

This unedited transcript of a live webinar is provided in order to facilitate communication accessibility for the viewer and may not be a totally verbatim record of the proceedings. This transcript may contain errors. Copying or distributing this transcript without the express written consent of continued is strictly prohibited.

Bridging the Gap: Adding Cortical Potentials to our Pediatric Care in partnership with the American Academy of Audiology

Presenter: Tamar Gomes, AuD

It is my honor to introduce our webinar today titled Bridging the Gap, Adding Cortical Potentials to Our Pediatric Care. Today's course is presented in partnership with the American Academy of Audiology. Our presenter today is Dr. Tamar Gomes. Dr. Gomes is the specialty audiologist in electrophysiology at Boston Children's Hospital. She provides diagnostic and amplification audiology services for for pediatric patients and focuses on current trends in electrophysiology.

She trains and supports students and staff in electrophysiology as well as documentation and health data informatics. Please read more about our presenter in the handout and at this time I am turning it over to Dr. Gomes. Thank you so much Anna and thank you all for joining me today. Hopefully we'll get some interesting nuggets out of this, but before we get started, here's a quick message from AAA. Welcome.

I'm Jamie Bogle, the President of the American Academy of Audiology and I'm here to share important information about the organization. The Academy is dedicated to achieving recognition of audiologists as the experts in hearing and balance care and the field of audiology as an independent clinical clinical specialty that is integral to the healthcare team. Through our partnership with Audiology Online, we're excited to offer courses like this one to help you broaden your knowledge and skills. We also offer the latest resources in practice management and evidence based clinical practice so you can grow professionally and improve patient care. We advocate for our members in Washington and across the country to ensure that the voices of audiologists are heard and we help connect audiologists to one another through our valuable networking opportunities like the annual convention.

To learn more about the Academy, make sure to visit audiology.org and now I'll turn it over to our moderators to introduce today's presenter. Thank you.

Or back to me since I was already introduced. So these are my disclosures and I also would like to give a quick shout out and special thanks to these two groups of collaborators. The first group is our Boston

Children's Hospital Cortical Working Group. This is a group of dedicated audiologists that are really interested in improving patient care and adding corticals to our service. The second group is an international pediatrician CAEP action potential working group.

So it started as 30 plus participants and it has grown to over 60 people with representation from at least seven countries. It is a group of clinicians, researchers, manufacturers, they're folks from private practices, hospitals, universities and we all have one goal in mind and that goal is to pull together all of our knowledge and experience to help develop practical guidance for cortical potentials in pediatric care. So we're actively working on that. And I really have a lot of appreciation for all of these people because there's significant contributions to this knowledge that I'm about to share. It comes from both of these groups.

These are the limitations and risks for today's course. I do want to particularly note the second one here. It's of particular importance here with that the information and knowledge and research related to cortical potentials. I like to think of it as active growth phase. It's really our cortical knowledge is going through this growth spurt, if you will, when you know, we talk about that with pediatrics and we are definitely constantly learning and growing.

So things will evolve rapidly and change.

These are the learning outcomes for today's course and this is the plan for the hour. Before we really jump into it, I'd like to get a sense of who's on with me today. So if you guys will just pull up your chat and just type in your role in relation to this particular topic of corticals and pediatrics. What brings you here? Are you a pediatric audiologist?

Hospital based audiologists, Private practice? Do you. Are you in a school? Manufacturer, researcher? Are you a speech pathologist?

Are you a parent who has found your way to this course seeking answers for your child? I see pediatric hospital audiologists, educational audiologists, lots of educational audiologists, ENT audiologists. Fantastic. Private practice, university clinic. Amazing.

So we also. I love public health and newborn hearing. This is fantastic. This is really. All of us are working together trying to figure this out.

I love that. Thank you. Patrice said regular audiologist. Just interested. Right.

There's a lot to be interested in. And I am also just a regular audiologist, but I work with the little people, so. All right, let's see. Okay, so let's get a brief baseline knowledge of what I'm talking about when it comes to corticals. So that would be cortical auditory evoked potentials.

Caep. It is a response from the brain measured by eeg. It's an evoked response that's time locked to the stimulus and it comes after the stimulus onset. It is a late latency response that's measured higher up in the cortex of the brain. It's approximately 80 to 300 milliseconds after the stimulus onset.

But this timing can change and we'll talk about that a little bit later. The response is relatively huge compared to ABR. It's marked as or referred to sometimes as the P1, N1, P2 complex. And when we see a present response, this is, it means that there's detection of that particular stimulus in the cortex of the brain. So up to that level.

