambley (MH): No, I was not Ted. As a matter of fact, when I was first introduced to this profession, I was residing in Prince Rupert in northern BC. I was an optician, managing about four optical outlets, in Prince Rupert, Kitimat, Terrace, and we also used to travel to Smithers and the Queen Charlotte Islands. While there, I met an otologist by the name of Dr. Malcolm

Graham, who was an eminent otologist out of Victoria. About two years later, after I met him, he was invited to become one of the surgeons in the House clinic, which as you know, was sort of the "Mecca" of ear surgery for otology. He'd come up to Prince Rupert on a quarterly basis and he'd see patients.

As he didn't have anyone to refer those patients with a hearing loss to, he asked me if I'd be interested in caring for their needs. I agreed to take on this new profession, and soon moved to Victoria – returned to BCIT and completed the required course. The class was certified by the provincial government, at that time which was Social Credit.

Once I gained the necessary experience, I must say that I enjoyed the profession immensely! You see there's a difference between the optical and hearing instrument practitioner profession. In the optical field, one typically sees a client for approximately 15 minutes to pick out a frame. You then take the client's prescription, grind the lenses, fit the frame to the client. Then after ensuring the prescription is accurate, they leave. So the whole process with the client might take 30 to 45 minutes. Whereas, with the hearing aid client, a hearing professional can easily invest up to five hours of time. In that additional time with my clients I noticed that I started to really enjoy the relationships that I forged with them, and the

generation – or demographic I was serving was so much more appreciative. At that time, 1969 through 1970, we were fitting mostly body aids and some BTEs.

Looking back, I really have to give credit to Dr. Malcom Graham for prompting me to consider a career in hearing care. I was in Prince Rupert for a short period of time when Dr. Graham introduced me into the profession. I loved it, but was then invited down to Victoria to join a hearing instrument practitioner (HIP) by the name of Ken MacLaren. Ken had a practice in Victoria, and worked with Dr. Graham. Soon after, I moved my whole family down to Victoria and worked with Ken for close to a year.

TV: Now you've mentioned to me that you were a pilot, that you had a Cessna, and that you flew around to Powell River etc., around to some of the more remote communities. Is that while you were working with Graham?

MH: No, that came after; I was seeing clients he referred up in Prince Rupert. As mentioned, I later decided to move down to Victoria, joined Ken MacLaren in his practice, and was with him for about a year. Now Ken and I didn't quite see eye to eye on a few things, because I had agreed to join him if he would make me a partner after a year. He taught me a lot, and I owe a much to Ken for that,



but when it came down to keeping his word about partnership, he declined. So, in frustration I left, and I purchased a practice from a gentleman who was retiring. His name was Humphrey Golby. He was also known as Mr Swiftsure, the guy who'd do the cover commentary on the Swiftsure races at that time (*Editor's note: Swiftsure was an international Yachting Race; for more details, refer to the 1980 publication of Swiftsure: The First Fifty Years, by Humphrey Golby and Shirley Hewett*). Among other interests he had a hearing aid practice. Since he was anxious to retire I was able to buy his practice for \$1500 - can you believe it!?

I soon partnered with another colleague of Ken MacLaren's by the name of Bill Findlay. Bill and I started a company called *Hambley & Findlay*, which was my first entry into this profession, and we started to grow our small practice. At the time, I was working with an ENT surgeon named Dr. Ben Page, and he and I would go out to Duncan on a one day per week basis. I'd do his audiometry and he'd refer his patients to me, both in Victoria and Duncan. As a result the practice grew!

Also my sphere of influence grew. I was working very closely with the medical profession; specifically, a number of Ear, Nose, Throat surgeons. One of the people I really enjoyed, who was teaching the BCIT hearing instrument practitioner's course, was an ENT surgeon by the name of Dr. Irwin Stewart. Dr Stewart. We did a lot of work together at that time, dealing with the Ministry of Health in attempting to move the B.C. Government out of the business of dispensing hearing aids.

During that time with Dr Stewart, we came to know each other well. He invited me to open a satellite clinic in the Gibson's and Sechelt medical clinic he visited monthly from Vancouver. I was based in Victoria and was mainly serving the island at the time. I would go as far north as Campbell River, but I wasn't going off-island at that time. Well, Irwin called me one day, and said; "Marke, I'm going out to Gibsons, I've have no one there to refer patients to, would you be interested in serving that community?" After a short internal deliberation I heartily accepted - as I have always been interested in expanding my practice. However, in order to travel there each week, I had to wake up at 4:30 AM, travel

from Victoria to Nanaimo to catch the 7:00 AM ferry from Nanaimo to Horseshoe Bay in West Vancouver. Then I would hop on a 9:15 AM ferry from Horseshoe Bay to Langdale. Finally I would end up in Gibson's at 10:30 AM. That's when I saw my first client, and continued to see clients until 6 PM. Then the trek started again with a rushed trip to the Langdale ferry terminal to catch the 6:30 PM ferry to Horseshoe Bay - travel across Vancouver to catch the 9 PM ferry from Tsawwassen to south Vancouver Island, and finally arrived home at 11 PM. After a short while of follow this exhausting schedule, I thought, "My Goodness! There's got to be a better way to make a living!"

So to get back to your question about my pilot's licence; I'd always wanted to fly, and realized that if I could just skip the ferries and fly over to Gibson's, I could save myself an enormous amount of travel time. So, I worked to acquire my pilot's license, and purchased a little Cessna 172. Now it would only take me about 40 minutes to fly over to Gibson's from Victoria. I just loved it! It wasn't long before I obtained my instrument rating, purchase a faster Beechcraft Bonanza retractable gear



Marke Hambley (right) and otolaryngologist Dr. Michael Legge, his wife Joyce, and his mother. Marke took them on a flight over Georgia Strait. The plane is a Beechcraft Bonanza, Marke's second airplane.



