Introducing ReSound ONE: Hear Like No Other

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- [Laurel] All right, welcome. It looks like we can get started. I'm so glad that you all join today to learn a little bit about our new product ReSound ONE. I'm Laurel Christensen, I am the chief audiology Officer of GN Hearing, and it's really great to be here to talk to you today about our new product. I will take you in the next hour through really the whole product as an overview of all of the new signal processing and everything else that's new with the new hardware and the new charger, and everything that's new about the products. We'll spend about an hour going through the entire product. But let's start with just going through the learning outcomes. So after this course, learners will be able to explain the patient benefits of All Access Directionality. Identify situations where Ultra Focused binaural beamforming is recommended for patients. Describe the improvements provided by the new microphone and receiver in ear technology. We call that M&RIE. And discuss the components of the ReSound ONE ecosystem.

All right, so we will get going. So since its beginning, the ReSound philosophy has always been to emulate the natural hearing process as close as possible. We call that organic hearing. It's the foundation of our technology that leverages the individual's hearing anatomy, how the normal ear works, and how normal hearing individuals process sound to enable people to connect to the world around them in the most intuitive and natural way. We have followed this philosophy since before I joined the company which was 18 years ago. And following that philosophy, we have brought to market innovations that meet end user needs, and more of the truly industry, industry changing technology advances than any other company. If you take a look at this timeline, you'll see some of the advancements in hearing aid technology coming up along the timeline. And I won't take a lot of time, I could go through each of these, but I won't go through each of these, but I will highlight some of the really big technological advancements that have occurred in our industry. And I start back in 1988, which is when the first wide dynamic range compression hearing aid was introduced onto the market at that time. And so at that time, there were linear hearing aids and the gain

was applied no matter if it was a soft sound or to a loud sound the same amount of gain was applied. And ultimately they would hit a ceiling and they would either be peak clipped, or compression limited and these hearing aids, for the most part, lots and lots of them ended up in the drawer, they really did not have a good sound quality. Even studies that have done actually showed that they did the opposite and noise, then improve speech understanding they actually made speech understanding worse. And then in 1988, Wide Dynamic Range Compression it was actually introduced by ReSound. And this was a technology of course, that gives more gain for soft sounds than loud sounds. And today, there isn't a hearing aid on the market that doesn't use this technology. And of course, it's based upon the organic hearing philosophy. What is the cochlea do? The cochlea is Wide Dynamic Range Compression, there is gain given for soft sounds by the outer hair cells. So you're mimicking what the normal ear does, and again, when you mimic what the normal ear does, and you build it into the technology, you tend to have, you know, big advancements and this was a huge advancement in our industry.

If you fast forward a little bit to 2003, again another ReSound advancement, where open hearing aids were first introduced to the market in the form of ReSound air at the time. And what happened to, to get to that innovation is first digital hearing aids had to come out on the market, which is another very large innovation. And then through digital signal processing, we were able to create feedback cancellation. So we were actually able to know what the feedback look like and put in a filter that was the opposite of that feedback so that you could cancel it out. And so being able to cancel out the feedback, allowed then for an open fitting, completely open. And this also changed the industry cosmetically, there was a thin tube with a very small cosmetic BTE, and so this really is kind of the beginning in 2003 of where the industry is today, where 79% of the hearing aids that are sold today are either receiver in the ear behind the ears dials, or truly behind the ear dials, with the receiver in the hearing aid. At the time in 2003, 80% of the hearing aids sold in the United States at that time were

custom products. So this was a huge advancement to have an open hearing aid and it brought with it a big change in the market. Again, I'm not gonna go through all these technologies. But if you move over to 2012. Again, this was a ReSound and innovation, and we put out 2.4 gigahertz onto the market in 2012. And at that time, all wireless technology had some sort of intermediary device that the patient had to wear around their neck, and the intermediary device picked up the wireless signals usually Bluetooth kind of transmitted signals, and then sent through magnetic induction up to the ears. So, frankly, people didn't take advantage a lot of the wireless connectivity, especially connectivity to TVs and microphones and things like that, because it wasn't something cosmetic that people would really wanna do. But yet, look at the innovations there where you use 2.4 gigahertz to connect direct, take that necklace away. And now cosmetically, you are connecting to accessories directly.

But then further, you really had to be on 2.4 gigahertz in order to connect to mobile phones. And so really 2012 was the beginning of really the whole connectivity in our industry to mobile phones and then of course, ear to ear connectivity at the same time could be done using that 2.4 gigahertz. So with ReSound One, we are about to change the industry again. And this is a product that comes with this microphone and receiver in ear we call it M&RIE, and All Access Directionality, both of which are new advancements in the industry that are going to help patients in many ways. And I think that you'll find, as we look back in history, again that this was another one of these large technological achievements that pushed our industry forward, and ultimately made for a better hearing experience for the patients that we serve. So how did we start? I like to kind of talk about, how do we come to the developments that are in ReSound ONE, and I think when we look back at it from a research and development perspective, we look at two clear drivers of hearing aid satisfaction. One of those drivers is natural sound. Patients want the most natural sound experience that they can possibly have. And, and we, even though there have been major improvements in sound quality in our industry through the years, we still really aren't at natural sound.

