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## **How to Win the Battle for Better Hearing in Noise**

**Presenter: Tammy Stender, AuD**

Hello everyone, my name is Tammy Stender and welcome to this presentation with a very dramatic title of how to win the battle for better hearing and noise. Thank you so much for joining me today. I know you are a very busy professional, but we're going to have some fun talking today about the number one thing that we do all day, every day, which is fight the battle to help our patients and clients hear better in noise, which is their number one complaint all day, every day. And I know you know what I'm talking about. So thank you again for joining me and please feel free to write questions in the chat or the Q and A and we will try to win this battle together.

I am the director of global audiology external relations at GN Hearing, so this topic is very near and dear to my heart because if there's one thing that we need to do as a hearing aid industry is to provide solutions, tools, or if you will, weapons for us to be able to fight this battle and win for our patients. So the learning objectives are all around this topic. We need to discuss the need to focus on hearing and noise for the best possible outcomes for our patients complaints. What brings them into the office? To begin with, we want to detail how to use directional technology to empower hearing aid users to battle this number one problem they face.

And we want to explain how the new wireless accessories and connectivity solutions that are available today can promote a more inclusive listening experience for everyone, but especially those with hearing loss who have very difficult times in these noisy listening situations.

So hearing and noise comes to no surprise to any of us that it is the biggest challenge we face. Despite the fact that hearing technology has been focused on this problem for several years, we are making great strides in this area, but of course, we are not perfect yet. We are striving for perfection because this is what we really need to focus on as an industry and as a profession. It is the number one reason why people choose to pursue hearing aids, and it is also the number one driver of hearing aid satisfaction. So if we can get this right, we will make our patients happy and satisfied and be able to live

their lives in the way that they want to live them, like a person who doesn't struggle to hear.

This behemoth survey from a few years ago talks about hearing and noise as one of the biggest innovation challenges the industry faces in the future, and they also link it to problems that we are well aware of in terms of complexity. If we have this technology that can help them hear better in noise, we have to make sure that they can utilize it and know how to use it to optimize their benefits. In addition, we need to look at the strides that the technological world has made towards better connectivity, not only in hearing aids, but in all of the ways that we communicate in loud venues with each other. How do we attack this triad of issues, hearing and noise complexity, which might lead the consumer to have the ability to fight hearing and noise, but not know how to do it or how to engage the system correctly? And then connectivity, how do we stay on top of the ever changing world of connectivity that we're in?

And so with this. I love this picture, because he's just so determined. Every day might feel like this for us. We're going out into the world. We are hopeful.

We have optimism. We're going to help our patients. But every day might feel a little bit like, wow, we're going into battle, and this is how we have the tools to use it. How do we make the biggest impact and the best satisfaction for our patients? As I mentioned before, I work for GN hearing, and our solution to this problem is all encompassed into our portfolio.

Everything we are doing currently is about this hearing and noise problem. So if you want to think about what's GN hearing, hearing really focusing all its R and D dollars on. It's this problem. And we have many ways to attack this problem. We talk about it in terms of next era hearing.

We talk about it in the ways that we are trying to make our instruments compatible with Bluetooth lower energy audio, and broadcast broadcast audio, which we'll be talking about later on, because this is the future of how we will sustain our users in a new world of connectivity that is rapidly approaching us.

Those three problems that the behemoth survey identified, hearing and noise complexity and hearing connectivity, needs to be addressed by any company's philosophy. So the philosophy of GN hearing is organic hearing. We want things to be emulating the way that the actual human body works, the way that the natural auditory system is working already, so that we can support the user's ability to use sound cues in their brain, so that things sound natural and feel natural, and also that it's not so complex that they don't know how to use it. We need them to be able to connect to this technology, both within the hearing aids and to external devices, in the most natural and intuitive way possible. So that's what we mean when we talk about organic hearing.

We want to make it easy, and we want it to be intuitive, intuitive and natural for people. So when I talked about we're going to be fighting the battle for hearing and noise. I thought about how to make this a little bit more engaging. And my son, who just turned 13, has just gotten a PlayStation five for his birthday. And this is not a picture of my son, but I'm sure this is somebody he would aspire to be someday because he's just starting out.

How does he win this battle that he's playing? And so I thought, why don't we just make this be an analogy to how we work every single day, fighting our battles to help people hear better in noise. So, hearing care professional, are you ready for your mission? Let's go. You are player one to that patient that walks in the door.

You are their hero. So let's go and make this work for them. We are uniquely situated with our knowledge and understanding of audiology and the tools available to us in the field to win the battle for better hearing and noise. So to win this battle, we will need two things. Number one, we will need our armour or our shield.

And that is hearing instruments that are versatile, powerful, and attractive enough so people want to wear them to accomplish the goals that the patient has. The patient comes in with demands, and they also want it to be as invisible as possible and as unintrusive to their lifestyles as possible. So we need that hardware, if you will, or that battle shield. And then secondly, we need some weapons. We need something to fight with.

We need some swords. We need the technology to meet the patient's needs, either as features within the hearing instrument or through connectivity to other accessories and phones that can further help us hear better in the noisiest, most difficult situations. So let's start with our armour. To win this battle, we will need hearing instruments versatile, powerful and attractive so that we can even get them on patients and start to join in this battle to help them hear better. The premier hearing aid from resound currently is the resound Nexia.

Many of you may already be acquainted with it. It is a very small micro RIE, but it is packed with power. So we are trying to make this be something that people want to wear while it also suits their needs. It is rechargeable. It is much smaller than even our previous smallest size, and it's packed with some features, such as tap control.

