AURICAL HIT Applications Part 1 - Applications for Hearing Instrument Fittings and Beyond

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Presenter: Wendy Switalski, AuD

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- [Mary] On behalf of the Hearing and Balance Academy and Natus Medical Incorporated, welcome to today's eSeminar, Aurical HIT Applications Part One, Applications for Hearing Instrument Fittings and Beyond. I have the privilege to introduce our invited faculty, Dr. Wendy Switalski. Dr. Switalski, MBA and Au. D is Director of Professional Development for Widex, USA. Prior to joining Widex, Dr. Switalski was Senior Market Development Manager for Fitting Solutions with Otometrics, now Natus and she owned both an audiology private practice and an equipment distribution company in Metro Detroit, Michigan in the USA. Dr. Switalski has also served as a highly sought after consultant specializing in probe microphone measurement technology. I'll now turn the presentation over to Dr. Switalski.

- [Wendy] Thank you, Mary. It's really nice to be here, among with my former colleagues at Otometrics, now Natus. So we're gonna go ahead and get started. Today, we're going to provide an overview of the Aurical HIT and OTOsuite, which is the software that it operates on as well as discuss some of the applications. Generally, when it comes to hearing instrument test backs, we think pediatric fittings but there are so many applications beyond that. So, I always enjoy talking about this topic because it's such a versatile underused tool. Specifically today, we'll be talking about how to program or pre-program instrument gain and output. So essentially, fit the hearing aid ahead of time. How to verify advanced features and then also how to assess the electroacoustic performance. Many of us depending on how long you've been practicing in hearing care, we remember running hearing aids and that's our primary experience with the hearing instrument test backs and turns out those runs are still really important. To review the learning objectives after this course, you will be able to identify the benefits of using hearing instrument test backs in the fitting clinic. You will be able to list the steps for programming and pre-programming using Aurical HIT and you'll be able to describe the feature to benefit comparison that lives in the system for

noise reduction and directionality features. Looks like we have a polling question. So Mary, I'm gonna turn it over to you.

- [Mary] Thank you, Dr. Switalski. So our first polling question, we would like to learn a little bit more about our audience. So please share with us what best describes your practice? Are you hearing care professionals involved in independent private practice settings, hospital, government, educational or other? And we have several responses coming in. I'll wait a few more seconds. And it looks like a majority of our participants today work in a medical environment and coming in sort of a distant second is independent private practice. And it looks like we have our second polling question. There we go. Do you currently perform real ear measures for hearing aid fittings? Always? Only with pediatrics? Sometimes, but not all the time? Or no, I do not perform real ear measures? And I'm very encouraged by those responses. I think our presenter Dr. Switalski will be as well. Always is clearly the winner in this case. I'll turn it back to you, Dr. Switalski.

- [Wendy] Thank you, those are really great findings to see and I think today, our approach is to expand your impression of how you can use real ear measures by incorporating the Aurical HIT as well. So that's great to see. So when you hear Otosuite, it's important for us to talk about Otosuite a little bit as we're talking about the Aurical HIT. It's important to be aware that all the equipment that Otometrics Natus manufacturers lives within the Otosuite universe. So this includes the HIT box that we're talking about today but it also includes all of the equipment that's used in the diagnostic and fitting journeys from video otoscopy and audiometry, tympanometry and OAE and right through to real ear and HIT box measurements. The important piece about this is that as providers, we actually interface with the software as much as the hardware, so we'll be showing you both today. Specific to the fitting journey, you can see the clinical tools here that are in line with the fitting clinics. You can see audiometry and here you see the AURICAL Aud but there are other options as well. You see the

Aurical PMM, which is the on-ear probe microphone measurement system. You see the OTOcam 300, it's always nice to know that the patient's ears are ready for the fitting and for the diagnostic evaluation and you see the Aurical HIT. The benefits of operating in this connected PC environment are numerous. First one up, well OTOsuite does operate in a standalone fashion. It operates smoothly and quickly under Noah if you're using Noah and from a learning point standpoint, you only need to master one software platform which saves time and makes life easier. The benefit also goes across fitting rooms and multiple clinic locations. And this efficiency has never been more important than in today's clinical environment, where chair time with patients is even more valuable. The PC integration also allows for visibility of results across locations, even if you're working outside of the office or from a different office from where you saw the patient. There are time saving benefits from avoiding having to re-enter data and that also leads to improved accuracy. And finally, a big benefit is that the hardware can be upgraded and updated just via software updates. When I owned my practice, this feature upgrade ability was a really big asset. It felt like getting new equipment when new software installs came out. So that was very exciting. This is just a quick view of how OTOsuite looks within the Noah environment. It's a module just like the fitting modules that you use. And Mary, we have another poll question here.