And I can just tell you from our own experience at ReSound, doing studies on sound quality, there were patients, some patients like some sound quality, some patients didn't like that sound quality, and it was a very individual experience of the sound quality. Even though, over the years, we've extended the bandwidth of hearing aids, up all the way almost to 10,000 hertz. And we've also extended the input dynamic range of hearing aids, to 116 dB, which is the same dynamic range as the microphones that you can put in the hearing aid. So, we've done technologically lots of great advancements in improving the sound quality, yet we've not lost that processed sound quality. Our patients still don't believe that it's just hearing with their own ears. And so definitely natural sound quality was a motivator in what we did here for ReSound ONE. Another motivator, of course is clear sounds and in clear sounds, we're talking about being able to hear noise. Of course, still, the biggest problem that people with hearing loss have is hearing in noise. And so, this is something that continues to need to be addressed as we move technology forward.

So to address these drivers, to address all these drivers, we developed a hearing aid that puts the user at the center and allows the user to hear the sound because everybody's hearing is unique. It's like a fingerprint. Everyone's sound is individualized, because everyone's ear is individualized. And so with ReSound ONE, we're actually going to allow the user to hear with their own ears with an open fitting, which, the most popular fittings out there, being able to hear with their own ears, rather than hearing where microphones are today. So let's take a look at that. So here on this gentleman, there's a hearing aid. And of course, on top of the hearing aid are the two microphones. And I've said it, probably this is the third time, 79% of hearing aid sold today, this is where the microphones are located. And so what do we give up when we locate microphones above the ear like that? So we give up a lot of things. We give up front back localization, because of course the pinna is for front back localization, is one of its very useful things that it does is you can tell the difference between front and back because of the acoustics of the pinna. The pinna also amplifies sound. You get

an amplification of about 20 dB, from 2000 to 7000 hertz, when you add the resonance of the ear canal and the resonance of the concha. But my resonance as a resonance of my ears is not the same as yours and is not the same as anybody, we all have our own shape, we all have our own size of ear canal and thus what is natural to me what I've been listening to my whole life is not the same that what you have been listening to your whole life. So we do in hearing aid companies today build in a pinna restoration into these hearing aids and we've been doing it for a long time. You hear words like in our company, we call it spatial sense, but every hearing aid company builds in this average pinna restoration and we do that because the pinna does amplify, the pinna does help with localization. And so we try to mathematically build that pinna compensation back in.

But the problem is, it's an average, and no ear is average, everybody has different ears. So the only way to get an individualized fitting is to actually use a microphone that is in the ear that can take advantage of the pinna of the acoustics, or everything that the outer ear does give. And so you see here in the picture in front of you, this is our new microphone and receiver in ear. This is the M&RIE receiver. And right underneath that receiver wire, you see an opening and that is a microphone. So now the microphone is placed down in the ear, it can be fit open, it can be fit closed depending upon the needs of the patient. But the point being that the microphone is where it needs to be, it is actually in the ear, where the patient can take advantage of their own ear acoustics, what they're used to hearing, and it will get the amplification and all of the benefits of the outer ear that the patient is used to having. So with that introduction, I will go through now and introduce you to this first full featured hearing aid with microphone and receiver in ear, and All Access Directionality. And there are four components to the hearing aid that I'll talk about. The first is sound quality. The next is connectivity. Finally, the design and then the fitting software. So as part of sound quality, I'm gonna go through All Access Directionality. So we have an entirely new directional system in ReSound ONE, I'm gonna go through that system and how it works. And our new Ultra

Focus setting which is another part of our directional system, and go through all the details around the microphone and receiver in ear. For powerful connectivity, I'm going to talk about all of our ecosystem of accessories, and talk about in detail our new standard charger. In the design for purpose section, I'll talk about all the new hardware, the new housings, new receivers, new domes, new colors, everything that we're introducing with ReSound ONE. And then lastly, I'm gonna talk about our fitting software because we have made some changes in the fitting software where we are individualizing, the prescription of advanced features. So you're used to it every patient getting an individualized gain prescription for their hearing loss, but we are actually going to individualize how much expansion, how much noise reduction, how much wind noise reduction, all based upon the patient's hearing loss and experience level, taking the fitting, actually to a more personalized and individual place as well. So let's get into the sound quality. So they're the three main new parts of ReSound ONE in terms of the signal processing inside the hearing aid, All Access Directionality, Ultra Focus, and the microphone and receiver in here.