It has an accelerometer within the case so that if you want to answer hands free calls without having to fiddle with a phone, you can just tap the side of device. That is an option. It's not for everyone, but it is an option and a tool that you can use it as an HCP to better help your patient if they choose. We also have wireless cross and bicross capabilities in our products, not only in the RIE that I'm showing right now, but also newly introduced is the wireless cross in a BTE form factor as well. We'll talk about that a little bit more and then all of our products in the Nexia family are made for the next generation of Bluetooth, lower energy audio and aura cast, meaning that they already have these capabilities built into them.

We have put these radios into the devices and they are ready for aura cast already. No firmware update needed. They are powerful enough for mild to severe hearing losses. So the majority of your patients can be fitted with our lineup, and we don't want people to run out of power. So we want to make sure that these rechargeable devices, some of them are rechargeable.

The micro Rae is rechargeable. Some of the others have a zinc air battery option for those patients who prefer that option. But when you have a rechargeable micro RIE, you're going to get through the day and then some 24 hours use time on one charge with three more charges in the premium case that they can store, and 20 hours of use even when streaming audio 50% of the time. This is one of the extreme benefits of using a low energy Bluetooth solution. You get to use the hearing aid all day long without cutting down on your battery life significantly.

This is great. I mean, 50% of the time, that would be streaming half of your day and that still would give you 20 hours of use. So this is really power saving power, economical. And the charger is really fast. As you can see, everybody forgets to charge their devices or their phones once in a while.

I'm guilty of that too. But a ten minute charge of these hearing aids and the charger is going to give you one and a half hours of use, and that is pretty fast.

So I mentioned before that we've got some new additions to the Nexia family that just came out last month. First of all, we have a ITC that is a 312 battery, making it small and cute. We also have the BTE as a cross now available. And we have a new wireless accessory called the multi mic plus.

So when you have a patient walk in the door and you're wondering what kind of armour to put on them, and they are a cross candidate, you not only have to offer them an RIE, but if they would prefer a BTE, they have that option now too. And the RIE works with the RIE models. The BTE works with the rechargeable customs and the BTE models. So they've got some options. They don't have to wear the

same armour as everyone else that's wearing a resound cross.

Now they can have an option, maybe if your patient would like a bigger device. Sometimes those micro ARI's are, you know, for people with dexterity or visual issues, maybe they prefer something they can hold on to.

Look, the Bte cross is there for them. Now, the battery life when streaming audio to the opposite ear is 16 hours. And that is because we are streaming the audio constantly in across. So it's 100% of the time streaming audio. And you still get more than the typical users days worth if you consider that they're probably not wearing them while they're sleeping.

So that covers the armour. Let's talk a little bit about what you're going to use to fight the battle. And that is technology to meet the patient's needs, either within features in the hearing instrument or also through connectivity to wireless accessories and phones.

I mentioned before that this is a big focus for our company, and we went through 1599 real users through the smart 3d app to find if they would recommend our product for hearing and noise. 89% recommended the Nexia for hearing and noise. That is a really high number. It's obviously we're fighting this battle. It's not 100%, but we are helping 89% so much that they would recommend these products for hearing and noise.

We want to stay on this track. We want to keep getting better. We want to provide even better solutions. Even though we have 89% of people who already note that they are doing so much better than they ever did before. It helps with sound localisation.

It's natural after a full game changer. Sound is amazing. I mean, these are just some of the things that were written into the app in terms of comments. So this is really encouraging, but it doesn't make us sit

back on our laurels. We want to keep going.

So what are some of the tools that are ready in our products that help us get to this level of satisfaction? When you think about a hearing aid and what it can do, a lot of times we focus on the end product, like this feature gives this much of an SNR benefit in noise, and that's really great to talk about. But when you think about real world usage, we got to think about is the hearing aid even going into that directionAL mode when it's supposed to? And staying in a more omni mode when it's supposed to also. And that's when we take it back a step and we think, ok, the decision making within the hearing aid is really important and something that we really need to focus on, because if you're thinking about a battle, you shouldn't be attacking when there's no one to attack, and you shouldn't be standing back when there's a need to defend.

So having a very accurate classification system, a way of determining what the environment is like before you turn on and off all these features, is of paramount importance. So we did a study looking at our hearing aids versus some other leading hearing aids in the market to see how accurate we could be in three different environments that are very typical to real world environments. So those would include a quiet environment, a difficult speech and noise environment, and a more noisy kind of environmental sound environment. And what we found, averaging the accuracy of how well we were able to identify what hearing aid environment, what environment were the hearing aids in, versus how the hearing aids were reacting to that environment. By turning on and off features, 91% accuracy was attained with the resound devices, meaning that when your patient walks out the door, if you've told them all of the amazing SNR benefit that they're going to get from directionALity, you can feel confident that this is going to be applying it judiciously and correctly, so that when they go out to that coffee shop, after they stop by and celebrate their brand new hearing aids that they just acquired, that it's going to be turning on and off features the way you would intend.

Because, after all, you programmed them to do this to give maximum benefit. So let's make sure that the hearing aids are actually doing that in the real world when they leave our office. This isn't always the case across the industry, and this is something that we really want to make sure that we get right. Because without a good classifier, the rest of the features don't really matter. Then we move on to how we turn on the biggest two, I think, features that we talk about, which is directionALity and noise reduction.