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airplane that cut my travel time to Gibsons in half again!

TV: You mentioned this BCIT course. What was that? That's not an HIP course as we know them today, like at Grant MacEwan etc. It's prior to all of those, right? How does that relate to the HIP programs we have today?

Well that's a very interesting question, because when I first entered the profession, there was no licensing. Anyone could be a so-called hearing instrument practitioner. All you had to do is pick up an audiometer, learn how to use it, and begin testing potential clients. Then you're fitting mostly body aids; primarily conductive hearing losses due to failed or declined surgery. At that time, hearing aids had a few trimmers, some of them no trimmers whatsoever. In that era, you just picked the model, with outputs, gain, and frequency response curves that most closely fit the client's hearing loss; there was no compression, only peak clipping.

There was, however, a big push in the profession to get credentialed, and the government of the day at that time was the Social Credit Party. The government was advocating for better consumer protection, and passed legislation to license practitioners. The legislation did not accept grandfathering, so the government created a course in hearing instrument dispensing at the British Columbia Institute of Technology. At that time (around 1973) there were about 3 audiologists in BC, and only one of them was dispensing hearing aids. Dr. Stewart was petitioned to lead the process of creating the hearing aid dispensing curriculum, and eventually taught some of the coursework of

curriculum. Everybody had to take time out of their practice to attend. As I said earlier, if you weren't grandfathered; you had to complete the coursework. The hearing instrument practitioners who wanted to stay practicing did so. We took a week off here and there from our practices to ensure we completed all the coursework, wrote the final exam at the end, and if a passing grade was achieved, the clinician received a license to practice in the Province of BC.

TV: How long of a time did that take? Was it over a year?

MH: I think for most people it took about 6 months, to sacrifice the necessary time off to complete the coursework. That's my recollection... it might not be completely accurate, but it's in that general time period.

TV: Let's go back to when you finished up at BCIT; what happened after that?

MH: Therein lies another interesting part to the story. We completed the course, and concurrently there was a change in government from Social Credit to NDP. And at that time, the then Minister of Health, Dennis Coke, was working with audiologists named John Gilbert (Editor's note: John Gilbert used to head up the Speech & Hearing department at UBC) and David Zink. They had convinced the minister that hearing aid dispensers were all charlatans, and not to recognize our credentials. They then proceeded to set up and dispense hearing aids at our cost through government programs. So there we were, attending our graduation, and the Minister of Health marches out on stage and says, "We are not recognizing

this program and we are going to proceed with dispensing our own hearing aids."

Now, the problem was, the then NDP government did not cancel the hearing aid licensing legislation, because the legislation had been recently passed by the prior government. We had completed our coursework, and were governed and regulated by the *Board of Hearing Aid Dealers & Consultants* created by the previous government in power. As a result, we did receive our licenses to dispense, but we were now competing with our Provincial Government. As provincially licensed hearing instrument practitioners, we had to pay an annual licensing fee to our Provincial regulating body, the *Board of Hearing Aid Dealers and Consultants*, and yet the provincial government was competing with us! To my recollection that went on for approximately 10 years. During that time, our numbers diminished from about 120 down to less than 40. Interestingly enough, the City of Vancouver chose not to participate in the provincial hearing aid dispensing program. The program was limited to primarily rural areas, Victoria, and other cities outside of Vancouver. Finally, after approximately 10 years and waiting lists of up to 2 years for seniors to access, the government hearing aid program which had a history of providing less than adequate services, things turned around! You see, there was another change in government, the Liberal government came into power I believe, and they cancelled the program overnight. Hearing instrument practitioners and dispensing audiologists were now regulated and licensed through the *Board of Hearing Aid Dealers and Consultants* providing consumer protection as the legislation was enacted.



TV: Weird, so very odd. I started an HIP program at Conestoga College, you are a graduate of an HIP training program, how do you feel about ongoing education, these issues about college training programs?

MH: Ted, I actually think it's essential! I believe that ongoing education is critical to one's own professional development, and I certainly felt it was vitally important to my own development. I've always been a strong advocate for continuing development, not just for the profession, but also for support staff as well. For example, John Roberts, who at that time was president of the Alberta Hearing Instrument Practitioners Association, and I as the then president of the Hearing Instrument Specialists Society of BC (HISSBC), worked with an audiologist named Jay McSpaden PhD. He was a great help in founding the Grant MacEwan College (now University) hearing instrument practitioners program in Alberta. John and his team played a much greater part in this accomplishment than we did. Nevertheless, John, Jay, and I worked with Grant MacEwan College for close to 10 years before we finally received curriculum acceptance.

All the curriculum committee members celebrated the victory at Grant MacEwan. While I was mixing and chatting at the event Elizabeth Dawson, the then dean of the college's hearing instrument practitioners program approached me and said "Marke, you've worked so hard to get this program in the college, I really think you should take it." I thought to myself, "Do I really want to go back to school at my age!?" Well, how could I say No? I mean, here I was an advocate for ongoing education,

and thought it's time to walk the talk so I said to Elizabeth, "Yes I will do it." I registered into the program, chipped away at it, and it took me until last year, when I finally graduated! I took it over probably about 10 years to complete it, because I was preoccupied growing Island Hearing.

Another cause for extending the program completion time was my involvement with Rotary. As a past president of my local Rotary Club and district committee member, I registered as a Rotary Volunteer, and co-founded the Rotary Hearing Healthcare project of Zimbabwe, and Uganda, with Dr. Irwin Stewart, an otolaryngologist I mentioned earlier. Irwin was a fellow Rotarian and district governor of an adjacent Rotary district. We both wanted to use our professions to help deaf and hard of hearing children in Africa through Rotary. Subsequently, we completed a needs study, first in Zimbabwe establishing the Rotary Zimbabwe program, and 2 years later the Uganda program. The Uganda program continues on today. The Zimbabwe program has been discontinued because of President Mugabe's oppressive government. However, I am extremely proud of what's been accomplished there. We've helped many hard of hearing children and we continue to so.