- [Mary] Thank you, Dr. Switalski. So in this question, we'd like to know if you're performing electroacoustic analysis on hearing aids? Routinely? Only when a patient reports a problem? Only one receiving a hearing aid from repair? Or no, I rely on the manufacturer's specifications? Okay, interesting. The top response is I rely on the manufacturer's specifications followed closely by only when a patient reports a problem.

- [Wendy] That's good to know and we're gonna come back to that and give you a couple little my clinical perspectives on that in just a few minutes. So let's dive into the Aurical HIT. First of all, HIT stands for Hearing Instrument Test system. This is an image

of the unit, both open and closed. The vertical design, the orientation saves desk space and it also allows you to easily move the system to and from various clinic rooms. It also allows as you can see with the lid open for easy positioning of devices for all the tests necessary without having to reposition the device. I've been in that clinic environment where time is limited and it's important that we make things as easy as possible for you to do to allow you to use something like the HIT as often as possible. With the Aurical system, the HIT box operates independently of the real ear system. It requires only a USB connection to the computer. By separating these, it really adds to the flexibility and it allows you to be more judicious in your equipment funds as well. Sequencing is available and a lot of times when you're doing HIT measurement, you're doing multiple measurements at the same time or in sequence. So just one button can select a sequence that you set up and really a HIT box gives you a consistent picture of every hearing instrument that you're fitting regardless of the manufacturer or type. Let's look at the elements. First of all, think about the HIT box as a miniature sound booth for hearing aids. It's an isolated acoustic environment and this isolation allows for testing and fitting using a HIT box even in sub-optimal environments which we face sometimes. Within the unit, there are three components. You see a HIT speaker to present various signals, a reference microphone to ensure that the signals are being presented at the intended level to the instrument and a coupler microphone which picks up the process sound after it goes through the hearing aid. This image shows a BTE adapter on the coupler but there are also adapters for other styles which we'll show you in a moment. Since so many of you are using real ear measures, it's nice to be able to relate Aurical HIT to those on-ear measures. Think about the probe microphone and an on-ear measurement system as the same as a coupler microphone and the reference microphone is the same as the reference microphone on the probe assembly on your real ear system. And the free field speaker is just like the HIT speaker. Here's the great part though about the HIT system, with appropriate acoustic conversions, this can serve as a substitute for measures that are done in your patient's ears. So even without the patient present, the

HIT box can serve as a stand in to allow you to measure what would be happening in the patient's ear if they were there. So for fitting issues, troubleshooting and even sound quality concerns, you can manipulate fitting options and you can see the results on the screen as well as even listen to the output yourself with headphones or a speaker. The value of this in our current clinical environment is it's remarkable actually to be able to do this. There are two main categories of operation for any HIT box but specifically for Aurical HIT. So you see that here, within OTOsuite, the Aurical HIT is operated with two modules. The first one is in the PMM Module, probe microphone measurement. This is for fitting-related measurements. Even though you're not putting a probe in the ear, you are doing a coupler fitting measure. So for anything related to gain and targets and fitting, you'll use the PMM Module. For quality measurements like electroacoustic assessment, you'll use the HIT module. Here are some images showing the positioning of various hearing instrument styles. So this is a BTE, the ear mold is removed, it's fit on a piece of tubing, it faces the speaker and that uses an HA-2 coupler. An HA-1 coupler is used here for both a thin tube or RIC and also for any custom product. Now, when you're doing a RIC or thin tube fitting what you will see is you'll use putty to attach the receiver to the plate. But it is important also to put just a tiny ball of putty somewhere else on the receiver wire and you see a little ball of putty right there. All that does is prevents the receiver wire from vibrating and showing up on your results. Now this is true for all test boxes but it's just something we strongly advocate. Now, just a note on programming devices, since so often we're programming wirelessly. For programming that is used, that requires a hardware connection, just loop the programming cable around the groove of the battery pill connector to keep it in place when the Aurical HIT is closed. For wireless programmers like maybe those that use a neckloop, place the loop around the device and close the Aurical HIT. The Aurical HIT closes very well but it's latch free so it will not cramp or harm the programming coil. But the good news is for wireless and wire-free programmers, the signal will travel through the Aurical HIT without any interruption. Mary, I'm gonna turn it over to you for a poll question.

- [Mary] Thanks Dr. Switalski. So our next question is how familiar are you with the advantages of performing coupler-based fittings? Very familiar? Somewhat familiar or I do not have a test box and cannot perform coupler-based fittings? And it looks like most people in the audience are somewhat familiar, which is great 'cause I think we're going to be covering this. We'll turn it back to you, Dr. Switalski.

