Innovation at NAL on Emerging Trends in Hearing Health Care
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Presenter: Brent Edwards, PhD

- [Christy] It is my pleasure to kick off the first ever series that we have in partnership with the National Acoustic Laboratories. We have Dr. Brent Edwards here, who's gonna spearhead the discussion. He is the director of the National Acoustic Laboratories, where he is currently leading new innovation initiatives that focus on transforming hearing health care. And for over 22 years, he has headed research all over the place, at major hearing aid companies, and also throughout Silicon Valley at startups that he has developed. At this time, I'll hand the mic over to you, Dr. Edwards.

- Great! Thank you, Christy. And it's really a pleasure to be able to talk about the National Acoustic Laboratories, the research that we're doing and all of these amazing trends that are happening in the field of hearing health care. So let's get going. We've got a lot to cover. So here's your standard disclosure. I don't represent any interests other than my own, and those of NAL. And here are the outcomes that hopefully, you'll get from this presentation. One, you'll understand, you know, how technology is providing solutions for different segments of people, and also to understand better the needs of different people, different segments of people with hearing help, and how those match with hearing technology. Finally, we'll be able to talk about the factors that make people decide, whether they're going to get hearing aids or not.

So let's start by who is NAL? Who is the National Acoustic Laboratories? Well, we are a government-funded research center here in Sydney, Australia. We're supported by the Department of Health and federal government. So we're kind of like an NIH research lab in Bethesda, Maryland in the US. And we've been around for a very long time, since the 1940s. We consist of over 40 researchers, audiologists, engineers, speech pathologists, a variety of disciplines, all focused on helping people with hearing loss. And I think a beneficial part of our organization is we are part of a larger organization that is the largest hearing service provider in Australia. So we're a part of a service provider who has over 600 audiologists, almost 200 clinics across Australia.

So work that we do, if we develop new tools, new protocols, they get rolled out across the country very quickly. We also are in conversation with audiologists about the needs that they're experiencing, and the patients and clients that they see, and we're able to observe and test and understand what's going on, so we can better refine our research to maximize the impact that we have. Because the reason that we exist, is to do hearing research and to develop solutions, that's the evidence-based innovation, that can help people with hearing loss and help those who help people with hearing loss such as, audiologists around the world, and also companies who develop technology for people with hearing loss and for audiologists.

And our research falls in four main areas. We try to keep on top of industry trends and understand what's going on and provide the evidence around them. We try to understand why people do what they do when it comes to the hearing health care decision-making. We develop technology, we develop tools for clinicians and for people with hearing loss, but we also measure the benefit that other people's products and technology provides for people with hearing loss, and for audiologists. So, and you're gonna be hearing more about this over the course of the month from other researchers at NAL. So there's a lot of innovation happening in our field right now, and it's causing a lot of confusion, a lot of really interesting questions, a lot of anxiety, a lot of excitement.

So we're seeing innovation in technology, you know. We now, we're getting direct-to-consumer hearing aids, OTC. We're getting hearing devices in different kinds of form factors, things that may not actually be hearing aids, but are starting to look like hearing aids and have some of the same functionality. And now we're seeing some really interesting technology being developed that is not just hearing aid technology, but is other kinds of enhancements such as, hearing augmentation or virtual reality as a part of hearing. We're also seeing innovation in the hearing health services. So remote control of hearing aids, remote programming, remote counseling and service, a variety

of different approaches to hearing health care services. And we're also seeing innovation in the distribution of hearing health care technology, so whether that's through the internet, whether that's through consumer retail stores, electronic stores, or pharmacies, we're seeing, and that's not just the provision of devices, but that's also hearing tests, and some diagnostics as well, some digits-in-noise and speech-in-noise tests.

So we're seeing innovation in all three of these different areas. And again, these are causing a little bit of confusion when you see an innovation in the distribution channel. What does that mean for innovation in hearing health services? Innovation in technology? What does that mean for innovation in the channel? So hopefully, I'm gonna try to explain some of those to you and give you a framework for thinking about all of this. Now all of this innovation has raised some really interesting questions that I get asked about a lot, and I know all of you have been thinking about as well. So probably the most common question that gets asked, and actually this has been asked for decades, why is it that so many people who have hearing loss choose not to get hearing aids?

So here's a quote from the National Academy of Sciences report that ultimately resulted in the OTC Legislation of 2017. Will OTC hearing aids replace audiologist-fit hearing aids? I get asked this a lot and, you know, recently people have been wondering whether the Apple AirPods Pro will replace hearing aids, and I'll get into that in a bit. Or will teleaudiology obsolete the services that I provide in my clinic? So I'm gonna argue, and hopefully by the end of this presentation, you will agree with me. These are actually the wrong questions. They're based on the wrong premise that you can only have one or only have the other, that two can't co-exist. And I'm gonna argue that each of these innovations don't necessarily just replace the current state of technology service and distribution channel, but can augment it.

So the right question in my mind, is to think about the different segments of people with hearing needs and what are their unmet needs. So if we can understand the different segments that exist and the different needs of those segments, then we can start asking the question, well, for which of these segments of people is an audiologist-fit hearing aid most appropriate? For which of these segments is a self-fit or OTC hearing aid most important? Which segment would do best with teleaudiology? And for which segment are hearables appropriate? So it's not just, there's one group of people, and it's either you get a hearing aid or you get a hearable, or you get an OTC device.

