Research QuickTakes Volume 6 (Pt. 2): Hearing Aid Fitting Toolbox - Practical Tips for Verifying and Validating the Fitting

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Real-Ear Probe Microphone Measures

- Welcome back, everybody. We're on volume 6.5 of Research Quick Takes, and today we're gonna be talking about real-ear probe-mic verification. And with us today, as usual, is Gus Mueller. Gus, welcome back to the show.

- Hey, thank you, thank you. It's been a little while, but this, of course, is my favorite topic that I've been lookin' forward to, and so cut me off, if I get a little long-winded on this. Back in some Quick Takes we did quite a long time ago, we went through all the steps of best practice, and, of course, it's no secret that probe-mic verification is a critical step in the whole best practice protocol. And back then, we just sorta glossed through it and said this is something you should do, so today what we're gonna do is actually do more of a step-by-step and go through some of the roles of how you actually would do it if you wanted to start tomorrow morning.

Rumor has it that something like 35% of the people who own it, own the equipment, are not using it, so if you fall into that category, take the dust cover off, and we're ready to get started. So when we think about a successful fitting, a lotta factors enter in, and I've just listed a few of 'em, which would be audibility, good speech understanding, loudness restoration. You also need good sound quality, which by the way, may not mix perfectly with good audibility. Sometimes people say when you give them good audibility, it sounds tinny, and then, of course, it has to be acceptable for the patient to wear. You really need to, you need to have a balance, and we're lucky that smart people have taken all those factors and tossed 'em in a big bowl and stirred 'em up and come out with what really is the best compromise.

And, of course, is what I'm referring to is prescriptive fitting methods, and over the years, there's been 15 or 20 different ones. We've now settled into two that are commonly used, the DSL5.0 and the NAL-NL2. For today, I think we'll just talk mostly about the NAL, simply because it is the most popular with adults, but everything that we'll be saying about the NAL would also apply to the DSL really. So you might ask,

why do I need to do these verifications? Why can't I just click on NL2 in the fitting software? Well, there are two reasons why you can't do that. The first reason is that once a hearing aid company has licensed the NAL, they can make whatever changes they want and still call it the NAL.

There's no restrictions. And, in fact, all, or at least most all companies have tweaked the NAL. Research has been done on this. Some NAL algorithms have been tweaked to the extent that they look pretty much just like the company's proprietary algorithm. The common thing to do is roll off gain in the highs. So even though you might click on the NAL, and even though on the fitting screen, it might be a perfect match to the NAL, it's very possible that those are not the true NAL targets. So a fit to the NAL may not really be a true fit to the NAL. In fact, I will bet it won't be, particularly for soft inputs, which as we've talked about before, is the the main input that you wanna get right.

Well, here's number two. What if all the manufacturers perfectly had the NAL to be the true NAL? Well, we still have problems, and that is, everybody's individual ear is going to be different. We're going to have different microphone locations. There's gonna be different residual ear canal resonance, particularly, if it's an open fitting, and the real ear coupler difference, the RECD, is gonna be considerably different from person to person. Also, you have to take into consideration the venting and how much of an effect is that going to have on the final response, so the bottom line is, you really have to measure it at the eardrum to see if you're fitting to the true NAL. Now, the goal that we have is pretty simple, and that is, we have these for the average person, and it's important to point out is the target is not a dot on the screen, it's a range.

In fact, back in Quick Takes 3.3 or so I'm gonna say, we had a whole session talk about that. It's a 10 dB range, so if as long as you're within that range, you're fitting to target. And so, we simply look at the ear canal SPL and see if indeed they're at targets. Now, just a few Quick Takes ago back in 6.3, we talked about the importance of doing

loudness discomfort level measures, so you will also enter that into the fitting software. So, you will have a target for loud sounds. So the NAL will provide you with targets for soft, average, and loud inputs. You will give yourself the targets from the measurements that you've taken for very loud sounds, and of course, we always use a calibrated shaped real-speech signal.

ISTS is the most popular today. For you Verifit users out there, most everybody's heard about the carrot passage. Some people just find it really difficult to give up the carrot passage. It doesn't matter. The carrot passage is shaped exactly like the ISTS. You'll get exactly the same results. In one case, you're talking about carrots, and another case you're talking about who knows what, because it's six different languages that we can't understand. This is what the fitting will look like. The fitting screen, you have, if we go up on the top, you have your measured LDLs, that have now been converted to ear canal SPL. We then have the hearing thresholds down on the bottom. We have our fitting targets, which is the dashed lines.

We have the range of the speech, which is the 30th percentile to the 99th, and then you'll see the dark line in there is the amplified LTASS, which is sitting close to the middle, a little above the middle. It's 18 dB from the bottom and 12 dB from the top to be exact, if it's a 30 dB window. So here we go, step by step. Anything, Brian, you wanna add before we get into the step-by-step?

- No, I think that the next part here is really important for those that are interested in how to, the step-by-step process, so I'll let you kinda continue on.

- Okay, yeah, I think this isn't anything we've talked about before. And it works a lot better if you're at a workshop. And I should mention, typically, I've been part of them, usually, a probe-mic workshop is two days, and we're gonna do this in 10 minutes. So, this is just to get you warmed up. So anyway, you enter in the audiogram, the LDLs.

You calibrate the probe tube to make it acoustically invisible. You get the patient positioned appropriately, this is important, two to three feet from the loudspeaker, located directly in front of them at zero degrees, horizontal and vertical azimuth. I've gone into some places, where it was pointing at their stomach, which was always sort of interesting to watch.

You put the probe assembly on the ear, and you insert the probe tip so it's within five millimeters of the eardrum. People are, they're a little hesitant, thinking, oh my goodness, what if I hit the eardrum? You will, but it's not that terrible. But there are probe fitting guides to help you with that, that work very well, automatic ones even today, where you just slide, you slide the tube very slowly down in the ear canal, and a little ding will go off when you're five millimeters from the eardrum. So, it's pretty simple to do. If possible, and I say if possible, because some people are uncomfortable doing this aspect of it, but if you actually do measure the patient's RECDs, you can enter that in, and that'll correct the audiogram for that particular patient.

If you don't enter them, the probe-mic equipment will enter the average RECD. This is very critical for children. For adults, you probably won't make a big mistake, if you don't do RECDs, but you'll be a little closer if you do. You need to enter some things in the software, whether this is an experienced user or new user, unilateral/bilateral fitting. These things will affect the targets. And I know sometimes people don't, they don't enter these things, and they'll end up saying, "Gee, my patients like things 60 dB below target." Well, it could be that you're simply the difference between experienced and new and bilateral and unilateral, which actually makes a six dB difference. And so maybe you're looking at the wrong target, because you didn't enter in all the correct information to begin with.

You put the hearing aid on, and I would have it pre-programed to the manufacturer's NAL fitting. And also with today's equipment, if you want, you can do a lot of these

runs bilaterally. You're still gonna have to program each hearing aid unilaterally, but now and then you save a little bit of time by doing the bilateral runs. As I mentioned, we recommend you use International Speech Test Signal, the ISTS, which is a speech shaped calibrated signal. You start with the presentation level of 55 dB. You're gonna do three levels for soft, average, and loud, 55, 65, 75. A lot of people like to start with 65 for a reason that I don't understand. It's much more efficient to start with 55, make the programming changes.