And this is helping people hear better in noise, but also help them provide better access to a more natural expeRIence in quiet. Because we don't always want directionALity on, we don't always need noise cancellation. In fact, some of the best sounds in life are the ones which are quiet that you want to hear all around. And those are the ones that we want to make sure we provide in the most natural and undistorted versions that we can so number 1360 all around is our premier directionAL option, and it automates this decision making that it takes from the environmental classification to how and when we would apply these kinds of features primarily in directionALity. So when you are in an environment that is quiet or there's no noise around you, it's just only speech.

Perhaps we want to make sure that we widen that sound environment so that people can expeRIence amplification such that they are within the. Their listening world instead of hearing it like they were under headphones, because that doesn't sound wide, that sounds narrow. We want to make sure that when they need that wide auditory expeRIence, they can have the spatial awareness that they need to feel like this is normal and natural hearing. Secondly, one of the improvements that came around with 360 all around is that we have increased the speed of our changing to different feature activation. So with our environmental classifier being active and accurate, we want to make sure that when we need to change, that we're getting there, that detection is fast, and it gets you to the right mode setting of directionALity, or asymmetric directionALity based on that environment as quickly as possible, so that there's not a lag that the user perceives.

And, ok, I think it's switching into directionALity. It sounds a little bit like it's getting quieter, but it's not quite there yet. We want to get to the optimal setting as fast as possible, but we also want to do it in a way that's not jarring so that the patient doesn't feel vertigo because all of a sudden they're hearing all around, and then all of a sudden, they're in front. So finding that happy medium where it is getting there fast, but also not jarring or pumping or giving artifacts from moving from one side, one kind of processing to another, is really important. And fiNALLY, we have the beamforming.

That's a four microphone beamforming directionALity. And that is something that is a very strong tool for your patient to have when they want to hear in front of them with background noise in a very difficult listening situation. So what this system will do is it will provide this kind of narrow beam forming directionALity only when it is advantageous to do so, meaning that they don't have to fiddle around with any kind of an app. They can manually choose this program if they desire, but they don't have to because it's all in that automated program, and that's usually the only program that most people use anyway. So, for example, if I was to explain this to my patients, when will I be getting this kind of narrow beam forming?

It's when you really want to hear somebody in front of you, and there's noise behind you. So this would be something that would activate when they're talking to a grocery store clerk and trying to check out and get their payment situation all worked out, and there's noise behind them. And this is when it's going to be activated, and it's really going to help improve the sigNAL to noise ratio dramatically so that they can have the best access to that sound. We did a study looking at if we could quantify what is the SNR benefit versus omnidirectionAL with different versions of our technology and beamforming directionALity that we've had in the past. So we took omnidirectionAL, which everybody is aware.

It just amplifies everything around you. And then Ultrafocus was our premier directionAL beamforming a couple of products ago, and we looked at how much benefit we could get versus omnidirectionAL

with ultrafocus, and we found a 4.25 decibels better sigNAL to noise ratio. And this is with speech and noise testing in a sound booth with real live users. So a very significant improvement over omnidirectionNAL with ultrafocus. But then, with our newest front focus, we were able to really almost double that.

We were able to get 8.61 decibels better than Omni, which is about four and a half decibels better than what we had before with ultrafocus. Why this is important is that it just shows you the progression of how we are focusing on this very difficult listening situation. And even though it doesn't happen more than maybe about 8% of the time in a user's day, that they would need to be in this automatic form, like beamforming. That's a really big pain point. I mean, imagine you're standing there and you're trying to check out at your grocery store, and you just can't hear what the checker was asking.

They're asking if you just bought plums, or if these are something else and you're not able to communicate with them. It's embarrassing. It's depressing. We need to make sure that in these very difficult listing situations, we give them the sharpest tools that we can, and that's what frontFocus is doing in our nine level devices. Ultrafocus is in our seven level devices.

So even if they decide to use a seven level device, they are still getting a huge benefit. But front focus is where the technology has taken us with a massive benefit over an omnidirectionNAL response. So we combine this narrow beam former in our directionNAL scheme, which is multi-band. And what we mean by that is that we have a band split in the low frequencies. We are always going to provide some kind of omnidirectionNAL processing.

And this means that you can have low frequency localisation cues without the distortion of making it into a directionNAL beam. If you think back to your school days, you know, every time you turn on a fancier feature, it's going to change the way that the sigNAL is going from input to output. So if you want to have natural cues for localisation, especially timing cues which occur in the low frequencies, you

want to keep those as natural and unmodified as possible. And that's where omni-processing provides you the best benefits. So we keep omni-processing for at least some of the low frequencies, regardless of what directionNAL mode that we are in.

It also helps with the user's own voice. Coincidentally, there is a phenomenon that when you are in directionNALity, your own voice becomes amplified more than what it should be based on the way that the directionNAL microphones work from a physical standpoint. And so when you keep it in omni, you prevent some of that over amplification, or undesired amplification of your own voice. And that's why we keep the low frequencies in omni. We have the beam former focused on the speech frequencies because that's where we get the biggest sigNAL to noise ratio benefit.

Those are those frequencies that we all remember from the aids, the 500 to 4000 Hz region. And then above that region, about 5000 Hz, we put it back into independent directionNALity, or fixed directionNALity, so that we can maintain some of the high frequency localisation cues. Those are the level difference cues as the sound travels from the right to the left, etcetera. And that is important also for better spatial hearing. We looked at a mannequin and presented white noise to the mannequin to the right ear, and then just rotated the mannequin head by 360 degrees to see what the response would be when we're in this kind of situation.