There are different groups who have different needs, who are gonna consume different solutions. And so by the end of this presentation, I hope you understand that that all of these can coexist. And in fact our industry is going to grow, as new innovations come along, and provide new solutions for people who aren't getting solutions today. So the way I think about segments is as follows. If you take the world of people who have some form of auditory dysfunction, not gonna say what, but they've got something that is not quite, that's abnormal about their hearing ability. And you can split those in two different ways. Those who have a measurable hearing loss, according to the audiogram, and those who don't.

So let's call the audiogram, audiometric hearing loss. You either have a pure-tone average of 25 or worse, or you don't. But then you can also split them according to their self-perceived difficulty. Do people, are they experiencing hearing difficulty? Is it causing problems in their lives or are they not? So let's consider these four quadrants here. The top left, you've got people that have some auditory dysfunction, but they have a normal audiogram, PTA less than 25 dB HL, and they don't really experience any difficulty. If you ask them, they kind of say, no, my hearing's fine. So this is a population who I'm not going to address, because I think this is a difficult population to figure out, do they even need a solution?

And if they do, what solution might help them? So let's, we're gonna ignore this segment for the rest of this talk. This one here is quite interesting. This segment here are people, they have a measurable hearing loss. They might have say 30-35 dB HL, according to an audiogram, but if you ask them they say, look, my hearing's fine, I don't have any hearing difficulty. And again, I struggle with this group, who is quite large in the US. This is over 20 million people, who have a measurable hearing loss, but if you ask them, they don't have any problems. And so I struggled to figure out how do we provide a solution to someone who says they don't have a need.

So I'm going to ignore this group as well, because you could argue, you might be able to convince them or get them to experience something and market something, but you know what? They're not gonna try a product. They're not gonna walk into your clinic, because they don't believe they have any hearing difficulties. So even though they have measurable hearing loss, I'm gonna ignore this group, because I don't think they, right now, need or want anything. Now, so the bottom group here is quite interesting, so the bottom left. These are people who have normal hearing. They have a pure-tone average less than 25 dB. So you would say, you know, probably no hearing loss, but they self-professed to have some hearing difficulty and they want help, you know.

Some of the clinics I talked to, up to 30 to 40% of the people who walk into their hearing clinics, have normal audio audiograms. So what do you do with them if they don't need gain? I'm gonna address that later in this talk, because this is a very large group as well. This is over 20 million people in the United States. And finally, this group in the bottom right, is also of course, very interesting to us. These are people who have a measurable hearing loss, PTA greater than 25 dB, and they also say they have hearing difficulty. They have an unmet need, they want help. And I've split this group into two. You've got those who accept hearing aids, they accept the help from hearing health care professionals, and they're getting treatment today.

But as we all know, there are people in this group who, for whatever reason, they don't have hearing aids, they're not going to see an audiologist or a hearing care professional. And I'm gonna talk about that group, why they might not be getting hearing aids, and also what solutions might be right for them that don't currently exist. Okay, so let's start by focusing on this group that we all know really well, because all of you treat them every single day. And you know, so many companies develop useful solutions for them. This is the group with a measurable hearing loss, and they say that they have difficulty and they want help. So how is innovation going to change hearing health care for this group?

And how is your care going to change for this traditional group that all of us see today? So, you know, very directly, is audiologist provision of hearing aids going to go away with all of these provisions? I'm gonna cut to the chase right here, 'cause I get asked this a lot. Are my patients and clients gonna start going to OTC hearing aids, or hearables, or apps on their phone? I'm gonna say, very, very quickly, the answer to that, in the short term anyways, is no. There's a lot of data that shows the importance of audiology care for the outcomes of these people. This is some data in Sweden that shows, for thousands, if not tens of thousands of patients, that the benefit that they get, that's the Y-axis here, or the total benefit, that's the X-axis here, is highly correlated with the treatment, level of treatment that they got from the audiologist.

So the better the proceed treatment from the audiologist, the better the outcome with hearing aids. And this is based on a survey of most of the people in Sweden who have received hearing aids over the past several years. So clearly, good treatment from audiologists is important for success with hearing aids. And we have, we've seen the same thing here in Australia. This is data from NAL where we surveyed, you know, hundreds, I guess 630 people here, several months after they received the hearing aid. And we asked a lot of questions, but fundamentally, what this shows is the benefit that

they perceive they're getting from their hearing aids, is very highly dependent on the level of care that they got from their audiologists.

So I think it's clear for this group, in order for them to have the best outcomes, they need the best care from an audiologist. And so for this group, I think that audiology care is always going to be important. Well then what about teleaudiology? Because that's starting to become a part of the terminology of services that audiologists provide, might that replace some of the services, might that replace the audiologists. Well, you know, a couple of years ago at NAL, we did a survey of audiologists and of patients to understand what, or people with hearing loss, what their attitudes towards teleaudiology is. And each of these squares here represents a different service by, are tasked by an audiologist, and within each of these small squares, our data for different age groups of patients.

So we asked audiologists, you know, how comfortable are you using teleaudiology? For example, if you look in the top right, for speech-in-noise test, or if you look in the bottom left for device maintenance. Now the blue bars are the results if the patient or client has an assistant with them at the far end. So the audiologist is giving teleaudiology services, but there's someone at the far end to help the client. Well, as you can see, the blue bars are always higher than the red bars. The red bars are when there's a situation where there isn't any one with the patient to help him. And so generally, we are a lot more comfortable getting telehealth services when there's someone at the far end to help out.

