Confidence in the Finer Details: A Sound Story by ReSound

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- - [Tamara] Hello everyone. Thank you so much for joining me today. My name is Tamara Stender, and I am the director of Global Audiology in Chicago for GN Hearing. Thank you again for taking the time to participate in today's story that I wanna talk about. It is Confidence in the Finer Details. What does that mean and how does that translate to what we do as hearing care professionals? How we help people hear. So, as I go through this presentation, please feel free to ask questions as Melissa had already indicated. Provide comments. I know that it's hard to be interactive on an online kind of course, but I do want this to feel very informal and to be as beneficial to you as it possibly can. So, let's begin with some learning outcomes. What do we expect to get out of this course today. Well there are four main areas that we at GN Hearing believe provide greater usability, convenience, and satisfaction for users of amplification. So we're going to discuss the story of how we provide amplification for people in the framework of these four main areas. From these areas, we derive user benefits, what does it actually bring to the patients. That is where we're going to see that everyday benefit, that everyday, "Aha, this is making my life better. "I can hear better. "I'm having less handicap after using "this technology in my life." And finally, we're going to talk a little bit about the LINX Quattro charger. It has been released in the previous year, but I'm going to overview some of the attributes that contribute to greater usability and convenience per user as, personally, I find it to be one of the most exciting kinds of advances to bring to the hearing industry, the ability to not have to worry about changing out batteries, to buy batteries, to fiddle with batteries. All of the things that we see our patients do on a daily basis, gets so much easier when it can be put into a portable, convenient, and usable kind of charger.

So, what is new? What is the same? The presentation will overview how our newest product additions, the custom models that have just been released for the LiNX Quattro line fit into the framework of the LiNX Quattro story and the story of where GN has been in the past and how it continues on the path towards its philosophy of

providing the most naturally good-sounding experience. The four areas that we believe attribute to the greater usability, convenience, and satisfaction, and this is where we develop all of our technology. In my role at Global Audiology, I am 100% in the research development department. And what we do is we put our input as audiologists into the technology. Is this something that's going to bring benefit, or is it just something that's a feature that's nice to have? And as the product actually goes through the development stages. We are there with it every step of the way, trialing it when it's a new concept, trialing it again with users when it is more developed, and finally trying to make sure we find the defects, find the problems before they get out to the field, and ensure that we validate how these products benefit people. So there's four areas that we concentrate on. First is brilliant sound experience, and this is what our patients usually expect without us having to say anything. It's 2019, and they said things are really good with technology. Sounds are good from stereos from cars, from phones. Why wouldn't they be good from hearing aids? So while we talk about brilliant sound experience in our industry, I believe it's something that our customers, our patients already expect to have. So we must not let them down at this most important facet. Next we have for the users who want to be able to tap into the technology around them, the streaming capabilities. How do we bring the sound of the television directly to their hearing aids in a way that is specifically designed and set for them. How do we make them be able to use their phones in a very seamless way to hear every word of that phone conversation, perfectly adjusted for their hearing.

This is the marriage of the technology in the hearing aids to the technology outside, for those very, very difficult situations like phones, and television, background noise, making it all much more accessible to people. Support and personalization is where people adapt or how the technology adapts to the patient's lifestyle. So, I'm sure that we've all thought in our lives that we've bought something. It sounded really, really cool. Wow, that's really neat. And when you bring it home, you realize, "Oh, it's got a lot of neat cool functions, "but I don't know how I would actually fit this in. "It's got a

lot of stuff I don't really need. "it's got a lot of stuff that I don't use. "I might try it once, but eh, it's okay." And then what happens to that technology that I paid so much for? I don't use it as much as I thought was going to. We don't want that to be including hearing aid technology. There are a lot of things that people can have, the hearing aids, the accessories, the connectivity to their phones, to their other smart devices, remote controls, chargers, you name it. We don't want it to just be an impulse buy that turns out to be not applicable to their daily life. So we have to be personalized. Another example is I bet that every single person on this phone call has a different set of apps on their phone, and that is because we have personalized our phones to make it make sense for us as individuals. And while we have some commonalities I'm betting, they're not always going to be exactly the same. So how do we bring that kind of personalization, that making senseness to hearing aid? That's the third area. And finally, the last area is the ease of use with the power supply. Batteries was something that we've dealt with for so long, and they still are useful, and they're used in many, many models of course today, and there are reasons for that. We're going to talk a little bit about why that is later on. But in the mean time, we're going to be discussing what went into the technology development of our rechargeable solution, and the thought processes, and the usability research that we took underwing to ensure that this solution was going to make sense and be usable for people.