Continual education should be critically important to all who practice our profession, because new innovative hearing aid technology is rapidly developing. Instead of a new innovative product being introduced every 5 years when I first started – now it's every 6 months. If you don't keep up with it through continuing education, you'll be

left behind, leaving you unable to serve your clients properly and adequately.

TV: OK, so back to your business – and your days flying Cessna airplanes, your business was growing, because you were now flying to these places in your Cessna, and able to service all these different locales (the southern coast of BC is all islands and inlets), and so then what happened after that? And then how did Island Hearing happen?

MH: Well, I started with a company called *Hambley and Findlay* in 1972, and after 3 years I knew I wanted to expand. So I bought out my partner Bill Findlay (he was close to retirement) and I was about 25 years old at the time. I recall thinking; "I need to expand, and to do it I need to get people with experience." So, I became involved with a couple of audiologists and another technician, and we created a company called *Western Acoustics and Instrumentation* in 1975. I already had the clinic in Victoria, then I opened clinics in Nanaimo, Vancouver, and another in Calgary. Unfortunately, all four partners were inexperienced in corporate growth; quite frankly, it was like the 'blind leading the blind'. I knew how to operate a single clinic, but I did not know how to operate, a clinical operation of that size. After about 3 years, the company was put into receivership, and I had to start over again.

The lesson I learned was that it's difficult to operate a company successfully with inexperienced partners without a strong single leader with a solid track record of success. And, that you can't operate a company by consensus. You really need somebody who's leading the show. So, I purchased the Victoria clinic from



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the receiver and then started *Island Hearing* in 1978, and that was when *Island Hearing* – *Island Acoustics* – as you remember it, was born. It then grew from there. From my previous failure, I realized that I didn't have the business skills and competencies to grow a company into the size that I wanted, so I went back to UBC and started taking various business courses, very specific courses. I wasn't after just a 'degree,' I only wanted the coursework that I could directly apply to growing my practice. I completed courses on Corporate Strategic Planning and Implementation, Incentive Compensation, HR, Accounting, and leadership. I then grew the company from a little clinic in Victoria to 125 clinics across Canada over the next 30 years.

TV: And, you were still called *Island Hearing*?

MH: We went from *Island Acoustics* and rebranded to *Island Hearing*.

TV: How come the change of name? What happened there?

MH: Well, we incorporated as *Island Acoustics and Hearing*. We just thought the name was too long, and consequently not marketable. So we dropped the "acoustics," because we thought people may be confused and think we're a television retailer. We renamed to *Island Hearing*, and that's how it remained, when I eventually sold it to Phonak, back in 2006.

TV: OK, so when did Connect begin being called Connect? Was it already Connect under your jurisdiction or was it Connect only when you sold it?

MH: My last responsibility as president & CEO of *Island Hearing*, was to change the brand. At that time, we had pretty close to 20 different brands across the country. We would acquire a clinic, and we wouldn't want to change the name to *Island Hearing*, because it might have taken some 10–20 years to establish that brand in that community. The clinic name we acquired was a big part of the good will of the purchase, so even though the new acquisition was operated by *Island Hearing*, the corporate entity kept its own name. We soon realized that with up to 20 different brands, the cost of marketing was enormous. We wanted economies of scale, so one of my last responsibilities as the CEO of *Island Hearing* was to find yet another name, a common brand that everybody would use across the country. In the end, the task force I created along with some key executive people, recommended the name "*Connect Hearing*." That brand was already well established in Australia, by Phonak. They had done a fair amount of due diligence in their market research on using that name, and we knew it would be timely and costly to establish our own brand new name. Phonak decided, after our recommendation that they'd adopt the *Connect* brand in Canada, and so it was. Therefore the decision to change the name to *Connect* was made on my departure. The transition happened shortly after I retired.

TV: OK, that's the general story then. Most people would be happy to ride off into the sunset, but not Marke Hambley. What drove you to begin again and anew with NexGen Hearing?

MH: Well, you know, my wife was really a big influencer when it came to

my retirement. Understandably, she wanted to spend more time together, so decided to sell the company. I enjoyed about 2 years of retirement. During those years I travelled a lot, and played a lot of golf. We purchased a large motor home, and travelled throughout North America. We saw a lot of country together. In the end Ted, I got bored to tears. I didn't feel like I had a purpose in life. I think you really have to. Back then I saw so many people who had retired and yet not found another worthwhile pursuit. Soon their health and well-being starts to diminish. Before long, they were gone. And, I felt I just didn't want to go down that path. So I thought well, maybe it's time to look at getting back into the industry. I decided, along with Bob Liew, who had been my VP of Operations with *Island Hearing*, to get back into the industry, and together we purchased *Mainland Hearing*.

TV: Was Mainland Hearing then already existing at that time?

MH: *Mainland Hearing* was a company that was established by an ex-franchisee of mine, Dr. Amir Soltani, an audiologist. He was trying to extricate himself from the new business culture established through *Connect/Sonova*; he didn't like the changes that were occurring, and so he wanted to get out. He successfully negotiated with *Connect Hearing*, and was able to pull himself out of his franchise agreement, hold on to his clinics, and the new name of the company became *Mainland Hearing*. Amir asked me if I wanted to partner with him, so I acquired 50% of *Mainland Hearing*, with the exception of Amir's downtown Vancouver clinic. Bob Liew had always expressed interest





in getting partnering with me, but he was under a non-compete agreement. Once his non-compete was over, I asked Bob if he wanted to join *Mainland Hearing*. He agreed, and he purchased a percentage of it, and then became the Director of Operations, as my replacement. As soon as Bob transitioned into his new position with Mainland, I immediately focused on building a new brand we named; *NexGen Hearing*. In about 2 and a half years, we opened up 14 clinics, which was an enormous undertaking. Soon we recognized the need to align ourselves with an Ad agency (*ImageSource Advertising Group*) and after 3 years, the *Mainland* brand together with *NexGen Hearing*, we've grown to over 40 clinics throughout BC including satellite offices. We've recently amalgamated the two brands into one strong brand; *NexGen Hearing*.