And so let's start with the benefits. And of course, I'll go through how they work and I know that you're interested in that but I think that one of the benefits that they bring to the person that's wearing the hearing aid or probably the most important. So when we talk about All Access Directionality, this is a benefit that will automatically steer the best microphone choice for the situation. So everything is automatic, the patient doesn't have to do anything, and we will steer the microphones to get out the most possible noise while they can still hear the speech that they wanna hear. This allows users to enjoy conversations and sounds without being cut off. It's been our philosophy for many years that we don't want to apply narrow beams for patients to listen in, that we want only to apply very narrow beams like that in the most difficult situations where we know what the patient wants to hear is right in front of them. Otherwise, hearing noise should be done in a natural way. And hearing a noise to anyone who has normal hearing, is that you walk into that noisy environment and it's

noisy and you hear the noise all around you, but you are still able to follow many conversations in that noise and not being cut out of the surroundings that are going on around you. Again, it's our philosophy. It's part of that organic Hearing philosophy, we don't we want, we want the users of our hearing aids to get exactly the same situation than a normal hearing person gives. And that is they hear everything around them, but they are able to still then hear in noise. In ReSound ONE, we have improved the directionality by now having a new four microphone beam former. So when you think about these hearing aids, there's actually six microphones on, the hearing aid set. So if you have a binomial fitting, there are six microphones. There's the marine microphone in the ear, and then there are the two microphones that you're used to having that have been there all the time. We're using the M&RIE microphone for more quieter or less noisy, just smaller amounts of noise. And then when noise gets you know higher 60, 70 dB SPL of noise, then we switch into All Access Directionality. And we very gradually move that M&RIE response up to the microphones that are above the ears, and then we use the microphones above the ears to create the directional response.

And in ReSound ONE, we're using all four microphones now to create a very narrow beam on the directional ear. And I'll go through a little bit more of those details as we get forward. We are adding a user controlled feature to ReSound ONE called Ultra Focus. And Ultra Focus is when we do use the beam former very narrow, we also increase noise reduction and really make for the best setting of the hearing aids to hear in the noisiest or the most difficult environments. And this is completely user controlled. Where they can turn on both hearing aids will be the narrow beam. And this gives patients that just extra boost of being able to hear a noise. It's up to a 30% improvement in speech understanding over our All Access Directionality. So it gives patients that confidence to hear in those difficult situations. But we give the user the control of using that, so that we don't make the decision. No hearing aid knows what the patient wants to hear. We want the patient to decide to use Ultra Focus. And then finally, I've already talked about M&RIE, as we got going here, but M&RIE has lots of

benefits. First, it has spatial perception. And I didn't talk about this too much in the beginning, but when you are given sound, with a bandwidth up to 10K, and your own ear acoustics, you actually have the ability for the first time in hearing aid to spatially separate out sounds in the environment. So we in marketing for years, we've talked about spatialization and spatial sense, but in reality, what it's perfect Finding his localization. Being able to provide spatialization is you not only know the direction that the sound is coming from, but you know the depth or the distance away that that sound is coming from. Hearing aids today, mainly the sound is kind of right out in front of the patient. If you haven't worn hearing aids for a long time, you should put some in and wear them. Because what you will experience even in our ReSound LiNX Quattro hearing aid, which is a great hearing aid, most of the sound is kind of right in front or kind of almost center of the head to the person wearing the hearing aid. You don't perceive sound with depth and direction.

Yes, you can localize using a link spotter, but you don't get that dual that depth of the sound, how far away is that sound? And the benefit that provides, is that you can then spatially separate out sounds in the environment and like a normal hearing person, you can attend two different conversations. So perhaps there's a conversation going on, on your right and one on your left, you can actually decide with your brain, I'm gonna listen to the one on my right, and not the one on my left. Hearing aid users without good spatial perception that's provided by M&RIE can't do that. It's all just kind of all together, they can't spatially separate out that sounds. Other benefits of M&RIE, wind noise reduction, because of course, the microphone is just down in the ear. So it's a natural wind noise reduction. So we don't have to place any, signal processing on that microphone to reduce wind. I already talked about that natural sound quality that you get because you're getting your own ear resonances. You're hearing with your own ears, so it's going to sound more natural. And then finally, the natural directionality that you get with the pinna because the microphone now is down in the ear. So lots of benefits to all three pieces here, All Access Directionality, Ultra Focus and to M&RIE.

So getting into a little bit more detail on them, All Access Directionality, it does build on the philosophy that we have had for many years about not cutting the listener off from the surroundings that they're in. So we will still with All Access Directionality, place one hearing aid on an omni directional response and the other hearing aid on a directional response. We put the directional response on the side with the most noise. And what is different if you look at our previous generations of this type of directionality, is now on the side where we place that directional microphone, we're using that for microphone beamformer. So we are providing about two dB more signal to noise ratio benefit, than we were in the LiNX Quatro using the beamformer, and of course, this translates into better speech intelligibility. For most materials, that's about a 10% per dB improvement, so 20%, better intelligibility over links quatro. We are doing some unique things with our beamformer, that haven't been done before. And I talk about both of them. One is that we are waiting, the beamformer, and we're waiting it with the side, with the least amount of noise, providing most of the beamforming information. And then we're also using a form of multiband directionality that's new for us.