Because when you want to beam form, when you want that sigNAL to noise ratio benefit to be optimized, maximized, you want to make sure that it is a narrow beam because that will reduce more of the background noise. So you can think of directionNALity as reducing noise around the user as much as you think about it. Focusing in the front to a certain speaker. And this is what we gained, what we attained from doing these measurements. We found that in this right half of the spectrogram, you see the Kemar head with some red and yellow and blue around it.

So red means that that's where the sigNAL is being picked up. And the frequencies around the head go from highest to lowest. So high frequencies are closest to the head in the spectrogram, and low frequencies are farthest away. And you can see the implications of this multi-band directionNALity right here. Because the low frequencies are in omni, they have the lowest amount of energy.

In this noisy situation, they're in blue. And then as you move towards the center of the spectrogram, you see the speech frequencies that's picking up that really tight beam former right in front of the user. And, of course, if you have the left ear working as paired in the fitting as well as you would, that would be a very narrow beam for the speech frequencies in front, effectively getting rid of a lot of the background noise. And then in the high frequencies, from five k to ten k, which is our frequency bandwidth, you see that there's that fixed directionNAL response, which preserves more of those high frequency localisation cues while also still reducing the noise behind the user. So this is a really interesting way of quantifying, or at least illustrating how our technology works and the reason why we do multi-band directionNALity.

It's not just because we thought it would be complicated to explain, but it's something that really has true user benefits for better spatial hearing and better sigNAL to noise ratio improvement in the most difficult situations that our patients face.

There's another tool in our toolbox called environmental optimizer. And what this does is it's like a volume control on top of your compression system that works automatically. So when you are setting up the hearing aid and you're verifying it to your NAL or propRIEtary targets, what have you, you're usually setting it up in a very baseline situation. But you know that when people get in certain situations, they might start to want to play with their volume control. So, like, in a quiet situation, they might just kind of turn it up just a little bit, or if it's in a very noisy situation, turn it down a little bit.

Well, the environmental optimizer is a way of automating what we have noticed over many, many years of patient behavior, which will do it for them as they move into these different environments. So when

they are in a loud noise environment, it takes the overall volume of your settings down three decibels and that prevents them from having to say, hold on, this is so loud. I need to really take this and reduce my volume. It's a really nice feature to have, and it's a great tool for us if we need fine tuning of a certain environment. If people say, you know what?

Loud is still really too loud. Whenever I'm in loud environments, I just want to tear these things out of my ears. And then you can take the environmental optimizer down to maybe negative five at that point, just to kind of take the edge off and keep those hearing aids being optimized for the user. It's a really great way of fine tuning without changing the relationships between your gain settings from frequency to frequency. It's just an overall reduction or increase in volume.

It happens automatically. Noise tracker two is a noise reduction system that works on, it's very intelligent. It works on the way that the environment is acoustically formulated using probabilities. So when there is a speech sigNAL, as you see right here, it's a very high probability that the system reads a bean speech based on a lot of cues, not just modulation, because you can see there's a lot of modulation, but also formants. Where are the formant frequencies?

What are the overall levels? Where is the sound coming from? What is the overall sigNAL to noise ratio? Is there noise or is there not in the background? That's how it determines whether or not to turn on.

So it's a very intelligent system, and what it does is it takes the sigNAL. In this case, it would be speech. It looks at it, it maps it, and then it finds noise and reduces that noise because it identifies that the noise does not have those speech like characteristics. What's wonderful about it is that it judiciously looks at the environment all the time. It's not categorizing the environment into certain cateGORIES or buckets.

It's actually looking at the real world environment, which is always changing so that it can make the best decisions in real time. This is a spectrogram showing the differences between noise tracker two and another system that's on the market. And what you're looking at here is a spectrogram of a speaker saying the words left and then right in a background of Babel noise. And the left is the high peak, and the left and the right speech you see on both spectrograms as the increased energy, about a fifth of the way in, and then about like about four, five of the way in. On the time spectrum, what you see without noise tracker to noise reduction, but with an alternative kind of noise reduction is that there is still some of this Babel noise present.

And the reason why there is is because other systems don't always look at the nuances that separate speech from noise. And the nuances that separate speech from noise are really clear cut when you're in like a white noise situation or a subway or a construction site, because that's just very basic. You know, that's noise. It's very low modulation, etcetera. But sometimes cafeteria noise is like a constant hum, but it's still noise, but it's speech like, too.

So you've got to be able to differentiate what's speech like noise that's still noise versus speech alone. So without the spectral subtraction features of noise tracker two, you might maintain more of that noisy background. When you consider the spectral subtraction addition to our system that's already built in, you see that it is better at identifying what is that Babel noise and getting rid of it. So what you want to see is this better contrast between speech and noise. Because, after all, noise reduction, what does it do?

It makes it easier to listen in noise. It doesn't have a direct effect on the sigNAL to noise ratio. We leave that to directionALity. But noise reduction is about listening effort, listening fatigue and comfort and noise. So if you're taking out that noise and making it a lot less prominent in the sigNAL, those speech sigNALS are going to pop out and be a lot easier to understand.