TV: And, just for the reader's clarification, the Mainland clinics are all over the lower mainland, and the NexGen clinics are in the interior, as well as on the island.

MH: As of April 1st, the *Mainland Hearing* clinics have changed their name to *NexGen Hearing*, and now operate under that brand. This allows *Mainland Hearing* clients to obtain service and have their warranties honoured at any *NexGen Hearing* clinic and vis versa – province wide.

TV: What is your business model for NexGen, or how do you consider yourselves to be unique? I mean, how do you not want to be known as an “also ran?”

MH: I recognize that I have been quite successful, but I also know that you

get your success through your people. When I left *Island Hearing*, I was able to negotiate a fairly large earn-out for my executive team, but I wanted to give a number of clinicians who so desired and approached me, a chance to get into practice on their own. Many wanted to, but simply didn't have the financial wherewithal to do so, or didn't have the experience. Or were reluctant to take the risk because of the enormous amount of business knowledge that's required in areas of marketing, human resources, accounting, IT, all the support services that are essential to operate a clinic successfully.

When you don't have those skills and competencies, it's difficult to focus on building your practice and compete successfully with the larger clinic chains. So, a new business model would have to mitigate those risks, and have a high probability of success. One of the reasons I came back was to assist others to be more successful or at least to have that chance. Our business model is based on a 50/50 partnership, so that neither partner has control of the business. To be successful, this business model requires both partners to work in collaboration and cooperation working together in order to create a successful outcome. With a 50/50 model, the clinicians focus on what they do best, serving clients, and exceeding their expectations, and we focus on providing the infrastructure, getting the marketing in place, building the brand, making sure they have the support services like HR, accounting, IT in place, etc. This *NexGen Hearing* business model has been in operation for close to 4 years now and achieved unprecedented growth and success in the industry.

TV: Well, it's a very competitive world out there today. Do you think it's harder to get started today compared to 30–40 years ago when you got started? It was a different playing field then, right?

MH: It was, but you know, there's still plenty of opportunity in this profession. There is a fair amount of reluctance by hearing health care professionals to start their own practice, because competition is more challenging and a bit frightening for most hearing clinicians. The *NexGen Hearing* business model mitigates those risks, and offers a much higher level of success.

TV: As I've heard you say before, “If it was easy, everyone would be doing it!”

MH: Yes, exactly! And I think one of the most important values or benefits of having the 50/50 type of relationship is that you have the clinician as a stakeholder in the business. So, one of the things that allows you to accelerate the growth of your business is to obtain experienced health care professionals with solid track records of success into partnership with you. They hit the ground running. They grow their practice quickly, because they are not having to focus on all the other ancillary business items that are required to run a retail hearing aid dispensary successfully. That's my job. Under this new business model they can focus on what they do best.

TV: How does NexGen Hearing stand out from its competition? How do you distinguish yourselves from the competition?



MH: That's important, because I think if you're going to have a successful brand, you somehow have to distinguish yourself in consumers eyes to ensure that you differentiate your brand. There must be a difference between choosing your practice and choosing a competitor. Every day you have to answer this question, "Why would they choose me over somebody else?" Initially we came out with a very strong value proposition or consumer offering, which has been key to our success. We offer clients a 90-day trial period, with no money down for the first 21 days, where they are able try our hearing aids without any financial obligation whatsoever. Then at the end of the 21 days, if they are happy, they may purchase the hearing aids, and still have another 69 days to try them before returning them for a full refund if not fully satisfied. We also offer up to 5 year warranty, 3 years loss and damage, up to 5 years of free batteries, and free in office serving for the life of the hearing aids. Also, we have had very strong relationships with the medical profession over the years. I always thought that was key. It took me years to build those relationships. Many of our competitors focus a lot of their attention on the retail sector, on building their clientele via advertising and promotions. When I came back into the industry, those physician relationships were still there. The doctors had a great deal of trust, faith and confidence in me, personally, and so as a result I was able to restart that whole referral program. That's been a huge part of our success; the relationship with ENT and family doctors.

TV: That's a really good point you bring up, about the relationships with family doctors. I too see that as a real critical link that some are not using

or mining, and I think we ignore that at our peril.

MH: In my experience, most clinicians are somewhat intimidated by having to go into a physician's office to differentiate themselves to physicians, and try to convince them to refer. Because it's so confronting, most of them decide not to do it. If they do it, it's infrequent. If you get a lot of "No's," it tends to reduce your motivation, and you just stop making the needed effort after a while.

TV: I noticed on your website you have a Physicians Page

MH: Yes we do. Physicians are a big part of the hearing health care team. Physicians, audiologists, and hearing aid practitioners, in my opinion should operate as a collaborative team to provide coordinated care to patients with hearing loss. One of the nice things about our group is that you see physicians, audiologists and hearing instrument practitioners working hand in hand as colleagues, sharing best practices, sharing cases, difficult cases, and looking at assisting one another, being committed to each other, and learning tremendously from each other.

TV: Do you have any personal beliefs, attitudes that you'd like to convey to those who aspire to be successful in the hearing aid retail sector?