- [Wendy] Thank you, that is good news that you're already familiar with it. We're going to dive more in detail into that now. So Aurical Hit, as we've talked about, what do we use it for? Let's talk a little more in detail. The first is coupler-based fitting. Everything that can be done on the patient's ear can also be done in the test box. We know this is important for pediatrics and others who won't tolerate fitting but clinically, I was shocked how often this was valuable to me with compliant adults as well. Just very, very convenient. Again, just to reiterate, that's access through the PMM Module by selecting the coupler button which we'll show you in a few minutes. Also looking at advanced features, whether you're verifying and quantifying the feature without the patient present, pre-fitting or even when you're working with the patient, if they have questions about how the device is working and what they've invested in. And finally ANSI measures, we know they're rarely done now but to me it's a good question, why? And in order to do that, you will have to have some understanding of the manufacturer's software to change hearing aid settings. So these are the three main functions that you can use it for. A fourth sub function, I would say is when new hearing aids launch, it's really nice to have a safe environment to look at the hearing aids and the features and how they're working and measure them objectively. So it's also nice for that. So why would we need coupler-based fitting for adults? Adults are compliant, they can tell us what they hear. We can put a probe tube down the ear but if we pre-program hearing instruments, it really streamlines the fitting and it frees up appointment time. Two to five minutes at the assessment, if you were to measure an RECD for adults or not measure it and use the average RECD for adults and then

maybe five minutes pre-programming the hearing aids. This can result in a huge time savings at the fitting and beyond. It's especially valuable when the patient can't be at the clinic due to geographical reasons, health reasons or other reasons. It's also a great method of evaluating the hearing instrument settings, even if you can't access the programming of the device. So I used to have patients come to my office wanting a second opinion on their fittings and even if they were hearing aids that I didn't have access to the software, I could use my coupler and I could very, very quickly without even placing probe tubes, get a good assessment of whether or not that was meeting their needs and then talk to them about their options. So that second opinion is a really powerful tool. And as I said, you can learn new fitting software without an audience. When you're looking at coupler fitting, what you'll see here is there's a lot going on on this screen but it's important to note that you're looking at essentially a real ear screen, an aided response measurement. And that's in the Aided Response tab within Otosuite. Now, it looks like typical real ear results. You see dashed lines for the targets for soft, medium and loud inputs, and an MPO target for the MPO suite. And then you see the solid line which is the actual responses. The good news is or I guess the interesting news for this session is that even though this looks just like real ear measurements, this was done in the coupler. Now how do we do this? Well, first we access the patient's Noah file. And then we launch the hearing instrument programming software and connect the devices just like we would do for standard fitting. You attach the hearing aids to the appropriate coupler and then you launch OTOsuite and select the PMM Module. I know we keep touching on this but it's a little confusing when you open Otosuite 'cause you see the HIT module and you think that's what I need. But if you're doing a fitting then what you want to do is use the PMM Module. Select the Aided Response tab and use the relevant fitting details. So I'll show you that here. The fitting details in Otosuite are selected or accessed using F5 or with the toolbar icon. You have a choice of targets and you can see here we're in the fitting mode coupler which is a HIT fitting and then you can make choices about whether you're using the predicted real ear unaided gain, what the hearing instrument type is,

what the venting is and whether it's monaural or binaural. The date of birth is important whether you've been measured the RECD and then how you measure the audiogram. Now, one thing if you're doing on-ear measures like traditional real ear measures, the hearing instrument type and the venting, they don't factor into your fitting but they do when you are using coupler fitting like this. So it's important to answer the questions, essentially these are questions, it's important to give the system the input. Here is just a view of the targets that are available to use in the Aurical HIT, DSL five, NAL one, NAL two, DSL 4.2 or if you have something manual you can work with the team at Natus and they can help you program in manual targets. This view here shows how easy it is to toggle between a real ear measure, on-ear and a coupler measure. The screen doesn't change but all you need to do is select that little button that's shown in the orange circle that goes from the ear to showing the coupler. Your view stays the same, your signals stay the same. So it's just extremely easy and that right there shows really what the beauty of the fitting in the Aurical HIT is, is it's just like real ear. Once you're ready to do that, this is certainly the methods of verifying with real ear and in a coupler, there are a variety of methods. Here's just an opportunity to think about one step. So what you see here on this screen is you see the dashed lines are the targets. This looks to be probably, yap, it's now two. So the orange is for loud speech and the purple is for soft speech and the green is for the output. So this specific graph does not show an average speech curve but let's pretend that that's there. So the first thing that you can do is present average speech, so 60 to 65 dB. Now I say present because you're using a recorded speech stimuli or speech-like stimuli. ISTS, for example, works really well, it's an international bubble symbol. So you present that and then you adjust the global gain for the instrument, even though you presented an average input, you're going to go ahead and adjust the gain globally within the instrument until that target is matched. Now, by matched within plus or minus five dB. Occasionally, you can't get that in the high frequencies depending on the degree of hearing loss but you do the best you can. And some people like to use a little bit of a more stringent requirement maybe within plus or minus three dB. It depends on your