Noise tracker two is also incorporated into the environmental optimizer. And so this is a great fine tuning tool for us. A weapon to use when we have somebody come in and say, you know, is, I love my hearing aids, but, you know, in noise, I feel like it's, it's a little bit, I could use a little bit more. So you can take the slider for moderate noise, for example, and make it more aggressive so that you get rid of more of the noise. Or contrast that with, you know what, when I go into a noisy, like Costco or something, it's all of a sudden, like, my hearing aids are turning off.

They're getting really quiet. Well, in that case, back off on the noise reduction because that means that they want to hear more of that noise around them. So it's not a distorted kind of experience. And these are great tools to have because instead of having to change the entire functionality, the entire setting of noise reduction, it can specifically help you as a warrior in this battle, get at the actual situations that people need help with, time constants. So we don't always talk about time constants, but we all remember them, probably from school, and that's the attack time and the release time of the compression system.

So how fast the and how slow we want the compressor to react to changes in volume of the speech. For example, faster time constants have been shown in past literature to prioritize speech clarity in noisy environments. For many people, slower time constants are used in music settings as a default, and oftentimes prioritize comfort. But this is also something that you can change if your patient needs it. Some recent research is indicating that slower time constants might be good for the most difficult signal to noise ratio situations, even though faster ones are fine for the moderately difficult.

So we're learning more about this and you, and that is why slow time constants are already set as a default in our front focus program. Additionally, we are learning that some people with cognitive decline, working memory issues. If you're doing any kinds of those kind of cognitive testing and you find that your patient has some issues or some difficulties in this area, research is starting to suggest that

slower time constants can be better for these people in understanding speech and noise. So if you're doing a cognitive test and you see some signs of working memory decline, especially a slower time constant, is a good thing to fine tune to make it even better for your patient. We also have something called the MaRIE microphone, which stands for microphone and the RIE.

And it is a receiver in the ear microphone that is inside the ear caNAL. So it actually is picking up sounds where sound was destined to be picked up anyways, in the natural human system, which is as close to the eardrum as possible. And what this does is provide benefits that are not even close to being accomplished by actual normal standard receivers available. It helps you localize sound better because you're picking up the sound right at the place where the human brain is expecting sound to be shaped by the pinna effects, etcetera. In this study, from NAL, 80% of listeners were better at localizing sound using a marine mic.

They preferred MaRIE in background noise, again, because the brain is receiving cues that are more natural because of the microphone location, and 90% of listeners experience less listening effort. So we're just scratching the surface of what this kind of technology can do with a microphone in the ear. It also, and this doesn't really need a study because it's pretty obvious that having a microphone located deep into the ear will reduce wind noise naturally. So the marine mic is active when you're in quiet environments of 360 all around. If that's when, if you fit a patient with 360 all around directionALity and it goes through the quiet and the moderately noisy and the noisy settings, which would activate directionALity.

The MaRIE setting is going to be active only in the quiet situations because that's where you're going to be able to hear better localisation. And you're going to reduce wind noise naturally because it turns off those other mics when you don't need directionALity and just focuses on the one that's inside the ear. The wind noise level with omni and wind noise reduction off can be very high. When you turn on wind

noise reduction, such as wind guard feature, you get a nice attenuation, about 16 decibels. But you can go ahead and leave wind noise reduction off and just have a marine mic and that reduces it by 22 decibels.

So again, it's like putting your microphone into a safe cave and that way the wind can't really cause that over amplification effect of wind. So it's a great option for listeners who are perhaps bikers, sailors, people who are really needing good protection from wind, and also ones who really want the best localisation of sound around.

So keeping on with our tools, let's talk a little bit about our connectivity tools. So we've talked a lot about the features within the hearing aid and what they can do for a user, but sometimes you've got a patient and they just have a really difficult time in noise. They might have the same audiogram as the person that just walked in an hour before, but they got 45% on their speech SNR score and or they have a huge SNR loss. They're not doing as well with word recognition is what I meant to say. And then they have an SNR loss that you measure as well through a quick send.

What do you do for these people? Do they get the same thing as the last patient who was doing pretty well in noise? Well, a lot of times they won't do as well as the person who's doing well in noise anyways because of the way their brain works. So we're going to need to have extra tools or extra ways to fight their battles for better hearing and noise. Noise and connectivity is all about that, trying to make it easier for people who have more difficulties hearing a noise.

So let's just review where we have been and where we are going. This idea that people need more help in the most difficult noisy situations is not new at all. Telecoils have been around since 1938 and they are wonderful. They are able to be in loop systems, especially today when they are in a loop situation more than in a telephone, like they used to be in landlines more often. But people use them more in loop situations to help them hear better in large and very noisy venues.

FM systems were developed in the late sixties, and those were able to really bring things better for people in classrooms or meeting rooms to bring the speaker's voice right to the user's ears so that they don't have to deal with. What we all struggle with is distance, low signal to noise ratio in the environment due to high background noise to make that speech easier to hear. For people who struggle in noise, especially, classic Bluetooth, was invented in 1999. And so it's pretty cool when you think about that. It wasn't even in the 21st century.

It was in the 20th century, just at the very end, 1999. And that has revolutionized the way that all of us, hearing loss or nothing, have used and functioned in our daily lives. It is a great equalizer, it is a great way of uniting us. It is a great way of connecting us to people, whether it's on our phones or through ways of connecting to accessories the way we used to. But in 2010, we found that there were some problems with using Bluetooth to connect wireless accessories.