You'll be changing the gain, overall gain of the hearing aid. It'll be under fit, I can assure you, because all manufacturers under fit for 55. So you're gonna have to pump up gain to get to your 55 targets, then you go up. Once you finish 55, go up to 75. Now at 75, you're gonna be programming compression, although you probably won't know that. You'll just go to the tab that says gain for loud, and you'll be making clicks on that until you hit your 75 target. And then after programming for 75, you drop down to 65. Well, the math here isn't too complicated. If you have it correct for 55 and you have it correct for 75, there's a very good chance you're gonna be correct for 65, 'cause it's right in the middle, and you usually are.

Once you, but you might need to tweak it a little bit, and if you did, I would go back then to 75, just to make sure that 75 was okay. Now, what's happening? And just this has only been in the last oh, five, eight years or so, Probe-mic systems will automatically calculate the SII value and give you an idea if you're at the right SII. And they will also calculate RMS error, and so you'll get these values to help you with your plus or minus five guideline. And then the final step is to do the REAR85 verification. This is where you make sure that the maximum output falls within close, just below your LDLs.

We actually went through that back in Quick Take 6.3, so we have the whole protocol for doing that as a matter of fact, and so I won't go into that here. And when you do all

that, you get to pat yourself on the back for following best practice guidelines, which by the way, what I just went through has been in best practice guidelines since 1990. So this isn't anything new. That would be what? 40, 30 years ago, 35 years ago. Probe-mic became popular in the clinic in around 1986, and then the first guidelines that included probe-mic meters were around 1990 or so. Anything you wanna add here, Brian, on the protocol?

- No, I think that the key point here is to do it right. I think a lotta people out there say they do real ear measures, but they may not do it in the the correct way. And if you don't do it in the correct way, then pretty much everything you talked about here is not going to fall into place.

- Yeah, and you know, it's too bad. I know there's this, if you go to the the audiology Facebook pages, there's #IdoREM and this sort of thing. It isn't doing REM that matters. What matters is fitting to a validated prescriptive method. You can do REM and still have a terrible fitting when the person walks out the door. And unfortunately, that's being done some places, because patients are getting savvy enough, that they will ask you if you do probe-mic measures, but the patient probably isn't savvy enough to really determine if you fit the prescriptive methods or not. And so, there's a big difference.

- Right, and one more point I wanted to make, Gus, and that is, both the NAL and the DSL are based on thousands and thousands of ears over many what, several decades, and trying to balance comfort and audibility. And I don't think you can really refute that kinda science.

- No, and the, I mean, you look at, well, you look at both procedures. What they have done is they've introduced one version. It's been out there for several years. They've looked at the data, and they've tweaked it, which shows you that the researchers

themselves would say, "Yeah, we can make it a little bit better. We're gonna do this, we're gonna do this." And that's what it's all about. I don't know how anybody in a clinic could think that somehow that they would know more about how to fit a hearing aid than these thousands of patients, who have been gathered in and looked at. It just seems unbelievable to me that anybody, and when somebody tells me that, I say very simply say, "Well, why don't you publish your fitting method then?"

Because if it's really better than the NAL, publish it. And I haven't seen any of those, but anyway, this is just an example of how much of a difference it could make. This is a real patient. I actually, I have to thank Lori Zitelli for, she used this slide in a talk, and I asked her if I could have it. This was a real patient fitted to the manufacturer's NAL, and on the left is what it started with. And as you see, she did a gorgeous job, and you see the fit to target on the right. You're looking of changing things by 12, 15, 20 dB in the high frequencies, and you have to believe that's gonna change the person's speech understanding and noise for sure to have all that audibility.

Speaking of that, we have the SSIs, just a little bit more on that. As I said, that's the way we normally look at the goodness of the fit. It's been around for a long time. It used to be called the AI, then it was modified to become the SII. But it's only been recently that it's a common calculation. One of the things that sometimes is difficult to understand is that you don't want an SII of 100% or 1.0. On a good fitting, to either the DSL or the NAL, for average inputs, you're probably gonna have an SII of around 0.65 to 0.75. That will probably be a good fitting that could very likely would be a perfect match to target.

Now what happens, as you would expect, as the input is softer, the acceptable SII gets smaller. What I just, those numbers I mentioned were for 65. And also, of course, as the hearing loss gets worse, the numbers will get smaller because you only have so much room to work with. Here's an example. This is from the Verifit, a slide from John

Pumford, thank you John. The DSL people have published several charts about what is the acceptable range for different input levels. What you see here is, in this case, oh, this must be, these are a little higher than usual. This must be for children, I'm thinking, but it doesn't matter. The example is that what they do is they put the range, you see those black marks on there?

They put the ranges, you see it down below for pink. They also have the marks. This must be for children, because those are, those numbers are higher than what we'd usually see for adults. But they have a chart for adults also. The other is root mean square, and I thought, Brian, I know you prepared some some little math problems that I thought we could do just to get into this.

- Yeah, we'll save that for another episode.

- You do square roots almost every day, right?

- [Brian] Yeah, exactly, in my sleep.

- Yeah, well anyway, we're lucky that the machines do it for us. And so basically, the RMS error is pretty much like the average absolute dB error. There's just a slight difference. What you do is, you square each number and add them together, and then average them and then take the square root of that number. And so, I mean, I gave you an easy one there. If you had a five dB error, by the time you added 'em all together and divided, the square root of it would be five 'cause you'd end up with 25. So I gave you one example down below though where you still have to think just a little bit.

And I came up with a hypothetical case, so I'm gonna read these numbers to you, where you had an error of zero at 500, one dB at 1,000, 2 dB at 2000, and then oh oh, 10 dB at 3000, but then back to two dB at four. That's a little unusual. But I did the

math on this and actually did calculate RMS, and you'd get an RMS of 4.7, which is passing. And you think five or below is usually considered okay, but that isn't a good fit, so you still have to think a little bit, but.

- That's why I need to be a good clinic. That's why good judgment is important. You gotta be able to look at the pattern.

- Exactly, and that pattern is not good. I'm pretty sure that RMS error is what Costco uses. I think their employees are actually graded by the RMS error of the fits, if I'm not wrong. At least at one point in time they were. And there you see is the RMS error in this particular case. It's five dB, so you probably don't even need that black line there, but they put it on there anyway. And so this would all be acceptable. And then finally, I'd like to talk about something that we're calling AutoREMfit. But every company has its own name for it, and every manufacturer has its own name for it. So there's probably 10 different names, but it simply means that the software of the probe-mic equipment and the software of the hearing aid equipment talk to each other, and they make agreements as to who's gonna do what and how the hearing aids are gonna be fitted.