clinical preferences. Once you've done that, you've set the overall gain for the instrument but we still need to look at soft and loud inputs as well. So you then present soft, 50 or 55 dB SPL speech and adjust the soft gain in the hearing instrument and then loud speech, about 70 or 75 dB and you adjust the loud gain for the instrument. And then finally, it is important to present a swept tone around 85 dB to get a sense of the MPO setting of the instrument. You want to make sure and with this, you see this with the green solid line. In this instance, you're not trying to necessarily match it but you're trying to make sure that it doesn't exceed this green dashed line. And you also wanna make sure that it's not so low, that loud speech is not going to be overly compressed, that you'll still have the peaks of loud speech available. Now, the time that it took me to talk about that isn't too much less than the time it takes to actually do that, it's a very quick process. And especially once you're familiar with the setup of the equipment, you already know you're fitting software, it's extremely fast, I would say about five minutes max. Now there is an option also, down below in the legend here, you can also verify that your targets or that your fittings are within not only acceptable tolerances from a gain standpoint but you can also look at your speech intelligibility index rating that you see here. You generally wanna look at that for average speech. So this is the purple box and you see we have a 65% and a 68% SII. Now, it is important to know that you don't need a 100%, you won't reach a 100% SII. We know one of the fortunate things about amplification and about the way the brain accepts it is that you don't need all of the information to get the message and the important context. So there are charts available for looking at the optimal SII and how a patient's results would correlate to speech understanding. So this is actually quite a good fitting. Now, in addition, I wanna show you a couple of views and you see right here the orange circle showing a bullseye target and then an audiogram graph. So let me show you what those do because these just make your workflow a little bit easier. The first is that audiogram graph and this is what's called On Top mode. This allows you to actually look at your curves whether you're doing real ear or coupler fitting on the same screen as your hearing aid programming handles. So that as you're making those

adjustments, you can see easily the effect of those hearing aid adjustments without having to navigate across multiple screens. The next nice view is called on target mode. On target allows you to compare the difference between the target and the measurement curve without having to zoom in. So what you see here is for this fitting in the right ear, you see the dashed line is the orange target, that happens to be for soft speech and the teal line is the target for loud speech and the solid lines are the hearing aid responses. So in the on target box below, you see the actual difference between those, so that tells you how close was my fit. In a perfect fitting, those lines would be right at zero. I would actually say this is about as close to a perfect fitting as you get. So you can see that they are definitely within plus or minus five and most of the way they're within about plus or minus two or three. So it's just a very easy way to look at a glance and see how close your fitting is. It's also a nice screen to use with patients. If you bring your patients into that fitting process, you don't have to go over targets and curves, you can just tell them, the closer to the zero line, the better the fitting is and it's just so quick and easy for them to see. So once you've done your fittings in terms of setting gain and output, the HIT is also a great tool for advanced features. It's hard to assess advanced features. It's because they act in multitude, they act together and it can be really difficult to demonstrate for patients what their hearing aids are doing. When you're going to do this, there are a few important considerations. First of all, because adaptive features in hearing aids interact, if you want to look at an advanced feature, it's usually necessary to turn off all the other features except for the one being evaluated. So even though our hearing aids use features in combination, this sort of assessment, we'll look at them in isolation. You also need to understand the duration, the level and the type of signals that the hearing instruments are going to use to trigger various advanced feature settings. It's not the same across all hearing instruments and it's important to talk with your hearing aid manufacturer to get guidance. What level is it that triggers noise reduction or what type of signal is it? It's important to set the hearing aids up for success. So your manufacturers can be really great partners for you in that way. So let's take a look at noise reduction. It's actually a fairly easy and fun

feature to take a look at. Takes about 30 seconds if you're looking at a single setting maybe a little bit longer if you're comparing different settings. I used to like looking at noise reduction for the various mild, moderate, strong, as well as adaptive noise reduction, which we'll look at in a little bit. So with the digital noise reduction turned on in the instrument, you want to present a 65 dB noise input for up to 25 or 30 seconds. What the system does, it takes an immediate curve right before the noise reduction kicks in and that becomes your baseline. And then as digital noise reduction kicks in, you'll start to see the measurement drop. And then you'll compare those two curves. Now, it can take anywhere from five to 25 seconds depending on the instrument to reach maximum noise reduction. So here is the setup for doing that. So there's an actual noise reduction tab within Otosuite to make this even easier. You do wanna change your signal type. So here's an option for the various signals you have, there are noise signals and there are also speech signals. Because even if your noise reduction is working really well, you wanna make sure that it releases for speech. So the babble or the children laughing is a great signal for that. So using your fitting software, what you'll do is program your hearing instrument for the desired noise reduction setting. Maybe it's off or maybe it's strong. Select the time difference between the two measurements, so maybe 14 seconds. This takes some experimenting with your specific hearing instruments and then you're going to click the measurement button in the control panel which I'll show you in a moment. The snapshot curves will be displayed in the graph and the overall noise reduction will be displayed in the curve legend, that's right here. So what you see here is the purple curve on the right-hand side of the screen is the initial response of the hearing instrument before the noise reduction kicked in. Specifically, this is showing vacuum noise, which is a constant, steady-state noise. After a certain amount of seconds, you'll see that the hearing aid settled, it reduced the vacuum noise and settled in to where the orange curve is. If you look down below that, you see a difference of nine dB. Now that's an average across the frequency spectrum. So at specific frequencies, the noise reduction was even higher but nine dB, that's a significant degree of noise reduction and it would definitely