But if you now look at the squares where the red bars are about the same height as the blue bars, equally high, what you can see is that there are some activities where we are quite comfortable providing telehealth solutions. And those are the ones that are really about counseling, so if you look here, or communicating, so if it's about counseling, if it's about asking questions, about hearing or devices, very comfortable with doing this

with teleaudiology, but if it's about really clinical protocols, speech-in-noise test, pure-tone audiometry, fitting the hearing aid, there's very low level of comfort right now from audiologists in using teleaudiology, for those tools, for those tasks. We also asked audiologists whether you thought teleaudiology would affect the relationship with the patient, and whether the quality of care would suffer at all.

And interestingly, we found two very different results, depending on whether the audiologist had experience with teleaudiology. If the audiologists didn't have experience with teleaudiology, that's the blue bars here. You can see, most believe that the quality of care is going to be affected. They believe the quality of that relationship with the client, with the patient will be made worse. So a little bit of suspicion and reluctance in using teleaudiology, because they believe teleaudiology won't help, in fact, will make things worse. However, for audiologists who did have experience with teleaudiology, it was a reverse. Because of that experience, they understood that the quality of care can actually be made better if used correctly. And that the relationship with the patient can be made better, because you're not getting rid of the face-to-face, you're just substituting some tasks with teleaudiology, and that's beneficial for you, and that's beneficial for the client.

Now, one of the challenges right now is, people with hearing loss who don't have experience with telehealth are a little bit suspect of the quality of care that they will get from telehealth. So this is data from asking people with hearing loss, what they thought of telehealth or teleaudiology. Most thought that the quality of care and the quality of their relationship with the hearing care professional is going to suffer. But I believe that if as they get experience with telehealth in hearing health care or other areas of health care, they'll start to see the same thing that the audiologists saw once they experienced it, that actually the care can improve and that relationship can improve as well.

But that's gonna be a barrier for acceptance at the beginning. So we did a study at NAL to look very specifically at the application of teleaudiology for follow-up visits during a hearing aid, typical hearing aid fitting. So we had two groups of people with hearing loss. And one group, we did the standard approach on fitting a hearing aid. They came in, measured the hearing, fit the hearing aid, did some counseling, they went away, came back two weeks later, asked how things went, did some fine tuning, they went away again, came back two weeks later, and then we finalized the fitting, and did some surveys and questions of their experience. Then we had another group where we did exactly the same thing, except we removed that first follow-up visit, and we replaced it exclusively with teleaudiology, with a remote app that one of the major manufacturers provided.

So they didn't come in. They had that first visit of the fitting. The next interaction with the audiologist was remote, and then they had the final visit at the end. So we wanted to see if having that, replacing a visit with teleaudiology made a difference on the outcomes with these groups of people. So that just says what I just relate to you. So the results of this study was we got the same outcomes, the same benefit from devices, with both groups of people. So whether that follow-up was done face-to-face, or that follow-up was done remotely, the benefit people got from their hearing aids, the satisfaction that they have with their hearing aids, their speech-in-noise ability that we measured in the lab, how often they're using the devices, they're all the same, regardless of whether that follow-up visit was remote or face-to-face.

The problems that we were able to fixed remotely during that first contact point, were basically the ones you'd expect, the ones where we could make adjustments remotely. So if they had complaints on tinniness, we would reduce the high frequencies. If they had complaints on feedback, we might also reduce the high frequencies or increase the strength of the feedback cancellation. They had complaints about wind noise, we might make that stronger and so on. So things that you can make remote adjustments,

we were able to do. Of course, there were some problems that we were not able to fix remotely. And those are the obvious ones here, things that are a little bit more physical in nature. And by the way, I should have pointed out in the top right, I'm gonna indicate where, which slides relate to questions that you'll have on the quiz afterwards.

So this one actually, there's a question, question number two comes from both of these slides, problems that can be fixed remotely and problems that cannot be fixed remotely through teleaudiology. In question number one is pretty easy, so I won't go back to that slide, but pay attention to the top right-hand corner here. So teleaudiology can fix some problems, but not others. So at the end, at the end of this study, we asked the people who experienced teleaudiology. How satisfied were you from the service that you received from your audiologist? Almost everyone said they were very extremely satisfied with their service. And when we ask them, the next time you get a hearing aid, would you like to use this remote service again or would you rather go back to face-to-face?

Every single person preferred the remote adjustments over coming in face-to-face. So why would that be? It certainly is not because they don't like their hearing care provider and don't appreciate that face-to-face, but if you think about it, you know, if someone just wants their wind noise made stronger, they don't want to have to book an appointment, wait a week, drive across town, come in, sit in the waiting room for a two-minute adjustment to the hearing aid. If they could make a complaint on the app and they can get it solved an hour or two later, remotely, that's a lot better level of care that the hearing care provider is giving to the patient.

And I think that's one reason why people believe teleaudiology can actually improve the care, and improve that relationship with the client. And we continue to investigate this area. You know, during COVID, over the past year and a half, you know, our colleagues in the hearing health care services switched a lot of their services to

telehealth, and they had a mixed model, where some patients came in to the clinics and some were treated remotely. So we did a study to try to understand, is there a difference in outcomes from these patients who are getting remote care versus in-clinic care? So it was a unique opportunity for us to gather some data and get some insight on the benefit of remote care.