The advantage that is usually purported, which I could maybe say stronger than purported, it's true, that it's gonna be a little faster, and it is. It'll be a little faster than what a good clinician could do. The other thing that isn't talked about as much is you don't have to be as skilled in programming hearing aids. I mean, you really don't have to know what tab to push. There's a little bit of setup that goes on, but if you had someone who wasn't very skilled, you'd probably end up with a much better fit than if you just let them go at it on their own. So I'm sure in some places that might be considered an advantage, where you wouldn't have to have really a trained person doing the programming.

If you compare it to a skilled clinician, you'll get about the same fit. Here's an example, this is just a bilateral fitting, and on top is what we started off with. This was the manufacturer's fit to NAL, and as I promised you earlier, notice that it's under fit for soft by about 10 dB for average and loud by about five db. And then we pushed a few buttons and let it go at it, and you ended up with the fit down below, still a tad low for soft, but considerably better than what we started with. John Pumford and I did a study, where we looked at, this was on, I think, about 16 or so real ears, and where we did first, we did the first fit and then we did the autofit.

And what you see here is that, look at the orange bars, we're seeing a real nice only two dB error. That's as good as an experienced clinician's gonna get, maybe even better. Remember really, if you're within five, you're okay, and two dB is good. So is this all sounding too good to be true? Maybe, maybe. Some of these autofit systems only fit to 65, and you could still have a serious mistake for soft. And the problem then is, if you then have to go and get soft correct, meaning you gotta pull up gain for soft, as soon as you pull up gain for soft, you just screwed up the average fit, because gain's also gonna go up for average, which means you now have to go and reprogram average, then you're gonna have to go reprogram loud, and basically, you're doin' all the programming all over again.

So, that's a problem. A bigger problem is bullet point number two, and that is, it depends who's in charge. Now the example I just gave you was with the Verifit, the work that John Pumford and I did. The Verifit, the rules that the Verifit has, is that the Verifit has to be the driving software, which means it uses the targets of the Verifit, which are the true NAL targets. However, with many of the arrangements that have been made, the hearing aid software runs the show, and the hearing aid software tells the probe-mic what to do. And so in those cases, you'll end up with, the fit to target will be the NAL that is stored in the fitting software, not the NAL that's stored in the probe-mic equipment. And as we've already discussed, that very probably won't be

the true NAL, so that's a concern that you have to be aware of. So, that's about it, a two day workshop cut into 10, 15 minutes.

- Well that's the way life is these days, everything is condensed and shortened.

- Exactly, exactly.

- Well, maybe this will be motivation for people to actually attend a workshop, if they look at this information first. Thanks for all your expertise, Gus. I think one of the most important points that you made was the NAL inside the fitting software is not the same as the NAL inside the probe-mic system.

- Yeah.

- And that you really need to trust is the one that's in your probe-mic system.

- Yeah, for any of you listeners, who are really interested in this, you can get the standalone NAL. I mean, you can order it from NAL, and so you can see who's really right by looking at the real NAL. But I can tell you already, it's already been checked. All the probe-mic manufacturers are using the real NAL, 'cause they don't have a dog in the fight. They have no reason to change it, so they I think you can rely on them.

- Yeah, well anyway, lots of good points. Thanks for your expertise, and we'll see you next time for 6.6.

- All righty.

Soundfield Threshold Measures

- Welcome back to another Research Quick Takes. I'm Brian Taylor. And today, we're going to be talking about soundfield thresholds and how to measure those, why you might wanna measure those, and everything you need to know about them. And joining us today to talk about that topic is, once again, Gus Mueller. Welcome back, Gus.

- Hey!

- Good to have you.

- Well, you know, the last time we were on together, we were talking about all the latest innovations with probe-mic measures, and now we're gonna go back to the 1970s. And so I see why you invited me. You're gonna have somebody who was born in the 1970s.

- Somebody was here in the 1970s actually fitting hearing aids. So it's good--

- Well, actually, I don't know, I guess I'm okay saying that I was fitting hearing aids in the 1970s and I was doing functional gain. And so anyway, it's an interesting topic but it's something that, I think, needs to be talked about. So, as I just mentioned, it goes back to long ago. We started using a prescriptive fitting methods. First, we were using speech audiometry and we dumped that when audiologists went out and started selling hearing aids and said, "I'm not gonna spend two hours doing all that speech testing. It never really worked in the first place." So then we got all these prescriptive fitting methods and they were all gain-based. And so to see if you're meeting the prescription, you had to do gain.

And the logical way to do it was to do unaided and aided in the soundfield which then became called functional gain. Now, this was all replaced in the mid-1980s, but why are we even talking about it today? There are occasions, not often, but there are

occasions when you do need to resort to either functional gain or simply aided soundfield. One of those, which seems to be happening more and more often is, when you're fitting other than a traditional hearing aid and you're fitting some type of bone conduction device or a cochlear implant. There have been some techniques that people have dabbled with to use probe-mic measures, but it haven't been very successful. So you may have to be doing soundfield measures either functional gain or simply aided thresholds.

There are also cases when you've all experienced this. You're in a busy clinic. You're trying to do probe-mic measures and the patient was very concerned that they had a glop of cerumen in their ear so that before they came in, they washed them out really well and they're still now wet and goopy. And every time you stick the probe tip in, it plugs up. And it always turns out that this is the patient who's 200 miles away. And what are you gonna do? And you may want to do some quick soundfield aided just to make sure that you're in the ballpark. Some middle-ear pathologies give you really funky results with probe-mic measures, starting with PE tubes and furs and we could then go on to larger perforations, mastoid cavities and some.

In some cases, functional gains really your only alternative. And finally, which I'm sure has happened to some of you, is a patient will walk in the door carrying a form with them. And on the form, it requires that you have aided thresholds or aided gain. So those are a few reasons why you still have to maybe resort to this. So I'm gonna go through step-by-step of how you do it. You have the patient first seated at a calibrated spot in your test booth directly facing the loudspeaker. Be sure they can easily make a five dB difference just by leaning forward. Tell 'em not to do that. And you can bet as soon as the sound gets soft, they'll lean forward every time.

You have to use masking. You can't stick an ear plug in the other ear that does not work and this creates a technical mess because you got wires going out into this chair,

in your soundfield, and you're trying to walk around the patient and the wire's in the way, but it's what you gotta do. And then you just do threshold testing as you would do four traditional audiometry. You cannot use the earphone threshold because for functional gain, you have to compare two different measures that are conducted exactly the same. So you can't cheat and take their earphone thresholds. So once you have the unaided, you put the hearing aid on, presumably you gave it your best shot through the software to have it programmed close to the prescriptive target and you then take the aided thresholds and you simply subtract the aided thresholds from the unaided.

And you then compare the gain that you just achieved and you compare that to then now fitting targets which can be displayed in gain. Not too long ago, we did one of these talks. Well, it would've been 6.5, where we talked about using speech mapping, which is an ear-canal SPL. But there are also targets for gain which you could just have the targets displayed on your probe-mic equipment, write them down, and then take that into the booth when you're doing your testing. If it isn't good enough, then you reprogram and you repeat until you have the gain that you want. This is just example of how it could be plotted. The difference then between the top thresholds and the bottom thresholds will be what's called functional gain.