So let's start with the signal processing, and always the part that's taken for granted by patients, but the part that I think we as hearing aid manufacturers tend to focus on a whole bunch. But what is most important? It's not necessarily what's inside of our platform. The platform itself, the chip, the processor, we talk about all of these terms. And every time there's a new product release, we talk about how much better it is. It has more computing power, it has a better speed, it has increased memory, it has reduced power consumption. All of these things are very nice to have, but they mean nothing in a vacuum. They don't mean any of these things in isolation that they're going to bring to sound experience to a greater level. It's how you use this as a means

to an end to enable the real improvements in audio capabilities. So, this is a useful bit of information of course if you have patients who are looking online, trying to find the most advanced processors, the most advanced chips. These are kind of information that they may feel very comforted in knowing. For example, the 20% reduced power consumption. That actually directly translates into a user benefit, because it means that if they're using batteries, they won't have to be changing them as often. And if they are using a rechargeable, then they won't have to be charging it as often. These are very important means to an end of what we put into the signal processing packet. signal-to-noise ratio improvement is a main focus for all hearing aids today, because it is the area where people usually have the most difficulties. Every patient that I've ever fitted has told me something along the lines of, "Well, I hear you fine. "If only everybody talked like you, "I could hear everybody just fine." Well, that's because I'm in a quiet room, in a fitting suite where everything is controlled and calm, and I'm not really speaking really quickly, and there's not a lot of background noise. But that's not real life, and that's not where the troubles begin.

The noise problem is, has always been, our biggest problem with hearing technology. So we have to build up what is gonna be our solution for that. And for most companies, that is a directionality option. For GN Hearing, we strongly believe in the concept of making the technology work together with the natural processes of how the brain works to help us hear. What does the auditory system automatically do and how can we augment that by making sounds more accessibly and audible to people. Over the last 10 years, we've been developing a foundation, which is in its latest culmination called Binaural Directionality III. And this is the baseline for our audiological philosophy. We have been working on it throughout the last 10 years to improve it as the technology has become more available to us, but it is based on research published in 1990 by Bregman, about how we as human beings use our auditory system, use our auditory cortex to make decisions about what to pay attention to and what to ignore in our environment, especially those with noise. We want to be inspired by nature, that is

the way that the human body works, to tailor our technology to fit those needs. How do we process sound the way that nature intended? Well, we have to respect the way that the auditory system was designed, and we also have to accept that we don't know, once that our patients leave our offices, what kind of environment they're going to be in at any precise amount of time. They might be going to a big-box store next or they might be going to see their grandchild's play at the school. These environments are not predictable by us and they're not predictable by the hearing aids either. We also don't know what the patients wants to listen to. Sometimes they want to listen to their conversation partner in a crowded restaurant. That's really what they want to hear in some cases. Other times they want to hear what the waiter just said to the next table, because they might be interested in that special as well. We as humans are always thinking about what is the most important signal to listen to. We just don't honestly consciously think of it most of the time, but it an innate thing that we do.

And so we shouldn't have technology overriding the way that we naturally want to hear. Our technology needs to maximize audibility and provide situational awareness. That situational awareness alerts us to things that are happening outside of our focus area, so that we know whether we need to switch focus. When somebody said something in the middle of a different conversation that you're having that is all of a sudden really important, like, "Come quick, this just happened, I need you." You need to be able to hear that and you don't want to be blocking those people out. So what we want to do is not have the situation with tunnel hearing. We don't want people to feel like they have to focus directly in front of them just to maximize their signal-to-noise ratio in a loud or noisy environment. We don't want to remove the listener from the acoustic environment. And we know that people don't actually don't always get to look at who they want to listen to. This research came out of Walter Reed in 2011. And the research was very simple. They took a very large number of people and had them write in a hearing aid use diary where the desired speaker was they wanted to listen to in relationship to them, and if they were able to look them on

directly, or if they were on the side, or the back, or maybe there multiple speaker, or people were moving around in the environment and not stayed stationary. So, while people do like to look at who they're interested in, because it does help us, it gives us visual cues, it gives us facial kinds of hints about whether a person is being sarcastic or not, or whether they're joking or not, we love to be able to look at people, get all those nice rich cues that are also non-verbal. That only is really applicable 68% of the time. The remaining amount of the time, the speaker might be on our right side or our left side. Maybe we're sitting next to them in a bus. We're not going to necessarily swivel ourselves all the way around to hear them the entire time, eve if that would optimize our signal-to-noise ratio. It's not a common human behavior. Or, if you're sitting at a lunch counter and somebody is speaking with you while you are eating. You probably can't move your plate all the way over to look to look at them. If you're driving a car or somebody is driving a car for you, that means you're not able to really see them. So these are all situations where you're not able to really look straight at the person who is speaking, and these are the times we need to pay attention to.