And basically, here's what we found. The measure that we, we used a lot of different measures, but this one is pretty, I think insightful, the Glasgow Hearing Aid Benefit Profile, which is a fairly standard measure of benefit that people experience from their devices. The blue data shows the outcomes from that in-person, face-to-face follow-up appointment. The gray one is when that follow-ups were done remotely. And you can see, according to this scale, whether it's benefit, perceived disability, handicap, satisfaction, device use, there was no difference. Statistically, no difference between the groups of people who got the in-person care and those who got the remote care for the follow-up appointment. So that continues to reinforce the benefit, for at least some people, of teleaudiology and remote care.

And obviously, very important in these times when there are situations where people are unable to get to the clinic. So one area we're also looking at, in terms of the current standard of audiological care, and that's the decision-making that happens during those face-to-face appointments. If you think about it, there's a lot of stages where either the audiologist or the person with hearing loss is making a decision about their hearing care, about their treatment, about their solutions, and what they're gonna do next. And there's a field of science called behavioral economics, which exists specifically to understand why people make the decisions that they do. And if there can be an improvement to those decisions, can you create what are called nudges, to get people to make those better decisions?

So, behavioral economics is really the science of understanding decision-making, and these nudges are about influencing those decisions in some way. And it's getting a lot of application to health care. We've been spending a few years now applying this to hearing health care. So what's an example of behavioral economics theory that might apply to hearing health services? Well, one common concept in behavioral economics is decision fatigue. And this is the situation where you keep having to make a decision after decision. And the more decisions you make, the more difficult it becomes, simply because you get tired of making decisions. And what eventually happens is, near the end, you just tune out and you say, look, I'm not gonna make any decisions anymore, or you default to the easiest decision possible.

So where might this be a factor in hearing health care? Well, if you think about someone who has just found out that they have hearing loss, they're already sort of, you know, thinking about that, and now you're starting to have a conversation with them about solutions. And right away, you're talking about technology, and you're saying, well, you can have a custom hearing aid behind a hearing aid, you can have a RIC, you can have a mic in the canal, you know, which of these do you want now? What level do you want? What's your price point? Do you want Bluetooth streaming? Do you want it to work with your phone? What about a TV streamer? You know, there's all these new features.

Do you want it to detect your voice? Do you want it to connect to Alexa? What colors do you want? There's all these choices that had to be made at that point. And you can imagine that for some people, it's just too much to at that point, come to making a decision. And I think all of us have seen where people with hearing loss, basically either default to the cheapest hearing aid, the simplest solution, or just simply say, I can't decide right now, and they come back later. So that's an example, I believe, of decision fatigue in our field. So we've spent quite a bit of time trying to understand, why people

make the decisions that they do about which hearing aids they're going to get, and by applying this science of behavioral economics.

Now in Australia, as the rest of the world, a lot of people end up choosing the cheapest hearing aid, which also turns out to be the least capable hearing aid for many people's hearing. So the issue is not that they're going for the low-cost solution, but the low-cost solution tends not to be what might be the best solution for that person. So I think there, without a doubt, are people who could benefit from higher levels of technology, who could afford higher levels of technology, but don't get those higher levels of technology. And we want to understand why are they not making the best choices for their hearing health. So that was a challenge, that we applied behavioral economics to this.

Ultimately, so that we could develop nudges, to try to get people to make choices for better hearing, basically, better technology, and better hearing outcomes. So we did a lot of research, a lot of observations, a lot of surveys of the attitudes and beliefs of people with hearing loss, and the audiologist. And I'm gonna give you just a sample of what we uncovered. This is researched by Megan Gilliver at NAL. So here's an example of some of the data that we got from this study. And I think you're gonna be hearing more about behavioral economics in a future audiology online course from us. So we asked audiologists, when a client or a patient is making a decision about what hearing aid they should get, does that person want to just get as much information from the audiologist so they can make their own decision, or do they just want to be told by the audiologist, this is the hearing aid for you?

And we asked audiologists, what do you believe your clients want on this slider. The far left would be, the patient just wants to make their own decision, they just want as much information as possible. The far right means, they just want me to give them the recommendation, and somewhere in the middle is a combination of both. So here's

what we found by surveying about 100 audiologists. And you can see, most of the audiologists we surveyed believed that the client typically wants to get all the information so that they can make that choice themselves, of what care they should get. And this is of course, considered patient-centered care, where the patient makes the decisions based on the information that they receive.

So then we asked, close to 100 people with hearing loss, who had received hearing aids already and said, in that situation, what did you want from the audiologists? Did you want them to give you all the information that you needed, so you could make your own decision? Or did you want them to just tell you what hearing aid you should get? And here's what we found. So most of the people just wanted to be told what they needed for their hearing loss. Now you can see here on the left, there was about a little over 20% of the people who very strongly believe they just wanted the information and they really wanted to make that decision themselves. So that's fine.

That means there are different segments of people, who have different needs and different demands. And by the way, this group of people, are probably mostly engineers who want to understand the technology and make those decisions themselves. But you can see the disconnect here between what the audiologist believes the patient wants, and what the patient actually says they want. So we uncovered a lot of these disconnects between beliefs and attitudes and the conversations that were happening. And based on this insight, we developed a few nudges, in order to guide decision-making towards hearing aids. And we implemented some changes in clinics around the conversation about hearing technology and hearing health care. And what we found was we were able to, through these nudges, double the number of people who were choosing to get better levels of technology, more sophisticated technology, and better hearing outcomes.