By the way, it should be the same as insertion gain that you measure with your probe-mic equipment. So normally, when we're talking about one of these tests, we tell you all the good things about it because we want you to get excited about doing it. This is gonna be a little different because we're gonna go through all the bad things about doing functional gain measures and there are many. We'll call them pitfalls. First of all, you have to make sure you eliminate the non-test ear. So I already mentioned this. That can be difficult, but you have to do that. There are room masking effects. If a person has a sizable hearing loss, even 50, 60 dB, you're gonna be giving them 30, 40 dB of gain for soft inputs.

Ambient room noise is soft. And guess what? That ambient room noise, even in a test booth, is now gonna be amplified by 30 to 40 dB which means it's gonna mask out the very soft inputs that you're giving the person. When it gets worse, those very soft inputs that you're hoping the person will hear might be below the expansion kneepoint. As a refresher, expansion squashes what's below the kneepoint. Compression squashes what's above the kneepoint for expansion that squashes below. And in today's hearing aids, you can't turn off expansion. So that could make your test invalid. Input compression, now, I'm looking at people with more hearing loss. Now, you could be squashing the signal above the compression kneepoint. And so what you think is a 60 dB signal may not be a 60 dB signal because it's being compressed.

Another problem is the actual gain information that's provided. And that is you're only going to get gain for low-level inputs. When we fit hearing aids today, we really wanna know gain for soft, average, and loud. And there's more, the frequency information just from a time constraint. Now, ideally, you would do a swept frequency like a Békésy audiometry for any of you old enough to know what that is. But we don't, we tend to use key frequencies. Well, guess what? Hearing aids have nasty peaks and dips at 1,500 hertz which might not be one of the key frequencies that you're testing. And so you easily could miss weird things in the output just simply because you skipped over it and you didn't test all the frequencies.

And finally, one of the biggest problems is efficiency. Actually, maybe this isn't. Finally, I think there's even one more bigger problem. When you do probe-mic testing, it is not uncommon to change the programming in the hearing aid five to 10 times and run a new curve. You say, "Oh gee, I need to bump that up by five dB at 3K." You bump it up, you run a curve and go, "Oh geez, that wasn't quite enough. I'm gonna bump it up some more." You run another curve. Each one of the curves takes eight seconds to

run. Well, what are you gonna do with functional gain? What happens when you wanna bump up gain then? It's very cumbersome and very time-consuming.

So be prepared for that if you're programming a hearing aid. And finally, the test-retest reliability is not good. David Hawkins, actually, when he and I were working at Walter Reed together, he did a research on test-retest of functional gain. At the 0.05 level, it was 15 dB, 15 dB, and we're trying to match a target. When test-retest is 15, what's the use really? Anything to add to all that, Brian?

- No, except for, to say, unless someone is actually making me do aided soundfield measures. It's a very poor replacement for probe-mic measures.

- Yeah, oh, absolutely, absolutely. But there are those cases that I mentioned. I mean, I've been there.

- If you're gonna do it, you might as well do it right.

- Is it better than not doing anything?

- [Brian] Exactly, that's basically the message here.

- I mean, you could argue putting the hearing aid on a coupler and getting in and maybe that might be a better alternative. But I can tell you, particularly with pediatric audiologists, it's still fairly popular to do soundfield. And with the cases I mentioned like with a bone conduction, a hearing aid. What's your alternative?

- Exactly.

- Well, anyway, the three things to remember this is, now, if you're just doing aided soundfield. So you're not doing gain, you're just doing aided soundfield. First thing to remember, every one of the pitfalls that I just talked about are still gonna apply. The second thing that's important is it's really critical now that the loudspeakers are calibrated. There is a study done, it's now been about 20 years ago, but in the study, they found out that only 15%, I think it was a study of audiologists, but only 15% knew if their soundfield was calibrated or not or how it was calibrated. So just because your earphones are precisely calibrated doesn't mean that your soundfield is. Now, for functional gain, that doesn't matter so much because you're comparing two different measures.

But if you're using, if you're only doing aided soundfield, now you need to make sure that when you have that Dell set at 35, it's really 35. And a final thing that I find, it's sort of unusual, I've seen aided audiograms were the report said, hearing aid A was hearing better than hearing aid B because hearing aid A gave a soundfield threshold of five and hearing aid B gave 15. The point is, once you get out of that test booth, everybody's hearing drops down to about 20 dB. So you don't have to have a battle of what hearing aid is that much better than 20 because it won't be better than 20 once the patient leaves the room. So if you can get an aided threshold of 20, good enough.

You don't have to go any farther. This is, I thought was interesting. And no, I'm not gonna read the whole passage to you. This is from the pediatric fitting guidelines. I'm just gonna do two sentences. I found this to be really interesting because they titled this "Aided Thresholds in the Sound Field Recommendations" and I'm thinking, "Gee, I wonder what their recommendations are." The recommendation is, "Measurement of aided sound field thresholds should not be used." which is sort of funny. You might say, "Why did you even put it in there?" And I asked Catherine Palmer that she said, "'Cause people are doing it and we need to tell 'em not to." And the very last statement there is exactly what we just went through.

But if you were to do it, this is just an example of a hearing aid that was not fitted very well and we made some changes to it. And so these are just aided soundfield. In one respect, I mean, if you were fitting a child, this is probably much more interesting to the parent than ear canal SPL measures because you can relate this to the real world, much easier to say. Look, we took the aided thresholds from down there and we moved them up to up here and notice that Johnny is only missing 20 of the little red dots. And therefore, he will do very well in school, we hope. Here's one thing you can do though when you get that form that you have to fill out for aided thresholds.

This is legit and this is what I would recommend. Do your traditional probe-mic measures fit for soft inputs. Once you've done that, switch to insertion gain. Use the average unaided response. Now, repeat the REAR for soft inputs. Use a 50 dB SPL if your room's quiet enough for that. And then what you do is you take the calculated insertion gain, okay? The machine will calculate insertion gain for you and you apply that to the HL audiogram. You just simply add up. It's not the true thresholds, but it's actually 100 times more valid than actually sitting the person down in the booth and doing the testing. And now, you would have what I would call a predicted aided threshold, but I would believe in it enough that I would write it on some form.

And if anybody ever questioned me, I would show them what I did and I think you'd be just fine. There's actually one or two probe-mic systems that do it for you. And here's one of 'em. This is the machine that automatically then took the insertion gain and added it to this patient's threshold. That's his left ear and right ear. And so you see what the aided thresholds are for this person based on the insertion game. So I know that, Brian, you like every and all things from Wisconsin, whether it's the, what's your special beer again?

- Spotted Cow.

- Spotted Cow, yeah, that's right. Whether it's a spotted cow or cheese curds or whatever it might be. But of course, the most famous thing from Wisconsin is Vince Lombardi in many respects, not to mention leading the Packers to World championship. So I thought that it needed something fitting to close this out, fold out a good Vince Lombardi quote which I think complies perfectly to functional gain. The measure of who we are is what we do with what we have. And if it's the only test you can do, do it well. It's unreliable, inefficient, and not very valid. But you might just have to do it. So the measure of who we are is what we do with what we have. And that's all I got on functional gain.