It takes a lot of power, and we all know that we don't want our patients to lose power on their hearing aids halfway through the day. So proprietary protocols were developed using Bluetooth low energy, which is like classic Bluetooth, but you take away all the extraneous processing in the Bluetooth package and just use the stuff that can be used by the hearing aid. I mean, when you consider Bluetooth is huge, it's powering all of your wireless mice, it's powering your garage door opener. It does everything, but it takes a lot of power. So usually Bluetooth is something that you plug into a wall because it has high power, we don't plug our hearing aids into a wall.

So Bluetooth low energy was a way of shaving off the extraneous parts of the Bluetooth package to just focus on the frequencies that are available within a hearing aid and what the hearing aid receiver can provide. And that's a way of saving power. So it provided the benefits of Bluetooth without the power consumption. Made for iPhone was implemented by Apple in 2013 in cooperation with the hearing aid industry. We were the first made for iPhone hearing aid because we truly believe that it could even be

better, that there could be a way to start thinking about making this work within the technology of the phones and then Android streaming for hearing aids followed afterwards, leveling the playing field for some Android users to be able to use this technology as well.

And now, today, or actually 2020, Bluetooth low energy audio was introduced, and we are just starting to get it implemented into devices in our world. And our hearing aids already have it in. Had we not had a global pandemic in 2020, we probably would have been in a farther state on Bluetooth low energy audio than we are at this point. But be that as it may, it's not brand new, it's been out for four years, but it's in our hearing aids, and it is expected to be the preferred audio standard for wireless communication and electronic devices for the next 20 years, according to the group that created it. So they are always working on furthering this technology.

And low energy audio takes the benefits and the fidelity of classic Bluetooth and also the universality of classic Bluetooth and puts it into a low energy package. And that's where we get better streaming to phones. We get lower power consumption, and we also open up capabilities that we've never had before, such as Auricast broadcast technology. So Bluetooth low energy audio is going to revolutionize the way that we connect to our electronic devices, because you're not going to have to have a certain manufacturer. It's going to be put into all different manufacturers.

Headsets, hearing aids, cochlear implants, earbuds, televisions, you name it, gaming controls will all be using Bluetooth low energy audio. And many of them are starting to implement already. And it is estimated that 3 billion of these Bluetooth low audio, lower energy audio enabled devices will ship annually by 2027. And we are almost at 2025. So we are definitely on track to see a lot more of this hit the market in a couple of years.

And this research used to say that it would be 2.7 billion by 2030, and now they're saying 3 billion by 2027. So they have revised their estimate. Because this is accelerating so fast, the benefits to a

manufacturer of any kind of electronic device, of using low energy audio are enormous. They get to conserve their battery power, which means they can make the devices even smaller. They can keep their patients or their users or their customers from having to charge all the time.

They maintain a higher sound quality than was ever able to be accomplished before with a low energy Bluetooth. And they are universal. So it doesn't take a lot of thought process of what model fits with what it's going to be. Just like regular Bluetooth, where, you know, you have a Bluetooth menu on your phone and it connects to everything Bluetooth. It's really a great advancement in our world that is going to shape the way that we all communicate, not just with hearing aids, but all of us.

So this is just a little fun slide showing some information, some about what the difference is between these three kinds of Bluetooth. The Bluetooth classic, widely used, good sound quality, but high battery consumption latency means that there can be a delay, which is why nobody uses classic Bluetooth in their TV streamers anymore, because it used to cause a delay in an echo effect when you'd be streaming to your hearing aids and hearing it from the Bluetooth, streaming from the TV. Nobody wants a delay, no one wants a lag, no one wants a lip sync. And so it's not the greatest for that kind of application. And we're all moving to Bluetooth, low energy for our wireless connectivity for sure, because it saves so much power and has low battery consumption, it's great for using.

That's how we communicate with the hearing aid apps. It has a low latency. But then the downsides is that, you know, MFI and Android streaming is not universal. And we, as hearing care professionals, we have to put our thinking hats on a lot of times to make sure that we're sure that the kind of phone that our patient walks in with is going to work the way that we want to for their connectivity. So that's where Bluetooth lower energy audio fixes a lot of these issues.

You get the benefits of Bluetooth classic in terms of the sound quality, the low battery consumption, the low latency. But you also get the low energy benefits of low battery consumption, low latency. You just

marry all these benefits together. And the only thing that we can say that is a con on this right now is that it's not yet in all of the products around us, but in a couple years, we will be seeing it everywhere. So the three benefits for Bluetooth low energy audio are higher sound quality, better sound quality, and lower power consumption.

You can also do things that we were not able to do before, such as multi stream. You can connect to multi devices, multiple devices simultaneously, and you can make hands free calls in Android phones, which is a huge advanced for those using that, Android phones that were not able to have that in the past. Our cast is broadcast technology and audio sharing technology. And it is going to be something that makes it easier for all of us, whether we're wearing an earbud or hearing aid or a headset, to hear better in the really difficult listening situations around us. It can be in public places, it can be connected on your television.

It's going to make it easier to hear in the worst situations that we encounter. So this new Bluetooth low energy audio has a brand new codec. And what that just means is it's just new way that they wrote the algorithm, the feature, the software coding guys, the people that write this have a new way of encoding it. And this new codec is what gives us better sound quality, even at lower power consumption. So what we're showing here is that the classic Bluetooth, which uses an SBC codec, versus the Bluetooth low energy audio codec, which is lc three, even at a lower bitrate, which means lower power consumption, you're getting a very, very high quality fidelity of the sigNAL.