So we were pretty happy that we are able to, through different ways of having a conversation, address some of these barriers and attitudes and beliefs that were causing people to perhaps not choose the best solutions for their hearing health. So what have we learned so far? What have we done at NAL that sort of tells us about this group of people who we're seeing today, people who are going to see audiologists and who are getting hearing aids? Well, what we know is that, this group is gonna persist. The audiologist is so important for outcomes for this group. And let's not forget that. But telehealth isn't a replacement for audiology care. It's another tool for audiologists to use, just like when PCs were introduced in the 90s for programming hearing aids, they weren't introduced to replace audiologists, they were another valuable tool for audiologists to use in the care that they provide.

That's the same with telehealth. And finally, that the decision-making that happens during those face-to-face conversations can be improved. So think about the conversations that you're having, think about some barriers, and some beliefs and attitudes and biases that may exist in the patient or yourself in that conversation, and how can we get to better care for everyone? So I'm gonna stop there on that group, who we know well. Now shift to this other group we don't really know well, but we know they have a problem, they have a measurable hearing loss and they have hearing difficulties. If you ask them they say, yes, my hearing's not great. I have problems and I need help, yet they're not coming to audiologist and not getting hearing aids.

So why does this group exist? Why are they not getting hearing aids or seeking hearing help? Well, I think a mantra over the past several years has been, the reasons are because of accessibility and affordability, that hearing aids aren't accessible, and they're not affordable for this population. In fact, that was the name of the report by the National Academy of Sciences that resulted in the OTC Legislation. Now, I would argue that this can't be the main reason, because you can get on Amazon today, you can type in hearing aid, and you can see all kinds of hearing aids for about 200 bucks that

they can send to you and deliver to you the next day. So you can get hearing aids that are affordable.

You can get access to hearing aids. Now, they may not be the best hearing aids, and they may not be as good as the traditional hearing aids, but they are accessible and affordable. So that can't be the only reason that this group is not seeking hearing help. Well, so how can we understand why they're behaving the way they are? Well, there's a wonderful model that can be used to understand the behaviors of people in health care, and it's called the COM-B model. And the C stands for capability, M for motivation, O for opportunity, and B for behavior. So question number three here, remember what these letters stand for, so the COM-B model. And it's a way of understanding why people behave the way they do.

And it's been very successful in a variety of ways. It's been applied to understanding why pregnant women smoke, even though they know it's bad for them, and it's bad for their baby, unborn baby. Why do people who are obese choose not to follow diets or still function in a way that isn't healthy for them? So it's a way of unearthing the reasons that people behave the way they do, particularly in health care. And it's been very successful in that way. So last year or so at NAL, we applied this model to this question of, why do some people with hearing loss not get a hearing aid? And the way this works is you categorize reasons according to these three areas.

So if you think about capability, what are some capability reasons that might keep someone from getting a hearing aid. Well, there may be physical limitations, it could be their dexterity is not very good, or they just, they're not very good with technology. They lack the capability to function with a hearing aid. That's probably not a large group of people, but it's probably some. Motivation's probably a bigger reason for this group. Now self-stigma means what you believe about yourself. Are you stigmatized yourself about the thought of getting a hearing aid? Like, oh, I'm gonna be so old if I do

that. I don't want it. Maybe they believe their hearing isn't bad enough for hearing aids, like they almost have to be deaf before they're gonna get a hearing aid, or they don't really believe it's gonna help them, or it's just, you know, they're lazy.

Not worth the effort. Ugh, I gotta make an appointment. I got to go see this professional. I'm just not gonna do it. So I think there's a lot of motivational reasons why people just don't bother getting their hearing taken care of. And then the opportunity are external factors in the world around them. So there's the stigma from others. What are others gonna think about me if I get a hearing aid? Maybe people around you aren't supporting a decision to get hearing help, or to get a hearing device. Maybe they're just like, those things don't work or they're saying, you know, you hear it fine. You don't need help. Then of course, here's where costs and accessibility might be a factor.

It'd be under the opportunity, or perhaps the world you live in doesn't require great care. And maybe you spend most of your time reading and watching TV with the volume loud on your own, and even though you have hearing loss, your activities don't demand better hearing. So I think there's a lot of reasons why this group, and it's about as large a group as the group of people who have hearing loss, about 8 million people in the US. Why don't a large group of people who have hearing aids, why don't they get hearing aids? So I think these are many of the reasons why. So a lot of people have thought that, well, OTC hearing aids, self-fitting hearing, is it gonna be really good for this group?

Well, is that the case? At NAL, we spent several years trying to understand what are the limitations and barriers to success with self-fitting hearing aids. And this is a summary of several years of research that Liz Convery did. And she discovered that there are a lot of things that you have to get right for someone to be successful with a self-fitting hearing aid. And this should be of no surprise to anyone on this talk,

because if fitting hearing aids and getting people successful with hearing aids were so easy, you'd only have one appointment, and it'd be short one, and you'd never see your patients again. That is usually never the case. Usually, it takes a lot of effort to get someone satisfied, and happy with good outcomes with their devices.

So it's not surprising that with self-fitting hearing aids, it's going to be difficult. So we did a study where we took a hearing aid that was designed specifically for self-fitting, and we looked at 60 adults and their ability to fit this device that was created for them without any help. So what we found was, only about one in four of this group ended up being successful fitting themselves with this device. Almost half of the group, if there was an assistant on call to answer questions and help them with certain parts of the fitting, is only then where they able to get success. And then one in three, even with the help of an assistant, just couldn't get there, couldn't be successful with the self-fitting hearing aid.