- I think the key message here, Gus, is that if you're gonna do it, do it right.

- Yeah, exactly. There will be times, I'm betting for our listeners. I'm betting they're saying, "Oh God, I remember, there was that day when I had to do that. I hadn't done that for 10 years, but I had to sort of go back and do some aided soundfield measures." So, yeah.

- Well, thank you for that. And now that we're done with number six, I'll see you for number seven.

- Okay, looking forward to it. See you soon.

- [Brian] Sounds good, see ya!

Identification and Treatment of The Hearing Aid Occlusion Effect

- Hi everyone and welcome back to another Research Quick Takes. I'm Brian Taylor and today we're on Quick Take 6.7, and we're gonna be talking about a topic that, I don't know, it's been around for a long time, something that most audiologists deal with from time to time, and that is the occlusion effect. And here to talk about the identification and treatment of--

- I'm sorry, I can't hear what you're saying. I have the occlusion effect. Oh.

- That could be one version of the occlusion effect, and here to talk about it is Gus Mueller. Well on that note, Gus, I'll let you take it away.

- Yeah, thank you, thank you, and good to be back. And sort of a fun topic. Fun for me in that way back when, when CIC's were at the height of their popularity, occlusion effect was the nemesis of everybody, and everybody was talking about the occlusion effect and how to get rid of it. Then of course we started going to open fits, not so big a deal anymore, but I think that we're gonna be going back to more closed molds. Hopefully people are realizing some of the lack of processing that happens when you open things up, and I think there's gonna be more occlusion effect issues. And so, just to review for those of you who haven't thought about it for awhile, it tends to be really annoying, particularly if your hearing's better than 30, 40 dB in the lows.

Patients report and many of you have had those patients that they say, well, I only use one hearing aid, it's not as bothersome to them. Some people have actually rejected hearing aids become of it, and they typically say, oh, my voice sounds booming, hollow, echoing, distorted, for their own speech. They'll always also notice that chewing carrots and Fritos and a few things like that. Now, I'm gonna keep coming back to this one point that I want to make right now, and that is, you could also hear those very same complaints if there's too much low frequency amplification in the

hearing aid. So, they might, almost the exact, exactly, they might say, boomy or echoey or hollow.

So one of the key things that we'll be talking about is understanding the difference between these two, because your treatment plan is totally different, whether it's the hearing aid or whether it's the occlusion effect. One of the reasons why I like to think about the occlusion effect is the older patients say it sounds like I'm talking in a barrel. And I remember not that long ago, I had an intern who was working with me, and she goes, Dr. Mueller, what does that mean? Talking in a barrel? And I said, you've never talked in a barrel? And she hadn't. And so people just don't talk in barrels as much as they should anymore. But this is my farmhouse where I grew up in North Dakota.

And my mom collected rainwater, we didn't have plumbing, we had a windmill and that water was orange. We drank it, the cows drank it, but my mom wouldn't use it for washing clothes. So we collected rainwater and there's a big barrel right by the back porch, and I used to lie on my stomach and put my head in the barrel and go, whoa. And I could find the resonant frequency of the barrel by moving my voice up. I didn't know it was the resonant frequency then, I just knew I could get this really cool sound. One day, it rained and the barrel was half full of water. I laid down and went, whoa, and it was at a different frequency, and it's when I decided to become an audiologist.

- Oh, sorry.

- So that's my story of talking in barrels. And I encourage you, if you see a barrel somewhere, just go and talk in it. So, back to the occlusion effect. This is important to understand because it helps with the treatment. So when we talk, particularly people like me, our voice goes up to 120, 130 dB in the back of our throat. It travels then by the mandible. So, it starts back there. It then becomes a bone conducted signal. It travels by the mandible, and as you perhaps know, the condyle of the mandible is right

next to the ear canal, the cartilaginous portion of the ear canal. So this signal, which typically is pretty low frequency, starts to, gets the cartilaginous part of the ear canal into vibration.

And if the ear is open and is a normal situation, it just goes right out the ear as low frequencies do. If you plug up the ear, it can no longer go out. So it vibrates the tympanic membrane and you hear it as an air conducted signal. And it can be annoying. So that's how the the occlusion effect works. And hopefully one of the things you notice is I never mentioned the word hearing aid. Okay? 'Cause the hearing aid has absolutely nothing to do with it. So one of the things that makes it interesting and why patients are, can be really annoyed with it, is the occlusion effect affects different vowels. It doesn't affect consonants really at all and it doesn't affect all vowels.

It particularly affects the E and the I, which can be boosted up 15 to 20 db. When on another hand, the ah is really not boosted up at all. So words just sound very strange. Those of you out there who routinely do probe mic measures, one of the things I would recommend on all your fittings, is to listen in. All probe mic equipment has that option. You sitting, we put on a headset, and you can listen to what's going on in the ear canal. It's a nice way to listen to how bad the occlusion effect can be for some people, and gives you really some insights. Also then if you're making it better when you do whatever treatment that you do.

Or you could do it on your own area, if you could hook somebody up. Important to remember, and I'll probably only say this three more times, it is not related to the sound delivered by the hearing aid. Totally unrelated. That's a whole different problem. So what I recommend doing, and you can do this, you can do this out in your waiting room before the patient gets too comfortable back in your office, is you just simply, well I guess you couldn't mute the hearing aid in your waiting room, but you could open up,

well if it has a battery. At any rate, what you need to test is with the hearing aid on versus the hearing aid off.

It's very simple. And that is, if it's the occlusion effect, it will be exactly the same with the hearing aid off as it is with it on, because it's not about the sound that's traveling through the hearing aid. So that's a real nice quick differential that you can do.

- Gus.

- Yeah?

- A really simple way to do that I think is to use some fun tack, the stuff that you use with your couplers, and put that over the top of the microphone and do the tests that you just mentioned.

- Yep.

- It's really simple and you don't have to hook the hearing aid up to any software.

- Yep. See I was, as I was saying that, you can tell that I haven't been fitting hearing aids for the last few years, 'cause what, two thirds of them are rechargeable now. So what almost fell out of my mouth was open the battery compartment, and it's uh-oh, now that's not gonna work to open the, fun tack will work no matter if there's a battery or not. So yeah, basically just come up with a way to have it either. It sounds like you've actually done that then Brian.

- I have many times.

- Yeah. Yeah, that would work perfectly as long as you don't cram it down into the port. So anyway, along those lines though, and I can see why some of you out there might be misguided relative to the occlusion effect. I don't know that this still exists. This slide's about five years old, but this was from one of the big six manufacturers and they had something called the occlusion manager. And that sounds like a pretty important guy. And so I sort of was wondering what does the occlusion manager do? And well there's what the occlusion manager does. It does not vent the hearing aid for you. It does not fit a more open fitting. What the occlusion manager does is simply takes out gain in the loss, which you see on the right.