MH: Yes, I've done a lot of reading, I love reading business books, and Jim Collins is one of my favourites; he wrote *From Good to Great* and *Built to Last*. Another great author is Ken Blanchard who some wonderful books on service leadership out there. One I

would highly recommend is *Leading at a Higher Level*. I believe very strongly in service. I have never been financially motivated, I've always been very service oriented; I feel passionate about – and I think really the people that operate in our group feel the same – providing exceptional client care. I firmly believe that prosperity is a natural outcome of providing exceptional quality care. Focus on the delivery of exceptional care and prosperity naturally follows.

Now that doesn't negate the importance of collecting statistics and financial data. That essential data is historical, and it tells you how well you're delivering care. However, you never want to be driven by the fact a hard of hearing person walking in your office door = 2 hearing aid units because they have 2 ears. Why? Because you don't see your client as an individual; you see them as 2 hearing aids units. You're then driven by the sale of a pair of hearing aids instead of trying to provide exceptional care and improved lifestyle for your customer while striving to exceed their expectations. I believe our passion to deliver exceptional care is the most important value that we operate from in the *NexGen Hearing Group*. After all as the name implies, as a team we strive to provide the *Next Generation of Hearing Care!*

TV: You hired me to work with you some 2 years ago; what were you thinking?

MH: Ha ha ha!, well Ted, we'll leave it at that!" You are an amazing educator and we are most fortunate to have you providing consulting service to our group.



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Hearing Loss and Cognition: The Role of Hearing Aids, Social Isolation and Depression

By Piers Dawes^{1*}, Richard Emsley², Karen J. Cruickshanks³, David R. Moore^{4,5,6}, Heather Fortnum^{5,7}, Mark Edmondson-Jones^{5,7}, Abby McCormack^{5,6,7}, Kevin J. Munro^{1,8}

ABSTRACT

Hearing loss is associated with poor cognitive performance and incident dementia and may contribute to cognitive decline. Treating hearing loss with hearing aids may ameliorate cognitive decline. The purpose of this study was to test whether use of hearing aids was associated with better cognitive performance, and if this relationship was mediated via social isolation and/or depression. Structural equation modelling of associations between hearing loss, cognitive performance, social isolation, depression and hearing aid use was carried out with a subsample of the UK Biobank data set (n = 164,770) of UK adults aged 40 to 69 years who completed a hearing test. Age, sex, general health and socioeconomic status were controlled for as potential confounders. Hearing aid use was associated with better cognition, independently of social isolation and depression. This finding was consistent with the hypothesis that hearing aids may improve cognitive performance, although if hearing aids do have a positive effect on cognition it is not likely to be via reduction of the adverse effects of hearing loss on social isolation or depression. We suggest that any positive effects of hearing aid use on cognition may be via improvement in audibility or associated increases in self-efficacy. Alternatively, positive associations between hearing aid use and cognition may be accounted for by more cognitively able people seeking and using hearing aids. Further research is required to determine the direction of association, if there is any direct causal relationship between hearing aid use and better cognition, and whether hearing aid use results in reduction in rates of cognitive decline measured longitudinally.

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INTRODUCTION

The prevalence of dementia in those aged over 60 years is between 5–7%, with the numbers of those affected globally forecast to double every 20 years between 2010 and 2050 [1]. Cognitive decline and dementia have a profound impact on the individual, on caregivers and society, and the financial costs of cognitive decline and dementia are a major source of concern [2]. However, there is some cause for optimism in the form of potentially modifiable risk and protective factors, including cardiovascular health, psychological and emotional health, cognitive and physical activity, smoking and diet [3,4], and these may offer avenues for prevention. In this study we suggest that remediation and/or prevention of hearing loss may offer an additional avenue for prevention.

Hearing loss is common in older adults [5] and is associated with cognitive decline and incident dementia [6–11]. There are two main explanatory hypotheses for this association. The first is that the association between cognitive and hearing variables reflects a ‘common cause’, namely age-related changes in the nervous system. In this model, hearing loss and cognitive decline share common, age-related neurodegenerative mechanisms [8,11]. The second is the ‘cascade’ hypothesis, where long-term deprivation of auditory input may impact on cognition either directly, through impoverished input, or via effects of hearing loss on social isolation and depression [6,12,13]. Hearing loss is independently associated with social isolation and depression [14,15], and social isolation and depression are associated with cognitive decline [3,16,17]. One further possibility is that hearing impairment results in increased

compensatory mental effort to perform cognitive tasks (such as remembering sequences of spoken digits [18]). This compensatory effort may use up limited cognitive resources resulting in an apparent decrement in cognition (the ‘cognitive load’ hypothesis [11]). However, this hypothesis seems unlikely to fully account for the association between hearing and cognitive performance given that the association between hearing and cognition remains similar whether cognition is tested with visual or auditory stimuli [10].

There is evidence that intervention in the form of hearing aids may improve quality of life and increase social engagement [19] and inconsistent evidence that hearing aid use may have a positive impact on performance of cognitive measures over a few weeks or months [20]. Some of the cognitive measures in these previous studies were auditory-based, so improvements may be due to improved audibility. In terms of longer-term outcomes of hearing aid use on cognition, Valentijn and colleagues [21] found no impact of sensory intervention (cataract surgery; $n = 22$ or hearing aids; $n = 7$) on cognitive measures 6 years after baseline. There is currently little evidence that hearing aids have a long term protective effect against cognitive decline.

The aim of this study was to model statistical associations between hearing impairment and cognitive performance in a large and inclusive data set. A positive association between hearing ability and cognitive performance could be consistent with both the cascade and common cause hypotheses. However, if auditory deprivation contributes to cognitive decline, as suggested by the cascade hypothesis, use of hearing

aids should be associated with better cognitive performance. The mediating role of social isolation and/or depression was also investigated.