So that's a little bit of evidence. Of course, it's only specific to this product that it's not as easy as it seems for someone to get to success with the self-fitting hearing aid. Again, this should not be news for anyone on this, listening to this presentation. So I published the results of several parts of MarkeTrak 10 last year, many of them that had to do with attitudes towards OTC hearing aids. And so, one of the interesting factors we found is that, about half the people of the 3000 and more people with hearing loss, when we asked them their level of comfort with the activities that would be necessary to get an OTC hearing aid, about half of them were uncomfortable doing that, selecting the device, making adjustments, you know, figuring out how to wear it, but half of them were comfortable with those tasks.

So that already tells you, there are different segments of people. Some people are comfortable. Some people are not for this kind of solution. When we asked them, for your next hearing aid, would you prefer to get one yourself, OTC, or do you still want to

see a hearing care provider to get your hearing need? When we asked the two different groups, those who are hearing aid owners already, and then the 2000 and more people with hearing loss who don't have hearing aids, here's what we found. Those who own hearing aids, almost everyone said, you know what, next time I need a hearing aid, I'm gonna see a hearing care provider. Interestingly, those who don't have hearing aids, still over half of them said, yeah you know, I might consider OTC, but I'm still, I think I wanted to see a hearing care provider.

And again, if you think about it, hearing loss is a health care issue. If you're really concerned about your health, you're going to see a health care professional. So this data and others should not be surprising that there's gonna be a lot of people who still want the professionals. So that question early on, will OTC replace audiologist-fit hearing aids? It's the wrong question. For some people, it will be the right solution, but for some people it will not be. And so finally, some other MarkeTrak data that was quite interesting, when asked, what people thought the benefit of a hearing care provider was in being successful with the hearing aid? Of course, hearing aid owners, almost all of them said, boy, that audiologist, that hearing care professional is really important for my success.

But even people who don't own hearing aids, but have hearing loss, the majority of them thought, yeah, I think that professional is gonna be important for success with that device. So again, it's that people understand the benefit of a professional and a lot of people are gonna still want that, but there's some people who aren't, and that's probably the people who currently aren't getting solutions today. So it's not an either/or situation, but OTC self-fitting hearing aids are gonna be solutions for segments of people who just aren't getting solutions today. And so when you think about, who is the ideal customer for OTC hearing aids, self-fit hearing aids that don't require a professional? Well, again, we can apply the COM-B model here to understand what are

the factors that will affect someone getting an OTC hearing aid and it's around capability, their motivation, and the opportunity here.

And one of the biggest factors here is probably under motivation. They believe that the self treatment can be beneficial. But they also have to have all these other things in order to be satisfied with OTC hearing aids. And again, the issues around stigma, they have to have the lifestyle need, they have to believe, and be able to actually manage the fitting, and all of the understanding of how the hearing aid works and so on. Having that social support is still important. So just by putting a hearing aid on a shelf, doesn't mean suddenly everyone's gonna rush out and get it. There's still a lot of factors that have to be in play for this solution to be beneficial for someone or for someone to even want to get that device.

So summary so far for this segment, the people who have a hearing loss, people who have a hearing need, but are currently rejecting hearing aids and hearing care professionals. There's a lot of reasons why someone with hearing loss may not get a hearing aid, and I listed those with the COM-B model. And there's a lot of reasons why these people may not be successful with OTC hearing aids as well. But there are some reasons why people may prefer self-fitting hearing aid and could be successful. So again, different segments, different solutions, different distribution channels, different service models for different segments of people is what we're seeing with innovation today in all of these areas. So now finally, let's look at this important segment of people here.

These are people who have no hearing loss according to the audiogram, but if you ask them about their hearing ability, they say they need hearing help. They self-professed to have hearing difficulty, primarily speech-in-noise situations. And they want solutions. As I said, in the clinics that I talked to, a large percentage of people who walk-in, seeking hearing help, actually have no measurable hearing loss by the audiogram. And

what does the audiologist typically do? At least the ones who I talk to say, well, congratulations, you don't have a hearing loss. Come back in five years and we'll test your hearing again, and see if you need any help. Well, clearly they need help. They're there, they may not need a hearing aid, they may not need gain, and I'll talk about that in a bit, but they need some kind of solution.

So let's think about this population. And by the way, in the US, this is a very large population, well over 20 million people here who need help, but they needed perhaps a different kind of help than someone for whom a hearing aid has been designed for. So if we were live, if you were in front of me today in an audience, I would ask you to raise your hand here on this question, and ask of all of these sort of prototypical audiograms here, what is the lowest number that you would be comfortable fitting a hearing aid to, when someone walked in, and you measured one of these audiograms on them? So typically, when I ask this question, there's not a lot of people who are comfortable fitting an audiogram to, that audiogram number one up top where, at the highest frequency it only gets down to 15 dB HL.

There's even a lot of audiologists who wouldn't be, you know, completely comfortable fitting hearing aid on someone who has that audiogram number two, where below up to 3000 Hertz, you're only at 20 dB HL. So how much benefit are they gonna get from amplification, if they only really will get amplification benefit above 3000 Hertz or so? It's really that audiogram three, where I get 100% of people saying, yeah, I'm comfortable fitting. So what about those people who have audiogram number one, or audiogram number two who need, who say they need hearing help, who are having difficulty with speech-in-noise for some reason? Well, there's been a lot of discussion just this year and interesting publications on exactly this topic.