We need to make sure that people are getting benefit not just 68% of the time, but as much of the time as they possibly can, knowing that we can't predict what another person wants to hear, and neither of course can the hearing aid predict what they want to hear. We should have a microphone configuration that provides directional benefit, making it easier to hearing noise while still hearing all around. So what we would rather have is a focus on what is going on in the environment. That's an awareness strategy, and this comes from the Bregman research in 1990. It states that the normal auditory system uses processing strategies for surround sound, and the auditory cortex needs input from both ears to be able to create a detailed three dimensional picture of what's going on around them. On the other hand, we also need to support a better ear strategy. That in layman's terms is kind of how I think of when you're in a noisy environment, somebody is saying something really interesting to you, and you can almost feel yourself zooming in on them, almost feel yourself focusing and being able

to understand them better. And we have all different ways of doing this, of course learning forward or cupping our ear. These are behavioral things, but they don't go all the way. So we need to also realize that part of that focus happens in our brains, and we need to be able to utilize this better ear strategy which also uses the inputs from two different ears to be able to focus and suppress signals that are not interesting and increase signals that are more interesting. And the fact that we have two ears separated in space on our heads on the sides actually is designed to help us have visibility, to be able to compare and contrast the sound coming from each ear to focus and make a better signal-to-noise ratio for a particular sound. So it really is, of course, a beautiful, beautiful system that we're trying to work with here, is the auditory system. And we need to make sure that we're not overriding it or making it more difficult by putting technology like hearing aids on top of it. At the same time, we need to realize that there's spatial hearing around us, and this is also a benefit of the way that the auditory system works. We're able to, from those two ears, create an auditory image of the environment that creates a natural sound quality. You can tell where sounds are coming from by interaural level differences, by pinna restoration.

The fact that you have a pinna basically funnels the sound to amplify higher frequency sounds more, which is helpful in noisy environments. We're able to tell if a sounds coming from in front, or in back, or right to left, based on timing, level, and pinna cues, spectral cues. So all of these cues need to be supported, and that is going to be built into our directional philosophy automatically as well. We did a study, because we were interested to see how much this actually makes a difference. And what we did is we had people do a task where they had to localize sounds coming from in front and sounds coming from directly behind, literally a forced choice, point to where the sound came from, zero degrees or 180 degrees. And we had them do with unaided, so it was loud enough for them to hear. They were mild, moderate loss, but we made the sounds loud enough to hear, and they, unaided, performed at about 3% of an error rate. So their front to back confusions, when they got it wrong was about 3%, unaided. And

actually, this follows with the normal hearing population as well. People are not completely 100% on this ability, because front to back is very easily confused since the timing and the loudness levels are the same on both ears. And all you have to help you are the vertical and the, I'm sorry, the front to back localization cues coming from the spectral help from the pinna effect. So this is a situation that's pretty difficult, because even unaided, normal hearing listeners don't get it 100% correct. But be that as it may, we realize limitations, and that 3% is something to shoot for. That is our gold standard in this case. When you put hearing aids set to omnidirectional without any kind of spatial processing on them, the location of the microphone above the pinna wipes out those natural pinna and spectral cues, such that you end up with 44% errors. And when you consider it's a forced choice kind of quiz where they either point to the front or the back, their chance, results of getting it right are 50%. So they're almost forming a chance. That's how much this kind of technology without spatial cues built in can distort the localization abilities that are natural in the brain.

Pinna restoration, as part of Binaural Directionality III or on its own as a selection option in the programs will restore that ability back to 4% errors. So, almost exactly what it was unaided in this kind of front to back localization quiz. So in summary, we want to provide spatial cues for the 3D environment and localization. We don't want to cut people away from things that we don't know what they want to listen to. We want them to have all of that information, so that they can make informed choices, that by better ear strategy and awareness strategy takes advantage of the advantageous location of the ears on both side of the head to promote what naturally occurs in the auditory system. And that is to provide as much speech understanding from the front and difficult listening situations without cutting the user away and while promoting good sound quality in all these situations. Some of the other advantages gained from the new chip is a improved A to D conversion. What this allows is a input dynamic range maximum of 116 dB SPL. That means that sounds that peak all the way up to that level will not be clipped, will not be distorted. They will pass through and be able