It's not dropping out, it's not sounding garbled, it's not being all fuzzy, because we are able to maintain that at lower power consumption levels with Bluetooth low energy audio. And this comes directly from Bluetooth Special interest group. This is universal technology that not only makes sense for hearing aids, but also other, also other electronic devices.

Our cast can be enjoyed in persoNAL electronic devices or in public places. So it's not just going to be hearing aid users that get this, it's going to be all of us that wear any kind of electronic device. And what I think is great about this is that it promotes better inclusivity and it makes our patients feel more of the part of everybody. I mean, there's a 20 year old wearing an earbud that's using Auricast in the next couple of years, and so will our 85 year old patient. The stigma of what kind of technology is available for people with hearing loss is becoming less and less because we're all using this technology just the same way as we all use texting on our phone.

Whether we need to read our text to understand the messages or not, on a phone call, we all text. This is just another aNALogy to that, how everybody is able to benefit from this technology. So our cast just some nuts and bolts because there's lots of questions about how to use it. There's three easy ways to join an auracast broadcast. You can either do it on a smartphone, which is very similar to the procedure you use when you connect to someone's Wi Fi.

There's a QR code that will be available, especially in public venues, and then there's going to be tapping a dedicated button that would be on an accessory, for example. And what it will do is allow you to share your audio. So if you're sitting next to someone in the airport and you want to be able to watch a movie because your flight's delayed and you're like, you know, we're bored, you know, we've already been to the Cinnabon three times. Now we just need to watch something that's fun. You can share your audio, so just one player can be shared to two people that have our cast technology and either their earbud or their hearing aid.

Public TV watching, you know, being on the treadmill, at the gym, you don't have to worry about not being able to listen as well as watch because our cast will be in that kind of setting, hearing your best in public address and assistive listening situations like an airport, a bus station, these are just some examples of how this will be implemented in the very near future, and it currently is being implemented

today. So the main point here is not to say that we're not going to have other kinds of ways of connecting. We're still going to have support for telecoils FM systems with a wireless accessory, Bluetooth, through a wireless accessory like our phone clip, propRIEtary, which is the low energy Bluetooth. The way that we connect to our wireless accessoRIEs, we've got all of this in addition to le audio. So it's not meant to replace any of these systems that your patients are currently using.

It just adds to it. So I have a question. What percentage of people do you think use wireless accessoRIEs today? Write it in the chat.

All right, we got some responses here.

All right, well, some of you are really good at selling wireless accessoRIEs, and I just want to applaud you for that, because they really do help everyone. But the sad truth is that according to Markettrack, only about nine to 10% of users reported using wireless accessoRIEs as of two years ago. And this is sad because we all can see the obvious benefits. Now, clearly, you guys on this call are doing a great job fighting the battle of hearing and noise, because you're fitting them to more than nine to 10%, I can tell. But overall, we've got a lot of work to do, and we got to make sure as an industry that we provide accessoRIEs that people actually want to use and wear.

You know that feeling when you are in a noisy place and think, I wish I could hear better? That's when this little microphone can make a difference. This is the new multi mic plus, the perfect tool to have in your magic bag of magic tricks to hear better in many unpredictable situations. This is how it works. You give it to the person that you want to listen to.

I clip it to my clothes close to my mouth, and now streams the sound of my voice directly to your hearing aids. Having a microphone close to my mouth is the best way to eliminate negative factors in the room, like reverberation, which makes conversations muddy and unclear. Vibrant noise, which

requires more listening effort, or distance, which completely grounds the level of my voice under the noise. Well, check this out. Now you can hear my voice loud and clear while standing here or all the way up here.

Hello. And all the way in the back of the room. Hello. It feels like something from a James Bond movie.

The benefits of a remote microphone are evident, but our cast is in this. And what this means is that if you've got a classroom of teenagers, that a couple of them are using the same hearing aid with the former multi mic, you had to make sure, or that they were all using the same kind of hearing aids in order to connect to it. But with the new multi mic two that has Auracast. If there are users of earbuds that, you know, people, maybe kids with normal hearing that have auditory processing, they're wearing an earbud. They can use that technology to connect to the archive if it's in their earbuds already.

And this is definitely the future. Meaning that the teacher in a classroom of those teenagers isn't going to have to wear multiple remote microphones to be able to talk to people with all of these, as long as their devices have it in. And our hearing aids already do. And cochlear implants will someday, and other brands will someday. We all know that the industry is looking at auracast as a way of universalizing the way that we communicate in these really difficult situations and making it a lot easier, too.

What you can do is you can select it as a public broadcast or private. And with private, you can just have up to one to ten people connected. With public, it would be overall. So there's three different kinds of modes. You've got the presenter mode, which is one to one, and that's when you place it vertically, when you set it on a table horizontally.

That's more for when you're at a table with fRIEnds having lunch and you want to hear all around, because that changes it to a table mode, more of an omnidirectionAL, so that you can hear everybody's conversation better. And then you have the audio mode for streaming, like audio. Our cast.

And here's a pro tip for our battle. When you want to get the greatest sigNAL to noise ratio benefit for any remote microphone accessory.

Deactivate the hearing aid mics while streaming. You can have them be set to a mix of environmental sound plus streaming, and that's great. But if you really want the fullest effect, deactivate the hearing aid mics while streaming, and that will really do it for us. We also have the TV streamer plus, which also works with Aura cast. This was released earlier.