And it comes down to this. What we're looking at right here is perhaps not the best way to consider whether someone needs hearing help. So if we look at publications

from the US Preventative Services Task Force, who concluded, unfortunately, that people who are aged 55 or older, shouldn't get regular hearing screenings. And the reason for that was, they concluded that the audiogram, the pure-tone thresholds were not a good indicator of need of hearing aids, based on the published evidence. You see in the bottom there, Sumit Dhar and Andrea Gatlin published a paper, basically calling this 25 dB pure-tone average an arbitrary cutoff, in terms of hearing difficulty and hearing need. The World Health Report published this year, also said the same thing.

In fact, it said very explicitly, the audiogram should not be used as the sole determinant of whether someone should get a hearing aid. And then finally, this middle one here by Larry Humes, I'm gonna dig into a little bit more. He was focused primarily on who needs, how to tell in an OTC environment, whether someone needs a hearing aid when you can't do an audiogram, but I think it applies broadly to all of us, to all hearing health care. So what was Larry's recommendation? His recommendation was to use a very simple 10-question questionnaire, the HHIE-S, the Hearing Handicap Inventory for the Elderly short form. And you can see these questions here, they're very intuitive. In fact, these are probably the kind of questions you would ask someone walking into your practice, just generally, you know.

Do you feel frustrated with talking to members of your family? Can you hear someone who speaks in a whisper? Is your hearing making you feel handicapped in some way? And based on the answers to that, you can either go no sometimes, or yes, to each of these, and you get a score of zero, two, or four. So your score can go from zero, which means you have no problems at all for any of these questions, to 40, which means you answered yes to every single one of these. So Larry recommends, as do others, that you use a cutoff of a score of 10 for determining whether someone needs, has a significant enough problem that they need some help.

So here's some data from his paper where he has both appeared for frequency pure-tone average and their HHIE-S score together. And this is over 10,000 people. So what you can see is they're highly correlated. If you tend to have a high pure-tone average, you also tend to score high on the HHIE-S. So the way to read this is, this is the HHIE-S score from zero to 40, this is the pure-tone average from zero to 70. And the higher the peak is, the more people in this cohort of 10,000 people who scored with that pure-tone average and that HHIE score. So you can see most people in this group scored very low in the pure-tone average and scored close to a zero on the HHIE-S.

So from this random population of people, most people were doing just fine. So what do we do today? Today, we might look at this threshold 25 dB HL and say, look, if you lay on the left-hand side of this, and I'm gonna give you a solution, you need help. If you're on the right-hand side, you're fine. You don't have a hearing loss. So Larry is arguing, as are others, that you should really consider the self-perceived need that they have. And so if they score higher than a 10, then you should be considering giving them help. They score below a 10, they probably don't need help, so probably not experiencing much difficulty. So let's consider the combination of these two criteria for a second.

So if you look, if you just went by the pure-tone audiogram, well, you would certainly capture, with this group of people, those who also have significant hearing difficulty by the HHIE-S, but you would miss all, but you would also provide solutions to people who don't have much difficulty shown here. So they have a pure-tone average of 30, 35, 40, 45, but on the survey they say, they don't have any problems. So why would they want a solution if you gave one to them? This group down here, however, they have a pretty normal audiogram, but they're experiencing quite significant difficulty scoring above a 20 on the HHIE-S, suggest quite significant problems in their life due

to hearings, due to their hearing ability problems that they should be looking for a solution.

They typically are looking for solutions. So this is that group of people. They have normal audiograms, significant speech-in-noise difficulty. How can we help them? Well, this was something that we looked at, at NAL. So we specifically looked at the group of people with this, we'll call, no to mild loss. And we have several studies in this area. But the one I want to talk to you about here is specifically, for people with a pure-tone average less than 25. So someone you would say has, according to the typical criteria, has no hearing loss and typically would not be prescribed a hearing aid. So what we did is, we wanted to look at both, what are the attitudes of this population towards hearing aids?

Would they even be willing to get hearing aids, if it was offered? And also, would they benefit from hearing aids if they were fit with the hearing aid, which you would think, well, how could it help them if they don't need amplification? But keep in mind, hearing aids also have directional microphones, they have beamforming, they have noise reduction, all things that may help someone in a noisy environment. So what did we do? We took two groups, a control group and experimental group, 15 people in each, and both of these groups had very similar audiograms. I'll show you in a second. But the experimental group, we fit them with a high-end hearing aid, with flat 8 dB insertion gain inside the device with all of the noise features activated, noise reduction, directional microphone, beamforming.

The control group also got hearing aids, but they were fit with zero dB insertion gain. So it's a placebo group. They thought they were getting help, but they weren't getting any amplified sound, although they could hear the mic noise, so they could tell them that it was on, they knew something was there. What we wanted to do was avoid the halo effect, where people may report that they're getting benefit just because they

thought they should, because they were wearing a hearing aid, even though we knew the hearing aid wasn't actually doing anything for their hearing. So here's the audiograms of the two groups. Very similar. You can see up to 4k, it was on average about 10 dB of hearing loss.

That wasn't until you got above eight, that you really started to see a significant hearing loss. So here's the results of the questionnaire at the end of this trial. You can see the results from the control group and the experimental group. And if you look at these two questions I've highlighted, are you convinced that obtaining hearing aids was in your best interest? The control group, this is a scale from one to five, most of the control group said, no, the hearing aids didn't help me at all, but quite a lot of people in the experimental group who were getting the 8 dB of insertion gain, scored quite highly on this score and really believed that it was in their best interest to wear these hearing aids.