METHODS

UK BIOBANK SAMPLE

UK Biobank was established for prospective investigations of the genetic, environment and lifestyle causes of diseases of middle and older age [22]. Ethical approval was obtained from the National Health Service North West Multi-centre Research Ethics Committee. More than 500,000 UK adults were tested between 2006–2010. Recruitment was via the UK National Hearing Loss and Cognition and analysis, decision to publish, or preparation of the manuscript. Participants attended an assessment centre and gave informed consent. They completed a two hour test session that included a computerised assessment of lifestyle, environment and medical history, cognitive capacity and hearing. Information on the procedure and the additional data collected can be found elsewhere (<http://www.ukbiobank.ac.uk/>). All data were anonymized and de-identified prior to analysis. As UK Biobank data collection proceeded, additional measures were included for a subset of participants. Participants in the present study were a subset of 164,770 who were asked to complete a hearing test (the Digit Triplet Test).

DEMOGRAPHIC DATA

Sex, ethnicity data (based on 2001 UK Census categories) and Townsend deprivation score (based on the area of residence) were collected for each participant. Townsend deprivation scores are widely used in health studies as a proxy for socioeconomic



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status [23]. Lower Townsend scores represent areas associated with less deprived (i.e. more affluent) socioeconomic status. Participants were asked to rate their health with two self-report questions “In general how would you rate your overall health?” (excellent/good/fair/poor/do not know/prefer not to answer) and “Do you have any long-standing illness, disability or infirmity?” (yes/no/do not know/prefer not to answer).

DIGIT TRIPLET TEST

The Digit Triplet Test (DTT) is a speech-in-noise test originally developed in Dutch for reliable large scale hearing screening, and which correlates highly ($r = 0.77$) with audiometric thresholds [24,25]. The English version of the DTT used in the UK Biobank was developed at the University of Southampton [26] (for a demonstration, see <http://www.actiononhearingloss.org.uk/your-hearing/look-after-your-hearing/check-your-hearing/take-the-check.aspx>). The DTT procedure is described elsewhere (<http://biobank.cts.uox.ac.uk/crystal/label.cgi?id=100049>). Briefly, the signal to noise ratio (SNR), reported in decibels, for the 50% correct speech recognition threshold was estimated for each ear. The level of hearing loss was based on better ear performance. Hearing aid users performed the DTT without hearing aids.

COGNITIVE TESTS

Cognitive tests were completed via a computerised touch screen interface. Further information is reported elsewhere (<http://biobank.cts.uox.ac.uk/crystal/label.cgi?id=100026>). Hearing loss would not be expected to contribute to performance on these visually presented tests. The background

and rationale for the cognitive tests is reported by UK Biobank elsewhere (<http://www.ukbiobank.ac.uk/wp-content/uploads/2011/11/UK-Biobank-Protocol.pdf?phpMyAdmin=trmKQlYdjnQIgj%2CfAzikMhEnx6>).

Reaction time. This test was based on the card game ‘Snap’. Participants were shown two cards at a time, with 12 pairs of cards overall. If both cards display a matching symbol, participants pressed a response button with their dominant hand as quickly as possible. The outcome measure was the average time to correctly respond to a matching pair.

Pairs matching. Participants were asked to memorise the location of as many matching pairs of cards as possible. Cards were then turned face down, and the participant was asked to match as many pairs as possible with the fewest attempts. This test was presented in two rounds. The first round contained one set of cards in a 2x3 matrix with 3 matching pairs, the second round contained two sets of cards in a 3x4 matrix with 6 matching pairs. The outcome measure was the number of incorrect matches across all three sets.

Fluid intelligence. Fluid intelligence (the capacity for logical thought and problem solving, independent of acquired knowledge) was based on multiple choice responses to 13 questions such as “Bud is to Flower as Child is to?” Participants had 2 minutes to complete as many questions as possible. Questions that were not completed within the time limit were scored as zero. The outcome measure was the sum of the number of correct answers.

HEARING AID USE, SOCIAL ISOLATION AND DEPRESSION

Hearing aid use was assessed via response to the question “Do you use a hearing aid most of the time?” Social isolation was assessed via response to the question “Do you often feel lonely?” Participants had the response options Yes/No/Do not know/Prefer not to answer. Depression was measured via response to the screening question; “Over the past two weeks, how often have you felt down, depressed or hopeless?” [27]. Participants had the response options Not at all/Several days/More than half the days/Nearly every day/Do not know/Prefer not to answer. Responses between ‘not at all’ and ‘nearly every day’ were scored from 1 to 4.

DATA ANALYSIS

Structural equation modelling [28] was used to test whether the association between hearing impairment and cognition may be mediated by hearing aid use, social isolation and/or depression in a sequence of four models, described in the Results. Structural equation modelling allows statistical evaluation of inter-relationships (pathways) between hearing impairment, cognition, hearing aid use, social isolation and depression while simultaneously controlling for the potential confounders of age, sex, general health and socioeconomic status. Structural equation modelling is a regression-based technique that requires data to be distributed along the range of variables (e.g. both hearing aid use and non-use, good to poor hearing). We considered mediation to be present when both the pathways constituting the indirect effect are statistically significant, and that this is partial mediation if the direct effect is also significant.

Cognition was measured by a standardised latent factor (mean 0, variance 1) in the structural equation model which was derived from a measurement model with observed indicators of the reaction time, pairs matching and fluid IQ tests. The covariates age, sex, general health (overall health rating and long-standing illness, disability or infirmity) and socioeconomic status (Townsend index) were included as predictors for each outcome variable in the overall structural equation model. Modelling was carried out using robust weighted least squares (WLSMV) in the Mplus program version 7.11 (www.statmodel.com/). Fit statistics and standardised coefficients were reported for each model. The Mplus estimates for paths from predictors to an observed categorical dependent variable (such as HA use and social isolation) are probit regression coefficients. A positive sign means that the probability of the categorical dependent variable (e.g. the category 1 for a 0/1 variable) is increased when the predictor value increases. A larger magnitude means that this probability is higher. For the standardised latent cognition variable a higher score implies worse cognition due to the direction of the factor

loadings. The depression variable with four response levels was treated as a continuous variable. Estimates for paths from predictors to these dependent variables can be interpreted as in a standard linear regression.