to utilize the full range of the MEMS microphones, which are modern microphones that are used in this technology. It also enables a 50% faster sampling rate, and that supports a new extended bandwidth up to 9.5 kilohertz. Finally, the better resolution from the A to D conversion bit rate provides a more accurate reproduction of sound, and that's the fidelity. If you compare the sounds coming into the hearing aids as the input sound, they are 100% fidelity because they are not distorted. And then when you put them to the hearing aid processing and you add more gains for high-frequency sounds perhaps, and you put on some noise reduction, et cetera, that fidelity, the way that it was initially will change based on the signal processing. But can we maintain as much of the quality as we can, knowing we were adjusting the gains to make things more accessible for our patients. That is where we get the benefits of that higher resolution. The input dynamic range being higher does a lot when it comes to music especially, and the nuances, the sound quality that we may take for granted with unaided hearing, but which could be distorted with hearing aids.

And increasing the input dynamic range enhances the ability of a hearing aid to process sound at all input levels in greater detail, without that kind of distortion. Marshall Chasin is an expert in hearing aids and music and how they work together. And this quote, I really like it. It really just sums up why we need this technology. He says, "Only when the front end," what goes into the hearing aid, "has been configured to be distortion free "can a hearing aid be optimized "for listening to and playing music." And when you look on the right side on the table, you see that these common instruments, while I don't necessarily consider all of them to be super loud, do have peaks going up into the DBA ranges of around 106, 108, et cetera. Traditional hearing aid processing would distort those peaks and change the nuances and the sound quality for a trumpet for example. So having a higher limit just allows more of the sounds to be processed the way that they should be. In the frequency domain, having an extension to 9.5 kilohertz also provides that richer sound experience because those frequencies are more audible, are more accessible to the user. So it makes sense to

widen and lengthen our ranges as much as possible, because realizing that the human auditory system, 20 to 20,000 hertz. We're not at 20,000 hertz, but we are definitely better than where we used to be, and hearing aids all used to be around five to 6,000 hertz, then 7,000 to 8,000 hertz. Now we're up to almost 10. So these are very big advances. I'd like to play a video here of what the significance of being able to classify the sounds in the environment for the signal processing. We talked about input dynamic range max. We talked about the frequency extension of the bandwidth, but we also need to make sure that the classifier inside the hearing aid is identifying different settings so as to know how to process those sounds, and maximize the sound quality provided by this technology. So, I'd like to go ahead and play this video here.

- Hearing aids today have sophisticated features that automatically adjust sounds like background noise and speech signals for comfortable listening. However, in order to take advantage of these advancements, the hearing aid must correctly detect or classify what type of sound environment you're in. If it doesn't, you can end up with less natural sound and poor speech recognition. A good place to test hearing aid sound quality is in a movie theater. The mix of speech, background noise, and music can make it difficult for hearing aids to react accurately. Today, we're going to listen to two different sets of hearing aids, ReSound LiNX Quattro and the latest from a competitor. First, let's listen through the competitor's product wile we play a movie scene in the theater.

- I love you, Rio. Take care of yourself because I'm so afraid to losing you.

- Now let's listen to the same scene through ReSound LiNX Quattro.

- I love you, Rio. Take care of yourself because I'm so afraid to losing you.

- As you can hear, ReSound LiNX Quattro has the most accurate environmental classifier. So, it makes listening to speech, when there are competing sounds like music, easier and more natural.

- [Tamara] Okay. So, Jill is actually in my department as well, and she had some fun making that demo, but it's meant to illustrate how it's important to make sure that the hearing aids are correct when they are determining is this a sound with speech and noise, is this speech alone, is this noise alone, et cetera. It is a starting point upon which all the other features and signal processing happens, and so it needs to be correct. This study was done to evaluate in a test box how hearing aids react to different sound levels and sound quality environments, such as speech babble, quiet, conversation with various background noises and levels, and a kitchen noise like a hand mixer. And we included ReSound LiNX 3D for this, as well as five other hearing aids that were on the market at the same time. And it was very simple. We put the hearing aids in the test box, play a sound file that is going to be data logged by the hearing aid, and you can read it out after about 48 to 72 hours. So the hearing sitting in that test box in one single environment, listening to the sound for 48 to 72 hours. We take it out and we hook it up to the fitting software and we read out, was it data logging, what environment it actually was in. The accuracy of our system was something we were really happy about and we focus on here the results per speech and noise, and this is because we find that speech and noise is probably the most complicated and difficult listening situation people are in. So we need to ensure that we are going to be accurate, so that we know which directional kind of mode we should be in for Binaural Directionality III, what kind of noise reduction setting is appropriate if we're using per environment noise reduction. If we are accurate in identifying what the environment is, our features will work as designed. So, 98% was the accuracy of our recordings for ReSound in this test. The next test that we did was to look at the proof of benefit for music programs. We want to validate that our technology actually make sense, and so that's why we do these kinds of tests. So