And then if we ask the question, do you think hearing aids are worth the trouble? Because again, people have mild loss, they may go, yeah, they helped a bit, but it's not worth the effort. Again, the placebo group scored pretty low and said, generally, no, not worth the effort. I wouldn't wear them again. But the experimental group, absolutely. They thought it was worth the effort. It helped them. And when we had a series of interview questions with them, these are a sampling of some of the quotes that we got from the people on the placebo group. Pretty much when we asked them about the benefit they're getting, and whether they will continue to wear their hearing aids, almost everyone said, no.

If you look at the people who got the 8 dB of gain though, yes, it improved my condition, yes, I would wear it in noisy situations, yes, I would in social situations, yes, the benefit was too great to not use them. So a population who typically would never prescribe a hearing aid to, were getting benefit from a hearing aid. Now, hearing aids

aren't the only solution for this group. There's a lot of other solutions out there, from hearables to iPhone apps, to online hearing aids, to Apple AirPods Pro. And recently, there was a lot of attention to the AirPods Pro because, there was an iOS released last year that allowed you to enter an audiogram and have the AirPods turn into almost hearing aids.

So we did a study, basically, just to measure the electroacoustics of these devices in this hearing aid mode, to see how they compared to actual hearing aids. So if you look on your iPhone, there's a mode where you can turn on the microphones on your AirPods, you're wearing them, and they're picking up sound around you, and they're amplifying it. And you could select one of these three presets, or you can enter an audiogram, and the gain will be adjusted in the AirPods Pro themselves. So we wanted to see what do these AirPods actually do, and how do they compare to hearing aids? So this is, if you just turn on that transparency feature, which is supposed to be passed through, so no amplification is supposed to allow you to hear the environment around you.

And you can see, it's in that mode, is pretty close to zero dB insertion gain. So it's doing what it's designed to do when you're not streaming, it's just letting you hear the world around you with very little amplification. But if you used one of these features here, we looked at all three, but I'm gonna show you the brightness mode here. You can see what it's doing. It's providing up to 15, 18 dB of gain above 2000 Hertz, It's providing up to 15, 18 dB of gain above 2000 Hertz, and it's doing compression, 'cause you can see there's level dependent gain here. As a level goes up, the gain is going down. When we entered some audiograms, we entered these three different audiograms and then measured what the devices were doing.

And here we see for the mild sloping audiogram. This is the gain, the insertion gain, the AirPods provided. And this is what the prescription for NL2 was, NAL-NL2 for those. So

you see, they're not coming very close to what a prescription is, but they're getting some amplification in the high frequencies. So they're doing something, they're giving some benefit. Of course they're not on target like a hearing aid, properly-fit hearing aid would be, but maybe better than nothing. So what's the summary for this group here? Note the question five in the corner. So people with no hearing loss or even mild hearing loss can benefit and be satisfied with hearing aids, and consumer technology like AirPods, Apple AirPods, or even hearables can benefit from this technology, even if you have no hearing loss or mild hearing loss in order to help you with speech-in-noise.

So the conclusion from this whole talk is, we're seeing a lot of innovation and technology, innovation and the provision of hearing health services, and how it's being delivered, the channel at which it's being delivered. But each of these innovations is going to be relevant and beneficial for different segments of people with hearing difficulty. It's not one size fits all. And rather than these new innovations replacing the current approaches that are being done, they're going to add to them. And in fact, they're going to provide solutions for people, who right now, aren't getting any help, that group with hearing loss, who are not getting hearing aids, or that group who don't have a measurable hearing loss, but have hearing difficulty.

So all of these innovations are gonna help more people, and they're not gonna replace current services or current technology or current channels, but they're going to enhance them. And as these innovations come out, whether it's new technologies, new approaches to services like teleaudiology, new delivery channels like OTC, we, at NAL need to continue to develop the evidence of benefit of these approaches, so that we understand whether these innovations really are beneficial or they're just something that we shouldn't be promoting and aren't really gonna help anyone, no matter what segment that you're in. So hopefully, that helps understand a little bit, what's going on in innovation and how it applies to different segments. You'll be hearing a lot more about from NAL over the next month on more deep, deeply on all of these topics.

So thank you for your attention. And if you have any questions, I'm happy to take them. And I see that Barbara Weinstein in chat pointed out that the WHO just published guidelines for screening, and you're absolutely right, on a two-stage screening program and that it should be routine. So there is some conflict there right now on whether screening should be routine. Obviously, probably everyone here including me, believes that it should. I think what we need is, we need to develop the evidence base, so that government organizations can have the same belief that we do, that if you measure people's hearing loss, we can help with this broad problem with hearing difficulty and untreated hearing loss.

So, again, hopefully this helps us understand the different segments and the innovations that are occurring. And I just want to emphasize, that these new solutions coming up aren't replacing, OTC doesn't replace audiology, hearables don't replace traditional hearing aids. They're complementary. And at the end, more people are gonna get help. There's a lot of people out there who aren't getting help today for a variety of reasons, and the COM-B model really helps with that. And I'm hoping you'll see that those questions that I had up front aren't valid, and we're gonna continue with our approach that we have with the professional, but these other solutions are gonna be there for people who, for whatever reason, are getting the help that they're getting today.

So again, thanks. Thanks again. And I hope you tune in to the upcoming NAL Talks on AudiologyOnline.