RESULTS

Table 1 contains the sex, ethnicity and Townsend deprivation score for the subset included in the present study compared to the corresponding section of the UK population aged 40 to 69 years. The study sample contains a slightly higher proportion of females and people living in more affluent areas than in the general population. The proportion of White ethnicity is similar to that in the general population.

In Model 1, after controlling for age, sex, SES, and general health, poorer hearing remained significantly associated with poorer cognition (Fig. 1). However, despite each predictor being statistically significant, the model fit statistics indicated that the model was not satisfactory in explaining variation in cognition. In Model 2, for equivalent levels of hearing loss, hearing aid use was associated with better cognitive performance, supporting the cascade hypothesis.

The effect of hearing loss on cognition remained significant, implying that the effect of hearing loss on cognition is only partly mediated through hearing aid use. Social isolation was associated with both poorer cognition and poorer hearing (Model 3), but hearing aid use was weakly associated with more social isolation. The effect of hearing aid use on cognition is partly mediated through social isolation, but there remains a significant direct effect. In Model 4, social isolation and poor hearing were significantly associated with higher frequency of depression. Frequency of depression and social isolation were associated with poorer cognition. Hearing aid use was not associated with depression, but was associated with greater social isolation and with better cognition. With the exception of the Tucker Lewis Index (TLI), fit statistics indicated that models 2–4 were a good fit with the data. As a sensitivity analysis and to provide a check of the robustness of the models, models 3 and 4 were re-run with alternative measures of depressive symptoms (frequency of unenthusiasm/disinterest) and social isolation (number of social/leisure activities). Use of alternative measures did not change the substantive results in either model (data not reported here).

Table 1. Participants in the study sample versus 2001 UK Census data for sex, ethnicity and socio-economic status.

		UK Biobank	UK Census 2001
Sex	Male	45.5%	49.2%
Ethnicity	White	91.5%	91.3%
Socioeconomic status	Mean Townsend score* (SD)	-1.1 (2.9)	

*Lower Townsend scores indicate less deprivation.

Sex and ethnicity are shown as percentages while socio-economic status is reported as average Townsend deprivation index score (with standard deviation).

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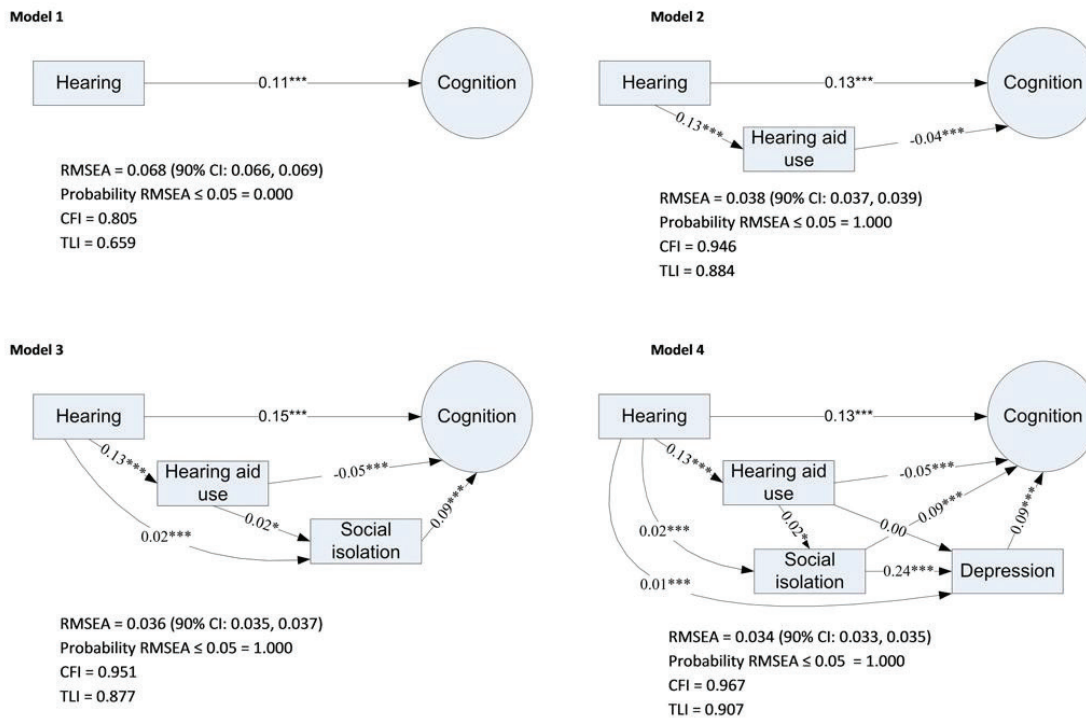


Fig 1. Structural equation models of standardised path coefficients between hearing, cognition, hearing aid use, social isolation and depression. Notes: *** $p < 0.001$, * $p < 0.05$, Root Mean Error of Approximation (RMEA). A value less than 0.05 indicates good fit. Comparative Fit Index (CFI) and Tucker Lewis Index (TLI), with a number greater than 0.95 indicating good fit.