We've done multiband directionality before, but we've added a piece for spatialization. So let me go through what that weighted beamformer really means. So in this scenario, you have a hearing aid user who has people around the table. But in addition, there is noise in the environment. And in her case, there's a lot of noise, there's a lot of noise on the left, there's a drill, there's a jackhammer, there's a car. This is a very noisy situation off to her left, and off to her right, in this again hypothetical situation, there's only fan noise. So if you're gonna use a weighted beamformer blending approach, you would actually wait that right side that side that only has the fan more, than you would wait the inputs from the left side the side with all of that noise when you're actually making the beam. And so that's what we do. We actually wait more over to that right side and then we're getting out the most amount of noise that we can opening up the world for her to be able to hear all the people around her because again, we don't use just two microphones pointed in one direction, we allow one hearing aid to be honest

Omni, while she's getting really good signal to noise ratio benefit with the other ear, and that's all you need, you don't have to have two microphones set to directional to get that signal to noise ratio benefit. And then you get all the benefits of being able to hear everything else around you. So the weighted beamformer again, we're taking in less noise so that the beam is cleaner, the beam has less noise in it. So again, it's a signal to noise ratio improvement. In terms of the directional approach, we still use this multiband or band split type of approach. We have done that for a number of years were in the low frequencies, we keep things on knee. So the very low frequencies and this is adjustable based upon the patient's hearing loss, we actually will assign the frequency that makes sense based upon where the hearing loss starts to slope down. And everything below that frequency will be kept omni. That preserves the interaural time differences for localization, but it also, it also makes things sound exactly the same in the two years, the low frequencies is where you get that loudness. And by keeping both hearing aids omni, and the lowest of frequencies, they sound balanced, even though you're doing something different in the higher frequencies in that side, that is in using the directionality.

So in the mid frequencies is where we will go to the beam former. And we're using that beam former from, that adjustable on the low side all the way up a little bit above 5000. So we're really taking in the speech, and we're going to apply the beam former to the speech. And then above that, we're actually gonna use a fixed directionality at that point, not a beamformer, because it gives better preservation it opens things up and gives much better preservation of the inaugural latency queues. So for better spectral queues, we actually will change the directionality above five K. So we're using that multiband approach, because of the spatial cues that we can preserve in the different ways of doing it, along with giving the best speech intelligibility that we can. So moving on to Ultra Focus. Ultra Focus, then we'd be when both beams are turned on, and we're using our noise reduction, and we're giving the patient the ability to say, okay, what I wanna hear is right in front of me, it's terrible, I don't wanna rely on All Access

Directionality. I just wanna go straight to a very narrow beam pointed exactly where I wanna hear. And so by giving the user the control over that, they can really hear in those situations, or certainly have much better ability to hear in those situations. We've measured about a 30% speech, and speech understanding improvement over All Access Directionality going with Ultra Focus. Ultra Focus is enabled by a new magnetic induction radio that we have in ReSound ONE, which is what we're using to create the four microphone beamformer. I should mention that the user can adjust the Ultra Focus using the push buttons on the hearing aids, and they can also use the app to get in and out of Ultra Focus. These are some measurements that we have made of the directional system in ReSound LiNX, versus the directional system in the ReSound ONE. And so the legacy that's LiNX is in red, and the black is the ReSound ONE beamformer. And so what you're seeing here is objective directionality.

On a KEMAR Mannequin, and you can just tell, or you can just look at the y-axis, that's the benefit compared to omni. And you can see that the directional benefit is about two dB greater across the four frequencies that are in this graph for that ReSound ONE beamformer. So it is no, it is definitely more directional than what we had in the LiNX Quatro. So let's talk a little bit more detail around the M&RIE. So we've already shown you up sorry, I just switched a little too fast here. I've already shown you that this is a microphone that is integrated into the receiver. So on the receiver, you actually have the receiver module and right next to it is the microphone. So I'm sure all of you are going, how on earth do they control feedback in this situation, and it has been very difficult, it's been the most challenging thing in terms of developing ReSound ONE, has been to control feedback. And we've had to add an additional entire new feedback system to the marine microphone. And of course, we still also have a feedback system for the microphones that are above the ears on the hearing aids as well. So there has been quite a bit of development, you just can't put a microphone next to a receiver and put it on a hearing aid and have it work, you really have to have that feedback reduction working, but when you can do it, there are a lot of advantages. We've