again, we took this time the LiNX Quattro versus a couple of other hearing aids from different manufacturers. And we had test participants choose their preferred instruments when listening to the instruments in pairs. And these comparisons were made for pop music. So we were asking them to comment on the music programs. Again, a place that you will see differences related to the extended bandwidth or the input dynamic range being widened. So they had two choices. They had to choose between them. And since they were using these hearing aid technology, we didn't want them to choose based on comfort or base on the way it felt on the ear, or what they liked better, or what they've been using before. So, instead, the sounds file were all recorded and presented over headphones. And this also was a nice way of doing a double-blinded study, because then the tester who was presenting the sound also was not sure, did not know what the patient was listening to at any given time, as it was randomized and double blinded.

The hearing instruments were fit to this audiogram here, which is called the N3 for ISMADHA classifications. It's a mild to moderate sloping. The music program was set at default settings for all the hearing aids, low-power receivers, closed fittings, and 10 hearing impaired test subjects were trained for listening to music through hearing instruments, and then also chosen because of their similar audiograms to the N3 standard audiogram, so that the gains would be roughly correct for what their hearing was. We used an acoustic manikin to make binaural recordings of music for each pair of the hearing instruments. And this pop music was played from the stereo speakers that were placed in front of the manikin. So the recordings were compensated to remove the influence of the manikin's ears and the frequency response of the headphones, so that we can really measure what we wanted to measure, which was the sound quality of these signal processors. Here are the results. And after several trials for each of the patients on each of these different forced choice alternatives, 95% of the time, listeners prefer the sound quality for music with ReSound LiNX Quattro. So this is another way of illustrating, again with music, our most demanding environment

for sound quality. Will this improvement in our chip capabilities bring better sound experience? Moving on to streaming. We know that streaming have been out. In fact, in 2014, MFI streaming, was the first time that we introduced it in hearing aids with the LiNX devices. But here we are five years later. What has changed? Well, a lot has changed in terms of the connectivity, usability, and in this case a full spectrum of streaming. This new chip also provides us more sound, action, and rhythm for streaming sounds from devices. So, the bandwidth of our hearing instruments is 9.5 kilohertz, and the bandwidth for our direct MFI streaming is also 9.5 kilohertz. As you can see here, this is a representation of ReSound LiNX Quattro versus a couple of other hearing aids on the market. And you see that extra amount of amplification passed 7,000 hertz to almost 10,000 hertz. Since people will stream phone conversations, but also music video from their devices, we find it really important to be able to provide this kind of capability to them.

Again, the testing. This time through the Delta SenseLab, which is an independent laboratory in Denmark that does testing for a lot of hearing aid manufacturers in fact. And this test looked at people's preferences for sound quality when streaming music and speech. And here are the results. LiNX Quattro and LiNX 3D were included in this testing. And you can see that the results for LiNX Quattro were even quite a bit bigger, greater than for LiNX 3D. And why is this? It's because of the chip enhancements and the ability to have these wider, broader, inputs be processed more naturally through the hearing aids. We don't wanna forget the rest of our wireless accessories however, and we are going to utilize the high frequency range in our wireless accessories with this technology as well. One of the accessories that is not new to us, but one that I think always bears reminding is the Multi Mic. The Multi Mic is an accessory that someone will wear for example, in a crowded restaurant, and be able to stream their voice directly to the patient's hearing aid, or if they're in a lecture hall, or a place of worship. This Multi Mic can be work or held or put near a sound source to make it be

optimized for signal-to-noise ratio in that noisy environment. So, we go ahead and play this one here.

- The ReSound Multi Mic and Micro Mic are able to improve the signal-to-noise ratio in difficult listening situations. Today in our demonstration, we are going to use the ReSound Multi Mic and simulate a restaurant environment with background noise. You are now listening through the ReSound hearing aids. You can hear my voice fairly well, but the background noise is also prominent. Now I'm going to turn on the ReSound Multi Mic. You are now listening to me with the help of the ReSound Multi Mic. My voice is much easier to focus on and the background noise is reduced, helping you to keep track of your surroundings, but also allowing you to enjoy the conversation.