be noticeable to the patient. Now, if you look on the left, what you see is called the feature to benefit mode. The feature to benefit mode shows you the actual gain of reduction for the patient. So again, when you're looking at the two curves on the right, as a provider, you know that one was pre and one was post noise reduction but how much noise reduction we actually see plotted on the left. So at 500 hertz, we had about nine dB. At 3,000 hertz, we had about 15 dB and at up to 8,000 hertz, 20 dB of noise reduction, so really significant. It's nice to be able to quantify not just for the patients to listen but also for your own ears when you're troubleshooting and working with new hearing aids. The next feature we'll take a look at is directionality. Now, just to reiterate, when you're doing fittings with the Aurical HIT, you use the Aided Response tab. And when you're doing noise reduction, you use the Noise Reduction tab. But the Freestyle tab is also one that you can use for real ear and for HIT measures. It's kind of a playground, I call it for fitting. It has a variety of signals, a wide choice of input signals. You can mix them together, you can separate them out of multiple speakers. So basically, you can set this up to see whatever it is you want to see for that specific hearing instrument. So let's use this freestyle tab to take a look at fixed directionality. With fixed directionality, what you're going to do is either face the hearing aid away from the speaker or use the rear speaker because the Aurical HIT has two speakers, front and back to really optimize your directional measurements. The first measurement you'll take is an initial measurement of 65 dB speech or noise with the hearing aid in the omni-directional mode. Then you'll activate fixed directionality in the hearing aid and run the same signal. Again, make sure the other adaptive features are turned off, like noise reduction because if noise reduction is turned on and working in conjunction, there may be a challenge in looking at just the directionality. But if your directionality is the only feature on, you should expect to see a difference between the curves, with less gain when the hearing aid is in a fixed directional mode for sounds from the back. So here's an example of that and this takes just seconds. So what you see is on the left-hand side this time, you see an Omni, the purple line is what the hearing aid was picking up with sounds presented from the back, from 180 degrees. And then once the

fixed directionality was activated, you will receive a measurement that is shown here with the orange line and on the right-hand side you see the feature to benefit view, the feature to benefit by the way is located on the tabs at the top and when you choose the icon that looks like the two intersecting circles, you'll be able to see this view. But here you see a seven dB difference on average of directionality for the specific signal chosen. And again, that's an average. So, you can see that at 2,000 hertz, there was a 10 dB directional effect noted. Now certainly if the patient is wearing these hearing aids in an open configuration, they may not have that full degree of directionality because of leakage et cetera. But this shows you that the hearing aids are doing all that they can to provide emphasis for front facing signals. Now let's take a look at how we would look at adaptive directionality. Adaptive directionality is even more dynamic to look at. So it just takes a couple extra considerations. The first step is to position the hearing instrument towards the front speaker and set the adaptive directionality for maximum strength, whatever that is in the hearing aid software. Then you're going to present a speech signal from the front HIT speaker, followed by the same signal from the back HIT speaker. Now, if you use a speech signal, like I just said, you shouldn't see much of a difference because adaptive directionality is designed to reduce noise but maintain speech. So you start with two curves for speech, front and back and then you do the same process for a noise only. So it should be let's say, pink noise. So there you should see a significant difference between the front and back input and the third step that I like to do is to repeat the process with speech and noise combined. So when you do that, you should see certainly some directional effect for the noise but not as much as you saw for noise only because we want to know, again that the speech is releasing. That the adaptive directionality is releasing in the presence of speech. So in the Otosuite system, you can choose the station or scene, they have a variety of scenes and that has speech and noise. Now, adaptive directionality is one of those features where I strongly urge you to work with your hearing aid manufacturers to see what are the duration and the types of signals that will be needed. So let's take a look at this. If you run in this order, we'll start with saying that we ran speech in the hearing