already touched on localization, sound quality and comfort in wind, and I want to give you some of our studies around this receiver and some of the key numbers that come out of those studies. First of all, we have looked at the sound quality of the M&RIE receiver and compared it to standard receivers, and 90% of people with hearing loss that we tested prefer that M&RIE receiver over those standard receivers. And I'm gonna show you some data around that, that I think is really quite interesting and really points out why having that microphone in the ear, really can make these differences. We also have done several studies on front back localization and all around localization, been in our front back localization, we get 10% more accurate sound recognition, when sounds are from the front and back. And I'll show you those studies as well. And then finally, because there's that natural wind noise reduction with the microphone just out of the wind, we get a 15 dB reduction in wind noise when you compare it to an omnidirectional microphone. So I'm gonna go through these studies so that you can take a look at some of this data yourselves. First thing I'm going to show you is just a study that was very objective, this is just a spectrogram. And so what is plotted here, first on the x-axis is the angle of sound. So at what angle is the sound arriving at the ear? So is it right in front, is it in back is it off to the sides, so you have angle plotted across the the x-axis, and then frequency is up the y-axis.

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So all of the different frequencies from zero all the way to 10,000. And then the colors are really the intensity. So how intense is the sound from that angle at that frequency. And so intensity here, the redder or the maroon, those are very intense and the blue are less intense. So now you can kind of put in a picture of this is that that picture of what this one open ear looks like. Now I'm gonna put on the screen, what it looks like when we use our pinna restoration algorithm with the hearing aids on that same ear. So this time we are using that average built in pinna restoration that we use in LiNX today. And you can see that while it looks somewhat the same, the blues are kind of in the same location and the yellow and the red intensities are semi in the same location, you're really not getting an exact copy of the open ear. So now let's look at the same

data with the microphone in the ear. And so with the M&RIE microphone, I'm gonna put them side by side now. They are very similar. And again, the only difference here is we're putting the microphone in this actual ear, versus using an average pinna correction for the microphones above the ear. And you can just see that, they look the same the ear is responding to sound in the same way with the microphone and receiver in ear as it is the the open ear. So let's move to some of the localization data. So we'll start with front back localization. And we've done a couple studies. This is a study that we did quite early on, when we were doing what we would call proof of concept. So we're developing prototypes, and we're testing prototypes to make sure that we're getting the kinds of results that we want. And so again, this is data from normal hearing in the more orange color and the hearing impaired patients are plotted in the blue. And what's plotted in the graph is the number of errors that they're making. So localization errors, how many times do they get it wrong, where the sound is coming from. And the conditions are omnidirectional.

So having just the standard microphones without pinna compensation, and then the next one is with that pinna compensation or pinna restoration. And then finally with the microphone and receiver in ear. And you can see in all cases with both normal hearing and the patients with hearing loss, localization does get better as they move to using their own ears with the receiver, microphone and receiver in ear. If you look at overall localization, not just front back, so this graph on the right does show the same tendency, you get better localization as you use your own ear or the M&RIE receiver. So once the hearing aid was all ready to go, we actually did a much larger test on this in our labs again, this is internal. And in this time, we compared the M&RIE localization performance to four different conditions so unaided, an omnidirectional setting, so no average pinna compensation, and then our spatial sense, so what is in the ReSound LiNX today, which is that average pinna compensation, and then we actually compared it to all of the other manufacturers default programs with pinna compensation. So just again, looking at localization, we use 10 normal hearing and 10 hearing impaired, and

they sat in a laboratory, and they had to point at the speaker, where there was a white noise burst coming out of that speaker. And again, we're gonna plot how many times they make a mistake in pointing at the correct speaker. So the data from both the normal hearing and the hearing impaired participants is on this slide, but the normal hearing on the left and again, the number of errors is plotted. So the smaller the bar is, the better performance for localization. So in both cases, unaided is the best performance. And, I got asked, when I was giving this talk the other day why would that be? Well, the reason is we mess up localization by putting hearing aids on people. It's just part of the things that happen with moving those microphones to the top.

We don't have the pinna effects, and we don't have the completely natural everything that patients have with unaided. And as long as we make it loud enough, even for the hearing impaired patients, they will localize better unaided than they will with a hearing aid. Now look over at the Omni, so omnidirectional, again, doesn't have that pinna restoration, and when you don't have the pinna restoration, the results are really not good. It's about chance, you really have no idea if sound is coming from the front or the back and the localization errors really go up. Then when we use spatial sense in both cases, you can see that the number of errors have dropped down. So when we use an average pinna compensation and build that into the hearing aid response, we do get better localization. But in all cases, both with normal hearing and with hearing impaired participants, when you move to the M&RIE receiver, you get even better localization. And then we did test other manufacturers, pinna compensation strategies. And there was no significant difference between any of the other manufacturers. So we just average that result and put it here. And you can see that that results, especially with a hearing impaired, is almost exactly the same result that we got with our pinna compensation with spatial sense. So just kind of showing that average pinna compensation across manufacturers is gonna be about the same. And until you use your own ear, you're not gonna get that added localization benefit. This next slide is that the slide I was just showing you was about overall localization. This slide is