That's with the manager on over on the left is with the manager off. And so what happens then is the patient walked in the door with one problem and is gonna walk out the door with two 'cause he still has the occlusion effect, and now he can't hear soft sounds in the lows because you just took out all the gain for the lows. So don't do that. So why do some people complain about the occlusion effect that other ones don't? A lot of reasons. One has to do with the overall level. I did a study, geez, it's been almost 30 years ago now. We found that people, when when we had it, their ear canal closed, tightly closed.

The occlusion effect ranged from seven dB to 26 for different people. Has a lot to do with how they vocalize. People, Willie Nelson, I'm guessing, has a very small occlusion effect. And half our listeners are saying, who's Willie Nelson? He has sort of a nasal quality to his voice is my point. Then also then it's gonna say where is the peak? The peak of the effect can be at different places, which affects the annoyance. Most commonly the peak is down around 200 hertz, 250, which is good because that's the easiest to get rid of with venting. If the peak's up at around 750, you're gonna have a lot harder time getting rid of it. The patient's hearing loss matters. And that is, as the hearing loss is more normal, the more annoying it's gonna be.

That's shouldn't be surprising. Here's something that is a little interesting, is that if you have a lot of gain in the, let's say you have maybe a 50 dB loss in the lows, and you're given the person quite a bit of gain, they won't be as bothered as the occlusion effect because the gain of the hearing aid actually masks out the occlusion effect, and the processing of the hearing aid sounds more normal than that of the occlusion effect. And finally, it has to do just with the patient's general view on life. I've actually done probe mic majors of the occlusion effect on hundreds of people. And some people can have a 10 dB effect and be whining a lot.

Other people can have a 20 dB effect, and said, yeah, doesn't bother me. It sounds a little strange, but I'm fine with that. So, a lot of things can impact it. One of the things you want to do is actually measure it to see if it's really there. So this is, you start off doing your traditional probe mic measures, you put the probe the same as you would for any other test. And what you want to do is configure your probe MICA system so it's ready to use live voice. And there's different ways to do that with different systems. And so your first test is with the ear open. You actually have the patient vocalize and you need to make sure that this will be the same with it open and closed.

And I've always used the E, which works very well. You need to get, you have them give you a good strong E like, , and as soon as they start to vocalize, you click on the analysis button, and your probe mic system will analyze what the output is. And I have a curve of that I'll show you. And some probe MIC equipment will measure the SPL itself for you, which is convenient. On other systems, you can just simply use your cell phone. I'm guessing all of you have a little SPL meter on your cell phone. Just hold that in front of the patient, have them try to get around 75, 80 dB's, okay too, just so it's nice and loud.

As as if they were having, talking loudly. You analyze the spectrum, you place whatever it is, the ear mold, the ear tip, the custom hearing aid, whatever you're testing, you put

that in. You simply have the patient vocalize again and just make sure that it's the same SPL so you can compare apples to apples. Once you have those, you simply look at the curves and you see if there's a difference or not. And this is on the verifit. So what you have down on the bottom is the green green curve. Okay? And what you have on the top is the pink. And what we wanna look at is, is there a difference between the pink and the green?

Now remember, the hearing aid's turned off, so if there's a difference, you're 100% sure that it's the occlusion effect because what else could it be? Now, notice that out at 3K, you see the green there, the green was bigger than the pink. And why is that? That's the ear canal resonance, which then went away when we closed up the ear canal. That's why the pink has less than the green out there. But we don't really care about anything above 1000 hertz 'cause it won't be the occlusion effect. Occlusion effect's always at a thousand hertz below, usually down in the lower frequencies. This is actually more than we'd normally see at 500 and that might be a little harder to deal with.

But notice the main peak there that we want to get rid of is down around two 50. That'll be easy to do. You don't need a really big vent to get rid of 250. In fact, an instant fit tip, unfortunately, even the solid domes are, have enough leakage that that 250 will be gone. This is an interesting hearing aid made for my ear in a study that I volunteered to be a subject for. This, there was no occlusion effect, absolutely none. It also terminated two millimeters from my TM. This is from a company that had the theory of getting rid of the occlusion effect by putting something to prevent the vibrations that occur in the cartilaginous portion from preventing them from ever getting to the TM.

And it worked, it worked perfectly, but it wasn't very comfortable, particularly after you wore it for a few weeks. And that little tip on the end got hard and it never became successful. But it was for about two years. It was called minimal canal contact or

something like that, from a company out of Virginia. Anyway, back to the occlusion effect. This, we did do this with CIC's, and of course, as many of you know, there's a major hearing aid company out there now that has a special hearing aid that fits deep into the canal. And indeed there, I'm guessing there's no occlusion with that particular instrument. This was a patient of mine and this a comparing a deep fitted CIC shallow CIC.

And you can see the difference that once we went deep, we eliminated essentially the entire occlusion effect simply because the cartilaginous portion couldn't vibrate anymore. There there is a hunk of material that was preventing it from vibrating and consequently no occlusion effect. This is a another patient. This one actually was from a research project not too long ago, where we had two different domes. So you see on the most closed dome up on the top there, what did we have? It went from about 20 dB of occlusion effect. And by switching to a vented dome, we are able to bring that down to only about 10 db, down there in the lows is where I'm looking. So then you say, well what's the treatment?

We've sort of already touched on that and that is that you need to open things up. So first you need to determine that it's really the occlusion effect. You want to measure the magnitude and the beauty of the probe mic system is then you can continually remeasure. If you do something, you can remeasure, and see if you're making any progress or not. Usually, if the occlusion affects 5 dB or so, people don't complain about that. So that would tend me to think that it had to do with gain from the hearing aids. One of the things you also can do is the measure called the REOR, which simply looks at the direct sound that's going to the TM.

If the REOR looks like the REUR, or worded differently, if the REOG looks like the RUEG, you can be about 100% certain that there is no occlusion effect, 'cause that tells you it's a very open fitting. If there is an effect observed, the logical treatment that

is to increase the vent size, one way or another, go to a different type of tip. Whatever you can do to hopefully get the occlusion knocked down that it's no longer bothersome. Do not ask the patient, because they tend to try to make you feel good. And I've had case after case where they go, oh yeah, yeah, yeah, I think that's better, and I'll do the measurement and it only changed by one dB, knowing that they'll be back in a week when they realized it really wasn't better.

So trust your probe mic equipment, not what the patient tells you. And then, before you let the person out the door, you want to make sure that you haven't created a feedback problem by opening things up. And most importantly, you need to go back and run your speech mapping to make sure that now you still have enough gain in the lows if you've opened things up. So those are two things you would do before the patient left. A final word, now and then you'll hear people toss out the word, ampclusion. Richard Swedal, Robert Swedal wrote a article on that, which got a fair amount of press. I think he was consulting for White X at the time.

But I went back and looked where it really came from, and it came from fellow named Steve Painton, who I don't know, but it seems like it was a good article on the occlusion effect. And so, what the point is that what he said is that it's the ampclusion is the combination of occlusion and the amplification that results from the hearing aids. So it's a combined effect. Okay? So if we're understanding this, if you already know that the patient has the occlusion effect, then it really isn't a combined effect. And there's another thing to think about. I actually saw somebody in a talk had a slide where they were talking about ampclusion, and they showed that a person could have 15 dB of occlusion, and then they could have 15 dB of gain of the hearing aid.