through the signal, through the HIT back speakers. Speech from the front and speech from the back. So even though adaptive directionality was enabled, in let's say to a strong degree, because the signal was speech, you don't see any directional effects and this is what we should see. Next, we used pink noise and we measured the noise when it originates from the front and the back, you see quite a bit of a difference. So there's quite a bit of directionality kicking in for this pink noise. At 1,000 hertz, it's about 12, 13 dB. At 2,000 hertz, we have about 15 dB and at 4,000 hertz, 10 dB. So a lot of directionality for pink noise. So then what happens if we mixed speech and noise together? Well, that's what you see here. So this specific input signal is again called scene station. So it's like a train station. So there's train noise, there's people talking and so what you see is when presenting speech plus noise from the front, you see the pink curve and from the back, you would record the yellow curve. So you see not as much difference but you still see significant directional effect. Now, what's interesting is at around 3,000 hertz, you don't see a lot of directional effect and that is likely because the speech had a lot of information at 3,000 hertz and the train noise and the other station noise was more prevalent in the low frequencies, so it's very frequency selective. You can look at all of these curves together. So there's a lot of curves going on here, certainly, but all of the curves I just showed you are plotted on the right-hand side and let's take a peek at the difference on the left-hand side. So the difference for speech only, it's so close to the zero line that you can't see it and if you look in the legend down below, you'll see that there was zero dB directionality for speech only. That is what we would want. Next, for noise only, you see the teal line. So the most significant amount of noise reduction, an average across the frequency spectrum of nine dB and then for speech with noise, you see the pink line here for a difference of four dB across the frequency spectrum. Again, that's an average. If someone said to you, four dB of directional effect, you may think, maybe that's not that impressive. But when you look at the curve, you see that at 2,000 hertz, it's approximately 12 dB. At 6,000 hertz, it's 10 dB. At 1,000 hertz, it's about eight dB. So the average is a nice number to have but the graphs also tell you a lot. Okay, so now with that, now that

we've looked at advanced features, let's dive into electroacoustic analysis. This is definitely the traditional application that people think of for a test box. So do we still need it? I mean, this is often something that is kind of put by the wayside. We call it ANSI testing and it's something we used to do. It was common clinical practice to ensure that both the new hearing aids and the hearing aids that had been repaired were performing to manufacturer's specifications. It's rare that I come across a clinic that runs electroacoustic analysis routinely. But as early as recent as 2016, this study from Holder et al in JAAA found that an analysis of 73 new BTE devices from four manufacturers show that 7% were out of acceptable tolerances and that's before they've been fit on patients. So this suggests to me that electroacoustic analysis is still an important step. So, even if our use patterns don't suggest it, patient reports can make it really difficult to discriminate between programming issues and mechanical problems. The automatic and adaptive features we have add another layer of complexity. I had an experience in my clinic, I had fit a patient with a new set of instruments. He was a very experienced user and he was a great reporter and with his new instruments, he told me that everything was fine. We'd done real ear to evaluate the fitting, we had met our targets, he was pleased but there was one issue he was noticing. And when he would go to church and the organ would play, the right ear would decrease. So I started, I listened to this, I listened to the hearing aid, I listened to what he was telling me and I thought this sounds a lot like maybe an adaptive feature. So I dove into the programming of the hearing aids and I sent him out to try again Sunday at church, and then he came back with the same issue. So we dove again into a different level of compression and advanced features and finally on the third visit, I was out of things to do, I didn't know what else to try. So I just popped the hearing aids into test mode and within about 30 seconds ran them in my test backs and I actually didn't even have to pull the specs out. I just compared the hearing aids to each other and I saw right away, the output for one hearing instrument was about eight dB low. The OSPL curve was about eight dB low. That was the only difference between them. I sent them for repair, fit them, he was thrilled and we were done with

the visits. That was a little bit of a clinical hammer to the head for me to say, wow, this is so important to do. And I thought I was savvy enough to sort the difference between programming issues and mechanical problems but it turned out I wasn't. Again, I want to let you know those hearing aids sounded great and he did not notice it in other parts of his life but it was actually a mechanical issue that was hiding as a programming issue. So, I switched to doing ANSI measures whenever I questioned something which was very frequently and a lot of times the ANSI measures showed that the hearing aids were working fine and we could go into programming but not always. It can really offer you greater efficiency and allow you to provide more timely and thorough follow up care by using these measurements. And where allowed, depending on state licensure, you could even consider utilizing support staff for these features. So maybe you have an assistant that can run the hearing instruments in the test box and within about a minute, know whether or not they need repair and if they do, the repair is done. And the patient does not then require an appointment to see you with your constrained clinical time. Now when you're running ANSI measures, you choose from a series of measures that you see here listed and you choose the ones that you want to run and then you can run them in a sequence with just one button push. To set this up, you launch Noah because these results also are stored within Noah. So you can look at them later and you select the patient file. You launch OTOsuite and select the HIT module and then you launch your hearing instrument programming software to access the test mode. You do need to reach out to your manufacturers for information on how to do this because it differs across all manufacturers. And there's a little bit of a learning curve to find out where it is and what to do. You then attach the hearing instruments to the appropriate coupler and if you'd like to test battery drain, you plug in the battery pill, that's a great test. And especially in this streaming world that patients are living in, they have such different streaming habits that knowing whether or not their battery drain is a problem in the hearing aids or just a function of their use patterns is very valuable. You can then run the selected tests individually or as a sequence and then you compare tho manufacturer's specifications or to previously