showing you just front back. So now we only presented the signals to the front or to the back. And you can see that the data is really almost the same. Unaided is the best performance. They do the worst in the Omni condition, they do better with spatial sense, they do even better with M&RIE. And any other manufacturers, pinna restoration is about the same as spatial sense our pinna restoration. So the difference between those slides is whether you're measuring localization from all around, or just the localization from front back. So I wanted to also show you some sound quality data. And I really, I really like this sound quality data, but I'll tell you from the get go, that this sound quality data was done on normal hearing patients. And again, it was done in that stage that we would call kind of early concept or pre concept. And I think the data is very profound in what it shows. And so although we use hearing impaired, I think you'll understand why the data is really compelling to putting the microphone in the ear. So let me explain what's going on. Let's just look at the graph on the left, called overall sound quality. I'm in that graph on the right side. We had normal hearing patients listen with pinna compensation. And on the left side, we had them listen with M&RIE. And there were three different conditions in this, there was a restaurant condition, there was music, and there was traffic noise. So there were three different conditions. And they had to say, they had to rate the sound quality from zero to 100.

So if their rating was 100, then they thought it sounded great, and if the rating was more close to zero, this did not sound really good to them. So they're just rating sound quality from zero to 100. And I think what's compelling is looking at the spread of the data with pinna compensation. You have patients with the pinna compensation in that overall sound quality graph. I think it sounds fantastic. You have someone who rated it at 100. You also had someone who rated it 20. And you have points all the way in between. And and so what's the difference? Well, you know, the difference is, the ones who like it more have ears that are closer to that average ear that is used in the pinna correction. And the ones that don't like it, have ears that are further from the average acoustics that we build in. But when you move to the M&RIE, so move over to the left

side of the graph, where we have M&RIE. When you use your own ears, when you put the mic phone down in the ear and do the exact same thing, everybody thinks it sounds good. And there's really no one. And you can see the averages I circle, but there's no one who doesn't think it sounds good, because they're using their own ears instead of the built in pinna restoration. The right side of this slide shows the results when we actually asked the subjects to concentrate on spatial sound quality. So this time we said, we're not just wanting you to listen for the sound quality, but we want you to listen to how far away sounds are, and where sounds are coming from, can you estimate the depth and the direction of the sound. So we actually wanted them to listen for spatial cues. And again, pinna compensation that average, that average result it's all over the place. Some people think it sounds good, some people think it sounds terrible. But when they listen with the M&RIE, in essence when they listen with their own ears, they all think it sounds good. And so I think there is no more compelling data than this, that listening with your own ears is, it's what you're used to.

For most of the patients that we fit today, they have had a long period of hearing with their own ears. They're aging, they have hearing loss due to aging, and they're used to hearing in a certain way, and that all comes from that natural ear acoustics. And no matter what we did with hearing aids through the ears, input dynamic ranges and extending the frequency bands, and really improving the chip and the sound quality until you're listening with your own ear, it doesn't sound natural to you. That's one of the reasons why custom products were popular, is because the microphones were in the ear. But this is even further than a custom product, because in a custom product, you have Lot of plastic occluding the ear, and in here you have the benefits of the open fitting or the receiver in ear fitting which have become the most popular fittings, but you're also putting the microphone back where it belongs. On the wind noise. We put the hearing aids on a KEMAR Mannequin, and we had different amounts of wind noise coming at the mannequin, and we measured in an omnidirectional microphone. So just an omnidirectional setting, versus a M&RIE receiver. And we have the wind increased

from two to about eight meters per second. So it's a pretty strong wind by the time it gets to eight meters per second. The average results, well the results are ranged from about 14 to 19 dB of attenuation over that Omni microphone using M&RIE, so I kind of say with average wind, wind that will at least move the leaves on the trees, and a decent amount of when you get about 15 dB of wind noise reduction, when compared to an omnidirectional microphone on a KEMAR Mannequin. So I wanna take a minute to just talk about, with all of this new sound processing ReSound ONE, the All Access Directionality and the new beamformer, and the microphone and receiver in ear. It couldn't have been done without a bunch of new technology. And so there had to be a new chip, we had to add a third microphone input to our chip. We also added that new radio, so we actually have two radios in this hearing aid now, one for the beamforming and one for our connectivity to our many mics and our multi mics and to the TV stream or into telephones. With all new chips, there's more processing power, there is less power consumption, then there's more memory.