- [Tamara] So of course that's a very dramatic example, but that is the kind of signal-to-noise ratio benefit that we see from these direct streaming accessory. 20 dB of directional benefit can be attained from these kinds of accessories, whether they're FM systems, Multi Mics, Micro Mics, et cetera. And so that's why they bring a lot of value, especially for people who have difficulties listening in background noise more than even other patients. Along the lines of streaming, I'd like to talk a little bit about our newest development in the streaming realm, and that is the introduction of a Bluetooth Low Energy streaming protocol developed in partnership with Google for Android devices. We have a partnership with Google. And in fact, I was very excited to be able to be part of this partnership in the research and development of the product, helping them by fitting the products for their employees so they can test them before we were ready to launch. So this has been happening for quite a while now, because this technology did not exist for hearing aids. It's a new Bluetooth Low Energy protocol. What that means is that there are two different kinds of Bluetooth protocols used for audio streaming to hearing aids. One of the is Bluetooth Low Energy and the other one is classic Bluetooth. Classic Bluetooth has been designed in the past for sure to be able to stream signals with a lot of data. However, for hearing aids, that

does not always equal better audio streaming capabilities. The ranges of hearing aids are still less than what they would be on a big loud speaker kind of situation or a surround sound system you would see at a theater for example. Hearing aids simply cannot process most of that data. So that is why ReSound worked with Apple and Google to develop iOS and Android audio streaming protocols based on Bluetooth Low Energy. So, it has been optimized to provide the best sound quality while consuming 1/5 of the power of classic Bluetooth. And what that means for our users is that they have a whole lot longer battery life. Currently, because it has just been rolled out, part of the agreement has been that it would be rolled out in Google Pixel 3 phones at first. But then with the Android V10 operating system, eventually, it will be rolled out across other manufacturers. That is the way that Android works. It's developed as a protocol, and then every manufacturer can adapt it proprietarily for their devices. That is why it's not available in Samsung or Nokia phones at this time, because that protocol has not been made proprietary for those manufacturers yet.

But it is a huge step forward in the use of Bluetooth Low Energy to stream to hearing aids. And what can you do with it? There are no limitations. It is the same as what it was with made for iPhone. You will still stream phone calls, stream music and videos. You still do not need any accessory. The pairing process is a little bit different. Because it's an Android device, as you would expect, has a difference from the iOS devices. But it is developed with usability in mind, and it will accomplish the same user benefits. So when we look at the eco system now that we've been talking about, the hearing aids and how they interact with the wireless accessories, the Android, the MFI, and the apps, we have a complete ecosystem now which includes custom devices on the same platform as LiNX Quattro. So you have some more options for your patients that are more interested in a smaller custom device. The differences between Bluetooth Low Energy and Bluetooth classic, again, are highlighted on this slide. And as you can see, there are many similarities, but the major dissimilarity is the power consumption. With Bluetooth Low Energy, there will be lower power consumption,

meaning that you will not need to charge as often, and you will not need to change your batteries as often. That is the primary difference between Low Energy and classic. And at the same time, we realize that made for iPhone was also a lower energy option, and that has brought us the music preference for streaming results that I just discussed a couple slides back. So we're not sacrificing sound quality, but we're gaining better energy efficiency, and this is true for all of our devices now, including the customs. But before I talk a little bit about the customs, I wanna touch on that third area, support and personalization. How do we make these devices convenient for people? Well, as I mentioned before, everybody has got different apps on their phones, because everybody has different needs. And adjusting hearing aids to optimize the environment is a very personal kind of decision, and you can make this decision any time with an app. The Smart 3D App offers even more control for the patient now, and it is also including the ReSound Assist program, which allows you to communicate with your patients, to be able to receive and send remote fine tuning request, so you can adapt their programming to their needs. So this shows a little bit of what you can do. We still have a sound enhancer here on the screen. And when you press it, you will be able to change different characteristics, for example, the bass and treble.

If you have a Tinnitus Program programmed in, you can alter the settings of that Tinnitus sound generator to include nature sounds, even if you didn't program them in in that program. As long as Tinnitus is on in that program, the patient has the wide variety of Tinnitus solutions. So they can make choices. Maybe they didn't know at the time when you programmed if they wanted nature sounds, or if they want more traditional kinds of masking. They can change that with the app very much in the moment. The app also gives indicators about the battery status and indicates of course, as it has in this slide, when it gets to very dangerously low level. That means it's time to recharge the hearing aid. ReSound Assist is built into the app as well. And for those of you who are new to the ReSound Assist, how it works is that a patient on their phone will be able to send a request to the fitter who can access that request in