And then they showed 30 dB bumping on the TM. There's a problem with that, is that when you add 15 and 15 in the world of audiology, you don't get 30, you get 18. And I'm pretty sure that patients can't tell the difference between 15 and 18, or at least it's

not gonna change their complaints. So I don't see a need to ever use the term ampclusion. I think it's either the occlusion effect or it's too much gain from the hearing aid, one or the other. I don't think it's a combination of the two.

- Combined effect, right?

- What's that Brian?

- Yeah, I would agree with you, it's two different problems.

- Yeah, yeah. So anyway, talking in barrels is fun. I encourage you all to do it. Oh, one final thing I have to tell you. Just a couple years ago, I had a class of 12 women, not that it really would matter, but they were all women. I asked if anybody had ever talked in a barrel, and one of them did, had, she worked in a sauerkraut factory in Maine and talked in sauerkraut barrels all the time whenever she washed them. And I don't know why I just remembered that, except that I was up visiting Jay Hall in Maine, and I drove back to, I drove by the sauerkraut factory where she worked. Anyway, talking in barrels is fun. The occlusion effect is easy to detect. Use your probe mic equipment, it'll be your best friend. And I think you'll have good success, it's a problem you have to solve. Patients don't get used to it. You really have to solve it.

- Thanks Gus. There's a lot of things here that it's been many years since I've thought about and it's a good refresher, so thanks.

- Yeah. That's all I got.

- No, we'll see you next time for.

- All right. Well, I don't know if we'll talk about barrels or not. Maybe that was enough barrel talk for this series.

- I think we got barrels pretty covered, especially if we're talking about sauerkraut barrels.

Self-Assessment Outcome Measures

- Hi everyone. Welcome back to "Research Quick Takes." We are on volume 6.8. This is the last of our series here in the Hearing Aid Fitting Toolbox. And today we're gonna be talking about outcome measures. And with us today is as usual, Dr. Gus Mueller. Gus, welcome back.

- Thank you Brian. Yeah, the last, it makes it sound so final, but at least we got the topic right because we've sort of gone step by step, and we're now to what happens after the fitting. We've gone done all the things that you do before the fitting, how you do the fitting, two different ways, and even a little on the occlusion effect in barrels. And so now the patient's out using their hearing aids and they're coming back and we're gonna see if we did a good job. The classic thing about verification versus validation because these two terms do get confused. This is from industry, but it really applies to hearing aid fitting. And that is, did we build the system right?

Meaning, did you program the soft, average, and loud to a validated prescriptive method? That's verification. Versus did we build the right system? Which is validation, meaning does the now work? Is it a good algorithm? And so that's how these two things fit together is we're constantly validating, but we're also verifying. My mom made great chocolate chip cookies, and I do my best to follow her recipe and I do everything correctly. The right amount, the right baking time, eight minutes I think it is. But the true validation is when I take my first bite, and they never taste as good as mom's, but I don't know why. Maybe because it was mom, so verification's working, validation, not so good.

Not so good. There's some big reasons why we all really need to do self-assessment outcome inventories. And one of them is just that's the direction that healthcare is going. You can go to your family physician and I'm betting you're gonna do a satisfaction rating once or twice after you leave. Relative to hearing aids, there are many things that the patient really needs to use out in the real world to see if they're

really working. The prime one is signal classification to see if it's switching to omni when it should, to directional, when it's turning on noise reduction, when wind noise is present, and does it do what it's supposed to do. All of these things have to be validated in the real world.

And the other thing is that we have all these best practice guidelines. And what we need to do is we need to validate it. Brian and I did a 15 minute talk on why you should do LDLs and enter in. Well somewhere down the line, people need, and they have done this, but you need to do a validation. Did it really matter? And so that's sort of the overarching things. And then there's all kinds of practical reasons why you would always want to do one or two self-assessment validation outcomes. You can compare within your own, you can compare the different dispensing sites or different personnel. Does one HCP get higher satisfaction scores than another? Different fitting procedures.

One person in your shop fits to now, another person fits to DSL. Do you see any difference? Different circuitry. One person has one favorite product, another has a different favorite product. Do you see differences in the validation? A lot of post-fitting counseling is gonna be driven by these validations. And finally, it's great to document your own service. A lot of times you say "I know I do a darn good job" but do you have a chart that you can show people, like restaurants to use, or like we like to use and we go to Yelp to see how good that restaurant really is. I'll show you here that if you do a test like an IOI-HA, you could plot your norms over the past year and actually show them to a prospective hearing aid buyer of "Well let me show you how satisfied my patients are."

In this whole area, a person we really need to thank profusely is Robin Cox who unfortunately passed away about five years ago or so, but she's written some really nice papers about what we need to think about when we're using and designing outcome measures. And so this is taken from a paper that she wrote in seminars in

hearing about 15 years ago, but there's nothing about it that would ever go out of date. Clinician burden, and that is how easy it is it for you, the HCP, to give these tests? Patient burden. How difficult is it for the patient to take the test? How easy it to score? We're all busy. We can't have anything too complicated.

How can this scale be applied for treatment planning and counseling? Oh, and then there's also norms, reliability, validity, and sensitivity. Brian and I sat down and took a look at the 15 or so outcome measures that are available to use today. And we came up with three that we're gonna talk about during this little session. And there's a reason why we picked them, because they're different. They give you different information, but they meet all those requirements that Robin Cox mentioned. There's one other thing, Brian, and I don't think I told you this because I only discovered it not too long ago. On Noah software, in their questionnaire mode they have three outcome measures, only three in their software, and it just happens to be the three that we picked.

So how about that? So there's yet another reason why these are good outcomes because I'm guessing most all of you use Noah software or have access to it and you can easily go in and automate all these if you like. So here's the APHAB. Now we talked about this back in Quick Takes 6.4. We talked about using it as a pre-test. Now the patient's back and we're using it as a post-test. And what you see there are the four different scales and just examples of what one of the questions might be for one of those scales. The way that it would be administered is you can do it automated or you could have the patient do it, pay for a pencil, then you could enter their scores into the software.

I would strongly encourage scoring it with the software. It's a little difficult to score because there's a lot of odd numbers that have to be averaged, and you want it done quickly so you can talk to the patient about it. Now if you did it as a pre-test, now the patient's back and you're doing it as a post-test after they've used the hearing aids, it's

okay to let them see, this is straight from Robin Cox. It's okay to let them see what they said on the pre-test. Once you've done the scoring, now you can compare the patient's results to norms for unaided, aided, and look at the degree of benefit. How else might you use those?

Well if the patient was greater than the 75th percentile, I might start thinking about do we need to change programming? So here are the norms and you see you have norms for different percentiles. These are back from almost 20 years ago, but I don't really see that's a problem. I don't think technology would influence this much. This is percent of problems is what we're looking there. And so you see the four scales. EC is listening and quiet. Then you have reverberation, background noise, and aversiveness to loud sounds. You also then can take the aided scores and you can plot it on these two charts. One is elderly with fewer no hearing problems. One's young normal hearing. Normally I like to only use these charts when the results really look good because you can say "Hey, look at this, you're doing as well as somebody with normal hearing."