So it isn't all new chip and just point out that fact. But I wanna take just a second to point out the all new DFS ultra three. So there is a blow up schematic of the new M&RIE receiver on this slide where you can see that the receiver is right up against the microphone. And so those two things are sitting together. And that, that's the worst, the worst possible scenario for feedback is putting that microphone right next to the speaker like that. You guys have all heard bad feedback in auditoriums where microphones and speakers get like that, it's obviously the same in the hearing aid. And so we really had to be able to figure out how we could cancel the feedback on this receiver. So, there is a new feedback, you will calibrate this the same way in fitting software that you calibrate our hearing aids today, there is a one time calibration and calibrates all three microphones at the same time. And what it will tell you is it will give you a warning if it thinks that you need to move to a bit more closed of a fitting. And so you'll see in another slide that we've added some extra domes, or at least one new dome. And sometimes you actually have to go to a little bit more closed fitting for a

patient. I'll talk a little bit more about that. So just to sum up the signal processing, before I move into the rest of the sections here. We have three distinctive ways that we use our hearing aids in different environments. The first is what we call spatial cue preservation, that is M&RIE, and that's about 70% of the time. These are quieter environments under 65,70 dB SPL, that's when that M&RIE microphone is active. When you move in into noisier settings, we activate binary directionality, or sorry, All Access Directionality, it used to be binary directionality. But we activate our new All Access Directionality, with this four microphone beamformer. We do it in a gradual way, it isn't that we just turn off the M&RIE and turn on the other two microphones, they gradually will move to the top microphone. So there are times when all three microphones are on. But we eventually will get to the two microphones, being activated above the hearing aids using the directional and the beams in order to hear in noise better. And then finally, with that spatial intelligibility strategy, that's our Ultra Focus where it's user controlled, both beams would be on both ears are focused on what is right in front. So let's go ahead and move on to connectivity.

This slide just as pointing out and reminding you that all the connectivity that we have today with LiNX, you will find in ReSound ONE. So everything works, all of our accessories, our TV Streamer, that connectivity that we have today all works with ReSound ONE. And we do offer another rechargeable solution. We have a premium charger already that premium charger holds up to three charges. So it's mobile it can go and it can charge. This is a charger that will cost a little bit less, and it is a wall, you plug it into the wall it won't hold a charge. But I do wanna point out that we do have battery, battery life on this hearing aid. So with three hours of charge time in both chargers, you will get 30 hours of battery life if you're not streaming at all, and 25 hours of battery life with unlimited streaming. So think about that, 25 hours, it's more than a day if you're streaming full time. And so we really raised the bar in terms of the rechargeable performance. And there's just no need to ever worry that this hearing aid is going to die for sure. All right, moving into the hardware, we are introducing

ReSound ONE in three receiver in the ear, hearing aids, we have new colors, new domes, new standard receivers and the new microphone and receiver ear. So just showing you the three styles, the 13 and 312 battery and the rechargeable, and an all new color palette really to highlight hair and skin tones, I really like our new our new color palette. And then we have a new dome. If you look at the domes across from the left, you have an arch Standard tulip dome, our power dome, which is fully occluding our power dome, And then we have a new, what we call closed dome. But don't let the closed confuse you because it only has about five to six dB of occlusion. It has the same amount of occlusion as our tulip dome. So it's not fully closed like the power dome. And then finally there's the open dome. And so, just a little bit of advice when fitting if it's, if it's a candidate for an open fitting, either start with the open dome, or start with the closed dome. The closed dome does not add enough occlusion that you need to worry about it. But if you do calibrate for someone who has an open fitting, and you calibrate and you get a warning that there could be feedback, you should then for sure move up to a little bit more closed fitting if you are starting with an open fitting. I don't recommend that you would take a patient to a power dome if they're an open candidate. You would wanna stay with either the tulip dome, or the new closed dome and then proceed even with the warning. And if there is a lot of feedback at that point, then perhaps they're not a candidate.

We do have standard receivers for patients who are not a candidate who still, who still get whistling even in more of an open setting like this. I can tell you in our clinical trials, that was extremely few patients. We ultimately fit 156 patients in clinical trials, and only had a couple that we had to move away from the M&RIE receiver into a standard receiver because we couldn't control feedback. So really has not been an issue, and I don't think it'll be an issue for you, but do realize that if they are a candidate for an open fitting, don't hesitate to move to the tulip dome or to that closed dome, if it looks like there might be feedback due to a warning that you get in the fitting software. All right, and then the one last piece here, is on our fitting software. And like I said before,

we are going to individualize the fitting software for ReSound ONE, not just the gain, but we are going to individualize the advanced features. So we know hearing aid users have individual needs, and they depend upon their experience level, the type and degree of hearing loss. And research suggests the different user groups, can share common needs and fitting experiences. So for example, experienced users, and those with more mild hearing loss of the generally prefer less noise reduction. And new users generally prefer more noise reduction, and more impulse noise reduction. And users with better hearing in the low frequencies. They benefit from increased expansion. And so we actually are going to base all of the advanced features on the research that is out there to individualize that first fit for patients. Also you'll notice especially if you fit a lot of ReSound hearing aids today, that we now have automatic receiver detection that is just in there for convenience obviously, it's nice to leave out that step of having to select the receiver, as you're going through the fitting flow in the software. So this will detect the receiver automatically for you.