DISCUSSION

In cross-sectional modelling in a large sample of UK adults, hearing aid use was associated with better cognition. This is consistent with the ‘cascade hypothesis’, where long-term auditory deprivation or degraded auditory input may result in increased cognitive decline [6,12,13]. The positive association of hearing aid use on cognition that was observed in the present study was independent of any positive association of hearing aid use on social isolation or depression. Therefore any effect of hearing aid use on cognition is unlikely to be via reduction of the adverse effects of hearing loss on social isolation or depression. Rather, these data suggest that the benefit may be directly through increased audibility of sounds in daily life. This pattern of

association was observed within a large and inclusive sample of UK adults in the present study, and is likely to be generalisable to the UK population [22]. The cognitive tests were all visually presented, and so it is unlikely that hearing aids had a strong impact on performance on cognitive tests via improved audibility of test stimuli.

If hearing aids do have a positive impact on cognitive performance not due to a reduction in depression or social isolation, how might hearing aid use impact on cognition? According to the cascade hypothesis, untreated hearing loss may result in long-term auditory deprivation or degraded auditory input, resulting in increased cognitive decline. However, the mechanism

for this is not known and requires elucidation [6,12,13]. One possibility is that hearing aids may boost self-efficacy, and increased self-efficacy positively impacts on performance on cognitive tests. Self-efficacy refers to the belief in one’s own ability to perform tasks and achieve goals. Hearing loss is associated with reduced self-efficacy [29]. Low self-efficacy is associated with poor performance on a variety of challenging tasks, perhaps via affective or motivational influences [30,31]. Unfortunately, no self-efficacy data were available in the present study and we were unable to examine this possibility.

One unexpected result was a lack of association between hearing aid use and depression, and increased social



isolation associated with hearing aid use. It may be that hearing aids do discourage participation in social events by amplifying aversive background noise that is typical at social venues such as clubs, cafes and restaurants. However, hearing aids have been previously suggested not only to reduce hearing handicap, but to reduce concomitant social isolation and depression [32]. Evidence for this is limited however [33]. One randomised controlled study reported an improvement in social engagement and a small reduction in symptoms of depression in a select group of new hearing aid users (elderly white male US veterans with moderate to severe hearing loss) [19]. An explanation for the lack of positive association between hearing aid use and social isolation in the present study might be that the measure of social isolation based on a single Yes/No question lacked sensitivity. Note however, that associations remained unchanged when substituting an alternative measure of social engagement. Similarly with depression, associations were similar for an alternative measure of depressive symptoms. Information about hearing aid use was limited to whether participants reported that they use a hearing aid 'most of the time'. The amount of hearing aid use, how well the hearing aid was fitted to compensate for hearing loss, the duration of hearing aid use and whether participants began using hearing aids soon after the onset of hearing loss may also impact the effectiveness of hearing aids in improving outcomes including social engagement, depression and cognition [34]. However, one would expect that in a sample of the size utilized in the present study, the net effect of hearing aid use on social engagement, depression

and cognition would be apparent. The assumption in the present study was that better cognition in hearing aid users observed in cross-sectional analysis may reflect the long-term impact of hearing aid use in reducing cognitive decline. However, longitudinal data are required to confirm whether hearing aid use is associated with any alteration in the rate of cognitive decline over time. The data in the present study are correlational, and no strong conclusions about causality are possible. Alternative interpretations of the patterns of association reported in the present study are possible. For example, rather than hearing aids 'causing' better cognition, cognitively more able people might tend to obtain and use hearing aids. Cognitively more able people may be more likely to access specialist health services, including audiology, or may more likely recognise hearing disability and seek treatment. Establishing a causal association between hearing aid use and cognitive performance requires controlled studies with cognitive outcomes measured in the short term as well as after several years hearing aid use. The study was restricted to adults aged 40 to 69 years, so it is uncertain whether the associations identified in the present study are generalizable to older adults, in whom sensory impairment, hearing aid use and cognitive impairments are more common.

CONCLUSION

Hearing aid use was associated with better cognition in a large cross-sectional study of UK adults. The association was independent of social isolation and depression. Further research is required to determine the direction of association, if there is any direct causal relationship between hearing aid use

and better cognition, and whether hearing aid use results in reduction in rates of cognitive decline measured longitudinally. Treating hearing loss may make a significant contribution to reducing the burden associated with cognitive decline and reduced quality of life.

ACKNOWLEDGMENTS

The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR or the Department of Health. This research was facilitated by Manchester Biomedical Research Centre.

AUTHOR CONTRIBUTIONS

Conceived and designed the experiments: PD RE KC. Analyzed the data: PD RE ME. Wrote the paper: PD RE KM ME DM KC AM HF.

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Reprinted from PLOS ONE | DOI:10.1371/journal.pone.0119616 March 11, 2015 | 9
 OPEN ACCESS Citation: Dawes P, Emsley R, Cruickshanks KJ, Moore DR, Fortnum H, Edmondson-Jones M, et al. (2015) Hearing Loss and Cognition: The Role of Hearing Aids, Social Isolation and Depression. *PLoS ONE* 10(3): e0119616. doi:10.1371/journal.pone.0119616
 Academic Editor: Blake Johnson, ARC Centre of Excellence in Cognition and its Disorders (CCD), AUSTRALIA

Received: February 12, 2014 Accepted: January 29, 2015

Published: March 11, 2015 Copyright: © 2015 Dawes et al.

This is an open access article distributed under the terms of the Creative Commons License which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited. Funding: This paper presents independent research funded in part by the National Institute for Health Research (NIHR). The Nottingham Hearing Biomedical Research Unit is funded by the National Institute for Health Research. DRM was supported by the Intramural Programme of the Medical Research Council [grant U135097130] and by Cincinnati Children's Hospital. KJC was supported by R37AG11099, R01AG021917 and an Unrestricted Grant from Research to Prevent Blindness.

The funders had no role in study design, data collection

Finance

- QuickBooks integration
- detailed real time reporting
- inventory control

Architecture

- browser-based
- cloud-hosted or on-premises
- secure access from anywhere
- customizable
- scalable



Sales

- cash management
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- barcode scanning & printing
- claim status tracking

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