obtained results. So, generally what I focused on is the max OSPL 90, the high frequency average OSPL 90, the high frequency average full on gain, harmonic distortion and equivalent input noise and battery drain, if I was measuring battery drain. Now, one thing to know is that there are a couple of ways to do this, the best way is to put the hearing aids into test mode as I mentioned and compare your hearing aids to these tolerances. But there is another way and that is to leave the hearing aids at user test mode and set a baseline for those hearing aids and then just compare even at user mode, when the patient comes back in, compare the ANSI measures that you get. You can't compare them to the ANSI tolerances, to the specs but you can compare them to how they were working at the last visit. The only caveat to this is that you have to know that no programming changes were made between those sessions and if other clinicians in your clinic work with your patients, they could maybe go in and address feedback or gain and then you no longer have a valid baseline. So even though it takes just a couple of minutes, I do recommend putting the hearing aids to test mode in the software to run these measures. But if you have the clinic workflow, where you can make sure that no changes have been made to the settings in the hearing aids, it is okay to leave them at user setting. Now the last tool, the last application for the HIT box that I will talk about today is one called the hearing instrument transition. We didn't even have to make this a poll question to know that you have had clients who don't want to change technology or they really struggle to adapt to new technology and they're holding on to those hearing instruments for so many years and they reach a point where things change so quickly, you need to get them into new hearing aids. But when a new hearing instrument doesn't sound like what they're used to, especially for more severe to profoundly hearing impaired listeners, the adaptation period can be prolonged and very challenging. So a procedure called hearing instrument transition can be done using either the coupler, the HIT box or even on-ear but I will say this is far better done and far easier done in the HIT box. What you do in this hearing instrument transition is you use the freestyle mode and you use their current hearing aid to become their target. So, you set their current hearing instrument up, hopefully

it's still working. So if it's working, run these measurements and store them and you can pull them up later, when you have to transition them but we all know that this is, it's almost impossible if the hearing aid isn't working that they need replaced. So definitely run these while you can for your baselines. So what you would do is you would run a 55 dB curve with ISTS speech signal. Let's say a 75 dB curve with ISTS speech signal, and then an MPO sweep. And then when you get your new hearing instrument, what you're going to do is set the hearing instrument up, leave the curves for the current hearing instrument on the screen and then program the hearing aid to match those curves. So, like I say that current hearing aid becomes the target that you fit to. This is very easy to do using the on top mode. So you can look at the adjustments one by one, as you're making them and make your curves match as closely as possible. And then finally, just to make life easier, you can see that on the right-hand side, we've used the feature to benefit view to look at the differences between the current hearing aid and the new hearing aid and the lines are virtually zero. This is perfect actually. Now, this means that there's a perfect gain and output match but this does not mean that the hearing aids sound exactly the same but it is a big leap forward. So being able to show your patients, look, we've gotten this as close as possible to your existing hearing aids. Let's give this time and showing them this objective measurement can be really helpful. Now, I've also found that I've been surprised at even one or two generations forward from the same manufacturer, the compression and gain can be very different. So even if I think the hearing aids are somewhat similar, following this process helped me tremendous to really optimize and smooth the patient's transition. My long-term goal with patients to transition to them to new instruments is to not necessarily get them hearing as well as they were, it's to get them hearing even better, if possible but this allows us to do that in a very controlled fashion and give the patient confidence that they're going to be able to hear comfortably during that transition. And with that, Mary, I'm going to hand it back over to you to see if there are any questions.

- [Mary] Thank you, Dr. Switalski for sharing your expertise and experience with us, that was fantastic. We do have about seven minutes for questions, which is great and we have probably seven minutes worth of questions as well. So firstly, could you explain why the venting and hearing instrument type are relevant for coupler fittings or measurements?

- [Wendy] Yes, sure. So in an on-ear fitting, when you're doing probe microphone measurements, traditionally, the venting that's present is getting incorporated into the fitting but once you move to the coupler, you have to seal that hearing aid off to run the measurements in the coupler. So you have to tell the system what the venting is to get it closer to what the actual effect is. For hearing instrument style, it has to do with the microphone location effects. So where that microphone sits on the ear makes a difference. In a traditional real ear fitting, wherever the instrument microphone sits is exactly where the sound is picked up, so you don't have to add that in. So venting and microphone location effect, you have to tell it to the coupler so it knows what conversions or transfers to use.

- [Mary] Thank you and another question, this is a little longer. We routinely do real ear measures but presently, we're doing more remote fittings. We find that when we do coupler verification for slim tube fittings, it varies greatly from the real ear response. We don't see this when doing mold fittings. Could you please advise why you think this would be and we're very careful to select the correct settings in the fitting box.