the office at their convenience to analyze the request, to provide feedback, and to send a package of new fine tuning to the patient if they would like to. The patient, at their own convenience, will be able to download that package of information, that change to their settings, and the be able to provide feedback as well. So, the real benefit for patients is convenience. They could be in the restaurant having the issue and be able to communicate exactly what is top of mind at that time, and the confidence that they have somebody that can help them right at their fingertips. The benefits for the professionals, for us, is that we can be more engaged with our patients while at the same time addressing their concerns at a time that's convenient for us. So that when we get back to the office on that Monday morning, we can see that there was a request, we can see address it then at a time when it's not obtrusive to the rest of our schedule, but can also be responding back to that patient in a way that was never able to be before. So we've talked about the brilliant sound experience, and the full spectrum of streaming, and the support and personalization. The final area is rechargeability. That I believe is a huge asset to this technology. We have the most advanced rechargeable hearing aid with the lithium ion battery that is completely sealed. So it's easy to use and that is not hassle at all.

And finally, it's very quick and long-lasting. So that gives people confidence in using this kind of technology in their lives. They're already used to being able to plug in their phones, et cetera. So plugging in their hearing aids kind of seems to fit along those lines. Three hours will give you up to 30 hours of battery life. And even if your patient is one of those that streams a lot, they could stream for 12 hours straight and still have 24 hours of battery life on a three-hour charge. A one-hour charge will give you 16 hours of battery life. And we've all been in the situation where we've forgotten to charge something. Well, 30 minutes of charge gives you eight hours of battery life. So that is a significant amount of charging power that quick power charge really helps instill more confidence. In addition, the charger, as you can see peeking out of the bag here, is designed to be portable. It has a lid. So that when you use it as a storage case,

you have your charger with you, and it will not get damaged by debris or moisture. The battery in the charger carries at least four years lifetime of battery. And the charging method is induction, meaning that all the patient has to do is simply slip the devices into the slots shown here on the charger. They don't have to align with any kinds of contacts. There are no external contacts. It's induction charging lithium ion technology. So it's very much the top of the line. The charger case itself carries up to three charges. So let's say your patient forget their cord. They took their charger with them, put them in their purse, but the cord that connects it to the wall socket is still at home, and then went on a weekend vacation. That's okay. The charger will carry three separate full charges for the hearing aids. So even without the cord to be able to charge the charger, you're able to provide them that kind of ease and convenience. Again, we wanted to make sure it wasn't just us saying that it was easy. We wanted to make sure that it was easy. And so, this technology was designed and tested for usability. We have a whole department that's within Global Audiology as well just full of people who are user design and user experience specialist. And what they do is ask the questions of, does this actually makes sense to somebody who's not in the industry, who's never touched it before?

Can they do it intuitively without having to read all of those user guides which many of us don't have time to do? So, it has been designed to be easy to use. And in fact, our studies indicated that 90% of first time users can set up and use the rechargeable system without instructions. So, this is a major advantage to be able to provide this hassle-free kind of charging without having to make it difficult. So here we come to the part where we are adding the custom devices to our portfolio for LiNX Quattro devices. Our BTEs are still LiNX 3D and ENZO 3D, but of course those things change of course. That probably will be changing too. But today I'd like to talk about the custom line that we have just launched. We're getting this brilliant sound experience in our RICs to our custom devices in four different models. The CIC, the ITC, the ITE, and the Mic-in-Helix, which is like an ITC but with the microphone removed to sit in the upper

part of the conchal bowl, so as to be protected from wind and to also provide a greater vent. I've got a question. Will IIC be available? And thank you for the question. At this time, no. The CIC is the only one available at that size level, but the reason for that is because all of these devices have 2.4 gigahertz wireless technology. So if you're familiar with ReSound products in the past, we always have a little asterisk. Oh, this CIC isn't wireless because of the small battery size. It has a 10A battery size, it still does have a 10A battery size, but now with Low Energy protocols, we can bring Google direct streaming and MFI wireless streaming to the CIC devices. Without sacrificing the legacy that we've had, we're going to put as much as we can into these smaller devices, knowing that custom devices are very limited of course in their size and the spacing between the components, but they still have the new chips set with the new feature that we introduce last year of impulse noise reduction.