And one last comment I'll make about software in general, is that ReSound Assist and ReSound Assist Live, is something that we really put out that ReSound assists live in the beginning of our situation with COVID and I need to reach patients through a telehealth instead of coming into offices, and the assist live piece when we introduced it worked only with Apple hearing aids. Now with ReSound ONE all of that will work with Android as well. And so that also is here with ReSound ONE. So with that I've covered what's new in a very quick high level overview of the entire product with the sound quality, the connectivity, the design for purpose, all the new hardware, domes, receivers, and finally the fitting software and changes to our fitting software. So I thank you for taking the time to listen about it. What I know is, the proof will be when you get out there and fit your patients and I really think your patients will have a profound difference in experience when they listen with their own ears, versus to listening with what 80% of hearing aids do today. So thanks for your time, and I will look at these questions over here, and take these questions now. Let's see, so the first one says I

noticed on the, charger de shade uses wireless communication. What do you need the wireless communication, sorry, \oh, it's an inductive form of communication. So we're using inductive charging instead of using contacts. So if you look in some chargers, you have contacts on the hearing aid versus contacts on the contacts in the charger, and contacts on the hearing and they have to be placed upon each other in order to have the charge happen. Those contacts can go bad they get dirty, and we don't use that kind of charger where you were using inductive charging, where you don't have that need for the battery contacts. Let's see, is the premium charger portable? The premium charger is the one that we have on the market today. It is used with LiNX Quatro, ReSound LiNX Quattro today, and it is portable. It holds three charges and of course that is also now available with ReSound ONE. But then we also have the offer of patients who, again, battery life is extremely good as long as you charge it when you go to bed at night, you're not going to lose your charge through the day. So portable charger, of course great for vacation, and for other other times when the patient needs to take the charger with them.

But for many patients, all they need is the standard charger that is just plugged in at night. Let's see can assist be activated without patient being in the office. I believe that it can now, there was a change to our software that we could do that. At first that wasn't the case. But I believe they have updated that, and reach out to your sales rep to verify that, but I believe that was updated so that you can do that now. Any increased concerns with M&RIE and Sarum clogging in. Yeah I'll be completely transparent, Of course there is it's in here, there certainly is wax, we certainly have wax protection in our clinical trials we really have not had a lot of problems with wax. I can tell you and we've been testing this now for quite a long time on quite a lot of ears. We still get much more wax issues on the receiver side that is deeper down into the ear where the microphone side is more out where the air is and a little bit more away. But of course wax can get in there. So it's it's we haven't had to move anyone to a non M&RIE receiver because of wax issues, so far but you can expect that, that could

come up as an issue and something that needs to be watched and cleaned out. Let's see, the new charger will come with all of the ReSound ONE products correct? So that's a great question that I'm not sure I know the answer to. It's one that will you'll have to reach out to your sales rep, because I'm not sure what is being shipped with the products. I need my maybe the shipped with the standard charger, and there's an upgrade to the premium. And I'm not 100% certain it's a definitely a question for you to ask your sales reps. Does the M&RIE come in additional cost? Yes, it does. It does come in additional cost, and I hate to be quoted, but I think it's around $50 but I'm not 100% sure I'm not, I'm not really knowing all of the sales things. So it's another one of the rep questions but it is an additional cost to have that M&RIE receiver. Does it have the same lifespan as a low power receiver? Yeah, great question. Yes, we would expect it to have the same lifespan, we have no reason in aging test to show that it would be any different. And since you brought up the low power receiver, one thing I failed to mention is that the M&RIE fitting range is the same as the low power receiver. So the M&RIE can be fit all the way down to hearing losses that are in that moderate severe range of 75 and 80 dB thresholds at two, four and six.

So great question. Let's see, the next question is if I want to, oh, if I wanna rewatch it, will it be available on audiology online? Yes, I know that a recorded version will be available on audiology online. What could happen if the M&RIE receivers replaced in the office with a standard and not checked in the software. You really should recalibrate the receiver when you do that, because you are calibrating the M&RIE receiver on the bottom so it would be better to, when you're changing from, two completely receivers to recalibrate That said if it can't be done and there is no feedback, I'm sure it would be fine at the time if there is no feedback, but ultimately, you'd wanna get the correct calibration there. Let's see. Yeah, is the cost of the M&RIE receiver a one time fee? I don't know the answer to that question. I would imagine it is not. But you'll have to ask a sales rep that question. And let's see. How about molds for the M&RIE? Yeah, great question. You can use the molds, custom molds for the

M&RIE, now we don't know those fully encased power molds that come with our ultra power receivers, because there's isn't that kind of fitting? Or we wouldn't have that. But you absolutely can have custom molds made for the M&RIE receiver. I think that's all the questions. And I actually think that's all my time. So hopefully, if you have any other questions, and I really encourage you to reach out to the sales rep that you have, they will have the answers to those questions that are that are more for, for pricing and those kinds of things than I have the answers for. I think there was I'm looking at it, it's I think somebody raised their hand, so I'm not exactly sure what to do with that. I think now the hand raise is gone. So I think that'll be it. So thank you again for coming and I really.