- [Wendy] Let me think about what that might be. One, this would not lead to huge variations but one small variation would be just that extra bit of putty on the thin tube or on the speaker wire because you can get some harmonic resonances if you don't have that on there. It would be difficult for me to think off the top of my head without seeing your case files. But if you have some screenshots, I'm sure that Mary or I think

Jeanette's on here, I'm happy to help if you want to provide your emails and we could certainly look at that.

- [Mary] Thank you and yes, Dr. Jeanette Fitzke and myself will be happy to help with some of those questions offline. You can email us directly at Hearing and Balance Academy. And another question, two questions really on speech intelligibility index. Is it possible to obtain unaided speech intelligibility index from free fit and where would we find that speech intelligibility index chart that you refer to?

- [Wendy] So I will find that and email that to you, Mary, so you can send that out. You could measure unaided by putting a probe tube in the ear and measuring a 65 dB curve with no hearing instrument in, so then you're just getting the ear canal resonance. So, you can measure it that way. In the coupler you would not be able to measure it or estimate it but in real ear measurements, you can measure the unaided SII.

- [Mary] Okay, thank you. If you had an open fit thin tube hearing instrument to program, can you also do RUR and REOR in the coupler?

- [Wendy] You can't actually because those measures are ear specific. So what you could do is you could measure those, if you had both a coupler and a real ear system, you can measure those real ear, like maybe when the patient is there for their diagnostic assessment. And you can store those in Otosuite through Noah and then you can pull them up and apply them into your coupler fitting when you do your coupler fitting. So you can incorporate them in that way. If you've measured them with another system or if you have them manually written down, you can also enter them into the OTOsuite software. So the coupler fitting would use them but you can't measure that in the coupler because the 2cc coupler is not the ear canal.

- [Mary] Okay, thank you. Which coupler do we use for a slim tube and is there a diagram of how it should be fit in the coupler box?

- [Wendy] So for this slim tube or the RIC, you use the HA-1 coupler, the plate which is also used for the ITEs and you attach them with putty. I know that in terms of diagrams, the team here can share that with you.

- [Mary] Thank you. Does the HIT box have to be tied to the PMM or can they be used totally independently?

- [Wendy] They are totally independent. I mean you can hook them into the same computer and you can even plug the USB into the PMM, the on-ear system, if you want but there are a lot of clinics where maybe they have real ear system in each fitting room and then they have a one or two HIT boxes kind of floating back and forth. So they can be used on entirely different computers. I actually sometimes had mine at the front desk. I was training my assistant when I had my practice to run ANSI measures, so I attached it to the front desk computer and that way she didn't have to be in my fitting room to do those things. So it was a lot more efficient that way.

- [Mary] Great, one question very short. What does RTS stand for?

- [Wendy] RTS, it's in the software and I think it has to do, I'm reaching back, with an average measurement.

- [Mary] Oh, I think I hear from Jeanette, reference test signal.

- [Wendy] Oh, signal. Okay, 'cause I was thinking reference gain but okay, reference test signal, thank you Jeanette.

- [Mary] Thanks, Dr. Fitzke, she's in the background here.

- [Wendy] I got stumped, sorry guys.

- [Mary] That's okay. It's also a presenter question. Let's see, how often should one rely on the hearing aid manufacturer's predicted RECD?

- [Wendy] That's a good question. Every manufacturer uses different predicted RECD values and different predicted RURs. So I think if you're measuring RECDs which ultimate best practice is to measure RECDS on all adults as well as kids, I didn't measure RECDs on many of my adult patients just because of time. I would when they had some strange ears or when results look strange but I think what's important it's hard for me to tell you how often to trust those but it's important to look at the RECD values that are being used and just know how they differ from other hearing aid manufacturers that you're using and maybe even compare them to the RECD values that are programmed into your system.

- [Mary] Okay and we have time for one more question. Could you please explain the possible disadvantages using coupler-based fittings and what considerations should be taken?

- [Wendy] I think the only disadvantage is that it doesn't allow for you to evaluate the perception that the patient has to that sound, right? These are acoustic objective measurements and that's where we start but it doesn't allow you to know how will the patient perceive that? You can listen yourself to the hearing aids through the headphones or through a speaker to see if you hear any strange acoustic percepts but that's the only drawback that I see, is that it doesn't give you that final thumbs up from the patient but it gets you most of the way there.

- [Mary] Excellent. Well again, Dr. Switalski, I would like to thank you for sharing your expertise and experience with us and I'd like to thank everyone as well. I'd like to thank everyone for their participation. This ends our meeting but in closing, I would like to remind everyone if you've not done so already, please register for Aurical HIT Applications Part Two, RECD, Real Ear to Coupler Difference and Additional Verification of Advanced Hearing Aid Features, featuring Dr. Jeanette Fitzke which is scheduled for July 27th. You'll find the registration link on the Hearing and Balance Academy under Courses, Live eSeminars and again, thank you so much, everyone for joining our presentation today. This will now end our meeting.