Increased input dynamic range, extended high frequency bandwidth, new wireless radio, which allows that kind of capability in our CICs with 10A batteries especially, and all of the app, mix-in streaming, and connectivity that you would expect from the RIC devices. So, our options are, for the ITE, because of the improvements in our e2e, we also have the Binaural Directionality III available. And of course that is available in the nine level devices with that e2e turned on, and dual microphones. So, of course the directional response requires dual microphones with our company's technology. So if you have two microphones on these devices for an ITE and ITC, you will be able to have Binaural Directionality III. The ITC actually is a directional mic only, but it does not have the single mic option at this time. However, it just not have e2e. So, in fact, the smaller ITC will be available with soft switching and adaptive directionality, but the Binaural Directionality III is goin to be available in the slightly larger half shell or ITE form factor. The Mic-in-Helix is the same great product as it was before. Again, a single-mic device, but you get those through activity cues from the pinna effect because it sits deeper into the ear canal, and it's going to be available with the 312 battery. And finally, the all-new CIC, which is the world's first 2.4 gigahertz direct

streaming CIC with ear-to-ear connectivity, made for iPhone, Android, direct streaming, and Resound Assist. Now how did we do this? Well, we changed a little bit of the design for the pull-out, the removal cord. So, in the past, of course, CICs have a removal cord generally and it's basically just a little piece of plastic that you pull on, and it doesn't do anything but that. But we double purposed it into the antenna as well. And after a much, much testing on pull force and the amount of damage it could take from people trying to pull a CIC out of their ear, this is a very robust antenna that is built into the face plate and allows for the ear-to-ear connectivity for a CIC and the made for iPhone wireless accessory connectivity and Google Accessibility in a CIC device with a 10A battery. So, this is really something that we're proud of and excited about, because it is basically a new version of a CIC that's out there. That doesn't have the limitations that we had in the past. So, how do we sum up what makes a good product? A good product of course has to have great sound quality.

That's a given for our patients. Many of them expect nothing less. We also need to be able to support the needs of those that want to stream. Not every patient will be using their streaming capabilities. But for those that want to, this is the top of technology. This is the best that we have ever been able to provide as an industry. So we wanna make sure we provide them with that full spectrum of streaming. The support and personalization is how they build this technology in to their lives. They don't want to do the opposite and change their lives for the technology. I feel like the perfect goal working in R and D is to make technology that people don't ever think about, that is so seamless, that it fits into their lifestyle, that it becomes part of them, and it doesn't run their life. If any of you know how it feels like, I don't wear hearing aids for hearing loss, but I do wear contact lenses. And what I love about them is that once they are in, I don't feel them. I don't have to worry about them. I have peripheral vision. That is the adaptivity and personalization that I'm talking about, and we do that through support and personalization of the apps and the technology to make it specific to the patient. And finally, to those that have the receiver in the ear rechargeable solution, we wanted

to get it right. We weren't the first in the market with rechargeable lithium ion, but we wanted to do the best we possibly could. And I'm pretty excited about the way that our charger has been designed. Over the years, the philosophy of ReSound and GN Hearing has been how do we make sure that our technology is future-proof. We don't want to come out generation after generation with, "Oh, but now there's so much better "and it doesn't work with our old accessories," or "Now this works, but now you can't have that "because this is a different platform." It's not easy to actually do this, to make things work in that kind of line of succession, but that is our philosophy, and our philosophy is also about trying to go that extra step. What is the next thing? All the way back to 1988 with wide dynamic range compression, all the way through 2019 with the first Bluetooth Low Energy direct streaming hearing aid, we keep trying to do what has not been done before. Not because it's easy, but because we know that it is the best for what we can do to make this work. So, thank you so much.

And I'm seeing a question here, so thank you. Let me get that. So the current remote control will still be available. Yes, the current remote control will still be available and works with these devices as well. Are there any other questions? I want to thank you all for joining. If you have questions that you think of... Oh, we have another question. I was gonna give you my email, but I'll give that to you in a minute. The next question is, how much bigger is the new CIC? The new CIC is bigger than the old CIC. And so, from a fitter perspective, I would say that with the CIC anyway, you have to take into account the size of the ear canal and the patient's ability to get a device into the ear. So those are always considerations with any CIC. Because of the new face plate and the antenna in it, this CIC is bigger than our previous CIC. So, for my patients that have smaller, more stenonic ear canals, I think would make them, I would guide them towards perhaps the ITE half shell if they wanted that, all of the bells whistles, or receiver in the canal version, because I know that that would be a comfortable fit. But for the patients who have the more traditional sized ear canals or the larger ear canals, this is something that would be better for them then. And how much bigger is it, I don't

actually have the dimensions on that. But as I witnessed the trials that happened here in Chicago on this technology, I do know that many of our patients were fine, and we were able to fit them successfully with this kind of technology. So that's a really good question. Thank you. My email address is T as in Thomas, Stender, S as in Sam, T as in Thomas, E, N as in Nancy, D as in David, E-R, and @gnresound.com. And if you have any questions, I would love to hear from you. So, I wanted to thank you again for taking the time out of your day to listen and wish you the best of luck in all of your fittings.