As you can see, it has the same kind of auracast benefits as the multi mic plus. We are moving towards getting all of our accessoRIEs onto this platform of our cast as well. And you can use the app to select a public broadcast or a private. And with the TV streamer plus, it's unlimited with the encrypted or private, which people would use like a Wi Fi password essentially, but it would be an auracast password that you provide them that could just be one person or it could be up to ten different people. So it's very private when you want it to be private.

And that's so important in today's world that people have the ability to know what they are broadcasting and to choose if they want it private or not. So a lot of devices can be paired to resound next year. Up to eight electronic devices, up to three TV streamers or multi mics in the previous generation, the phone clip and the remote control. You can have a lot 13 different units connected to one pair of our hearing aids. Now, that's not maybe really simple, so maybe I would never really do this with a patient, but what this does is it provides us as hats a lot of flexibility.

So with that, are we ready to load our first place? Your first patient is awaiting. And let's go. Let's see how we can help them with our armour and our tools. So Sam is a 32 year old restaurant consultant.

He's a new user, and he's having trouble hearing in busy restaurants and meetings. He has normal hearing and low frequencies progressively sloping to severe high, and his SNR loss is 5.5, so it's pretty

mild SNR loss. What hearing instrument child would style would you choose as his bidder, and what kinds of features or accessories would you choose for him? Go ahead and write it in the chat. Well, since he's having some trouble hearing Microsoft Teams meetings online, I think I want to make sure that I can get him something that has Bluetooth, lower energy audio with Aura cast in it so that he can share that audio with PCs.

And there are some PCs already that have aura cast in them. So that way he can stream it right to his hearing aids. I think I would probably fit him with something like a micro RIE and I would make sure that he has 360 all around because he's a busy professional, looks like he's going into a lot of different environments that are difficult and he needs that. I might. I would probably suggest that a multi mic plus would be a good idea because he has talked about trouble hearing in busy restaurants and situations that are difficult.

But his SNR loss is not terrible. So if he wants to wait on that, maybe that would be something I talked about at the follow up appointment. So your next patient's in the lobby. Loading player one. This guy is Peter.

Mister Peter is 54. He is retired pilot, active lifestyle, uses a Samsung phone and he is again a new user. He travels to hear bands, he has trouble understanding speech and bars, difficulty understanding guides on tours, and his wife says the TV is always too loud and he hopes his new Bluetooth lower energy audio TV will help. And he has the same hearing loss as Sam did before his SNR loss when you do a quicksand is nine decibels. So although Peter has a similar hearing loss, he has more difficulty hearing a noise.

What kind of accessory do you guys think that would help with that? Or accessories? Go ahead and write it in the chat.

Well, I'm just going to go out there and say that I think that he would be a great candidate for the multi mic plus. So obviously I'm going to want him to get as much signature noise ratio benefit 360 all around with probably a Nexia 960, maybe a 961 depending on what he says he likes in terms of size. And get him that multi mic and a TV streamer. Plus because his wife said that she didn't like that the TV's always too loud. All right, so our final patient is Greta.

She's 57. She's a social worker with a long hearing aid history and she needs highest possible speech understanding at work. She has a harder, harder time in crowded social gatherings, struggles face to face on phone in meetings, and she's listening to the TV too high. She's got an even greater SNR loss of 16 decibels. So clearly we definitely want to make sure that she is able to hear better in these most difficult situations.

So when I'm choosing my hearing instrument style, it's going to be something that can give her the gain, the power that she needs and then also making sure that she can get the features she wants. So 360 all around definitely. I would probably put a front focus program in there as a second program so that she can really choose when she wants to really go into the maximal signals and noise ratio benefit, even if she wants to stay in it longer than 360 all around would provide because she does have a pretty large SNR loss and might appreciate a reduction of that noise is more than the average person a TV streamer plus. And for those meetings I really think that a multi mic plus would help her. So with that, I want to thank you all because it's not easy doing what you're doing.

What you do every day is really important and trying to figure out what the user's needs are and match them to the technology that is available is a formidable task. So I want to hats off to you. Thank you for all you do, for the people who depend on you to win this battle, for better hearing and noise for them.

So I want to thank you for joining and I want to look at some of the questions that are in the chat or if you have any questions you can also unmute and ask. So there is a question here about can you

review how these hearing aids can connect to a PC? So how you would do that is through the Bluetooth menu of your PC. And if your PC has the intel processor that supports our cast, then this is a very straightforward process. That is the best and simplest way to do it today.

There are some external connectors that are being sold, but some of them work better than others. So I would say that in the PC you would go to your Bluetooth menu, choose our cast and pair it to your hearing aids. And that would be one of your multiple connections that you could have with your hearing aids. So that when you want to listen to your PC, like for Microsoft Teams meetings, it would connect with that versus when you want to hear it on your phone. Great question.

And for everyone here, my email is [tstender@iesound.com](mailto:tstender@iesound.com) dot.

And then we have a question about do we need to disconnect aids from one device when switching to another device for streaming? It depends on your proximity. So if my phone is up in my bedroom and I'm working in my living room, then I probably don't need to disconnect to my phone. The pairing you say paired both of them all the time. But it's like when you're in your car and it picks up your phone because it's in your car with you, you don't have to manually connect.

It's the same kind of analogy here. So if I have my phone far away and my and my PC that's got auracast right here in front of me. I don't have to do anything special. It'll just automatically pair. However, if I have my phone right here and my PC, then I need to select in the menu of, like, the Bluetooth menu that you already have many connections in already, most likely which one of those inputs you want to hear, but the pairing should stay permanent until you decide it's not.

Thank you.