And that actually happens fairly frequently and it's sort of fun to point that out to the patient. And this is the scoring, not the clearest slide in the world, but that's all I could find at the Noah site. But this is from the Noah questionnaire mod, which by the way, they have the APHAB in 13 languages. 13 languages. That takes us to a scale that we didn't talk about before because this scale cannot be used as a pre-test. This is only a post-test scale. And this is the International Outcome Inventory for Hearing Aids called the IOI-HA. And this is in 28 different languages, the best I can tell. And I don't know if all 28 are available in the Noah software or not, but I'll show you how you can get them if you need it.

What makes this inventory useful is it has seven different domains, but it only has seven different questions. Each question is for a different domain. And so that makes it very easy for the patient to take and for you to score. I was trying to think when I was

thinking of naming seven, what came to mind and seven dwarfs was the only thing I could think of. So I tried to match each dwarf with one of the domains just based on what I know about the seven dwarfs, which is not really a lot. But anyway, that person seemed to be residual activity limitation. And what this means is is the person still limited? The question reads something, are you more active now than before you received your hearing aids?

Or that question maybe could be in participation. Participation is do you spend more time talking in groups and with other people now that you have your hearing aids? Impacting significant others simply would be, do the people around you notice an improvement wearing your hearing aids? Daily use is very straightforward. He's telling you he uses it one hour a day I think. Benefit, you can tell that guy's happy, that guy is really happy. If you want to see somebody satisfied, that's as good as it gets. And finally, the seventh domain is quality of life because he's still in his pajamas. And so you know he has to be happy. With each one of these is there's only one question, and I'll show you what that looks like shortly.

So how do you get this? Very easily, you simply Google Memphis Hearing Aid Research Lab, probably just Memphis HARL will get it to you. This is something that Robin Cox set up when she was still alive. All kinds of fun stuff here. Notice there's the APHAB, which we just talked about. So everything you need to know about the APHAB is there. Down on the bottom, you can see the old contour test, which we talked about when we did our little spiel on LDLs. But over here is the IOI-HA. And so you just click on that and you can go to the pages that you can print out any one of the languages that you desire.

This is the English version, looks like this. All of them are the same seven questions and they're all scored in the same manner. And different, the norms are very similar for different countries as you might expect. We're of course gonna talk about the norms

for the English version. It's meant to be simple paper and pencil, although you can do it on the computer, which might help for storage of information. Then you'll have it for the next time you see the patient. You simply just look at, the patient scores it as one being the worst, five being the best. The norms are shown on a score sheet, which I'll show you in a second. And then you simply see if the patient falls in the acceptable category.

Here is a patient who all of his ratings were threes and fours, all of them in the acceptable category. If one of them fell down below, then that's something that you might want to do some counseling with. If they were all falling below, then you might consider making changes with the hearing aid. It's not terribly uncommon for just maybe one category, they might fall one number below. But usually you see ratings pretty similar to what you see for this patient right here. And there's where you'd find it in the module at Noah. And so indeed you could have the patient do it on the paper and pencil, then you could very quickly just fill this out, and then you'd have a digital record of the findings.

And finally, we're gonna talk about the COSI briefly because again, we covered the COSI very thoroughly back in Quick Takes 6.4. It is by far the most used outcome measure. It was designed to eliminate irrelevancy. And what that means is it starts out as a blank sheet of paper and the patient designs their own. No two COSIs are the same. And so the nice part then is that when the patient comes back, you know what questions to ask because they were the situations that the patient already mentioned. They pick anywhere from three to five. You put them on this particular sheet. Once you have them on there and after the patient has some time to think, you have him or her rank order the importance.

And what we did earlier, what we did earlier is we then had them rate their expectations before they ever left with the hearing aids just because there are times when we have to counsel relative to expectations. So to review what I just said is that you want to

make sure they select goals that are things that they frequently encounter. Sometimes patients want to get off on talking about something that just happened the night before or something that maybe is only gonna occur once a year. You want things from their everyday life. I like to use the word percentage and just say "Tell me something where you have a problem that happens 20% of your day or 10% or 50% of your day."

And then sometimes, then they usually catch on. And so again, they're now back. Here's a guy that we saw in Quick Take 6.4. Here, we actually rated his expectations. His expectations were relatively high. We see that he had just been in the bar shooting pool and that was the place he really wanted to do better. Although when he ranked ordered things, it was the first thing he mentioned, but he ended up breaking at five. That's good for us because as you all know, that would be a tough one to make things much better because we know it's a noisy environment. Well he's back and has used his hearing aids for three weeks, which is the timeframe that we usually do the post-fitting. Actually, ideally we'd maybe wanna wait more like six to eight weeks.

But we of course have return policies that we do have to keep in mind in some instances. So here we now have, and I would consider this a very positive outcome for the things where we think we should do good such as hearing the voices of the grandchildren, not having to turn TV so loud, numbers one and three down on the bottom, we got much better ratings. Understanding numbers, calls at bingo we've got much better. To no one's surprise, we got just slightly better for hearing in the bar and understanding when his wife's in another room. Situations where even people with normal hearing have problems. And there you see it's a pretty simple scale. But again, if you wanted to have an electronic record of this, you could enter all that into the Noah. Which takes us to, whew, famous trios. Brian, you're a music guy. Who would you pick as a great trio? I picked three of them here.

- Yeah, I think you already have ZZ Top, Cream, and The Supremes, right?

- Yeah. Who'd you add to that?

- Who else? How about Three Dog Night? I don't even know if it's a trio.

- And I think there was four of them though.

- [Brian] I think you're right.

- I like that though. I sort of forgot that Cream was a trio, and so I started thinking about it and I thought... I don't know, but anyway, so the whole purpose of this, of course, first thing that comes to mind is the Kingston Trio because they're called the Trio, who did "Hang Down Your Head, Tom Dooley." And nobody under the age of 70 knows what that is. But anyway, but what we do have here is a really good trio. Each one of these scales measures something different. They're all easy to use, they're all automated, and they're easy for the patient to understand and they provide useful information for several domains. You wouldn't have to use all three.

I mean, if you had to eliminate one, I'd probably eliminate the APHAB just because it takes the longest. But it gives you good information on benefit. The IOI-HA, the beauty is it has seven domains. And the COSI, of course the beauty there, it's so personalized that the patients like the COSI, which is why it's so popular. So that's it, that's my story on outcome measures.

- Yeah, no, I think you picked three good ones here to talk about for the reasons you said, they're automated, and they capture a wide range of benefit from the patient's perspective. So that wraps up Volume 6, Gus.

- That's our whole volume, wow.

- Yeah, thanks for taking the time to be with us today. Really appreciate it.

- Yeah, it's been good, geez, this is our eighth, I guess, well it must be, this is number eight, so a good eight events of time per volume and who knows when Volume 7's gonna show up, you know?

- Right. All right, well that's it. I'm just gonna stop the recording.