So who are we? And by we, I mean the group that I'm representing because I work at Boston Children's Hospital. We are a very busy, pediatric focused hospital. We have eight clinical locations. And we are growing.

It's fast paced. There's high complexity with patients with high clinical demand. We've got a lot of, just a very packed schedule and there are complexities thrown in. We are diagnosing and identifying hearing loss, we're monitoring hearing loss, and we also manage, manage the hearing loss of those kiddos. We're audiologists, providing care and services to children in an effort to give them access to sound as early as possible.

We see all children, regardless of their developmental status, their medical complexities, or their nap schedule.

Why did we start exploring cortical potentials? The core clinical problem is that there's a time gap and a data gap. This isn't always the case. But we really, I think collectively as audiologists, and we've been pushing to get diagnosis sooner, you know, getting the screenings done and getting diagnosis really early. Right.

We're trying to meet the, we've done the 136 and we're pushing for the 1, 2, 3 guideline goals.

So, you know, we're doing a really great job of meeting those diagnosis goals in the first month or two. But what happens when we diagnose auditory neuropathy or if we fit hearing aids for a ski slope hearing loss? When we diagnose very early, there can be a long interval between the diagnosis and when VRA is robust and those behavioral responses are robust enough to support our clinical management or the confidence in management. We, during this time gap, sometimes families are making really important decisions on hearing aids or CI related decisions. We were thinking, you know what, maybe corticals could potentially be helpful as an additional objective tool for this.

If we can record a cortical detection of the sound, then that could complement the ABR and the behavioral testing. It could support counseling and management, and it could especially be useful when behavioral data is limited, delayed, or inconsistent.

So it's important to remember, as I'm talking about cortical potentials and pulling out this one piece, we are always talking about a full test battery. Nothing is in isolation. You know, we wouldn't, we wouldn't use tympanometry to describe the hearing status. It might give us some information, but not actually about hearing status. We would never use our DPOAEs to determine the type and degree of hearing loss.

We would never take just word recognition alone and rule out a hearing loss. So when we're talking about using cortical potentials when some of our other things are limited, it is important to remember that it is part of the battery and we still need as much information and it all works together. It's just another piece of the puzzle. It's an additional measure to include in our test battery.

So I touched on this briefly. But let's talk about who could benefit from, from corticals in the pediatric world. So I'd like you to send a thumbs up if you currently have or have previously seen any kiddos that fit into this list. So we're looking at infants in that ABR to VRA gap, developmentally delayed, medically complex patients, patients who have inconsistent behavioral responses, patients with auditory neuropathy, hearing aid users with unresolved access questions, CI candidates or CI recipients, patients with central auditory processing disorders. I am seeing so many thumbs up and right, like this is what we do.

So sometimes we need a little more information or it would be great if we had a little more information. That's where we think it would be nice if we could have something like cortical response testing. So we'll see.

So now we know who in our pediatric world could benefit from cortical testing. Let's talk about the basics from a familiar reference point.

So let's compare to abr. Can I have thumbs up for folks out there that are doing and familiar with abr? And if you're comfortable with it, and if you're not, because we don't have an easy thumbs down option, I'm going to ask for a surprise face or another emoji as the. No, I'm not. I love that.

Okay, so we have, we have some. I'm not comfortable with abr, so we'll talk about these things. I love these faces. This is great. But, but also lots of thumbs up, which is helpful.

Helpful. We'll use this as a, as a reference point and I'll go through some of the things. So those of you with the silly faces, you still probably know that ABR is an electrophysiologic measure. There are similarities to cortical testing, but there are also differences. So I do want to point out for this first similarity, I am very specifically sharing information that we've been trying to sort out for clinical use.

This is not intended for, you know, High complex research setups and doing things like that. What I'm trying to do is figure out, well, how can I use it for my patients in this really busy clinic? And how could you use it in your busy clinics as well? Because it's hard to, to do that. So, so what's the basic, what do we need?

3 to 4 electrode montage. You could theoretically do this on a single channel device. And so if you have ABRs going in your clinic, you could do this. So it's the same electrode montage. The stimuli for abr, there's a little bit of overlap.

So for abr you can use clicks and tone bursts. Stimuli for corticals you can use tones. But really what we've been focusing are speech bursts, but you can use tones as well.

When it comes to waveform identification for the abr, you know, we're looking for waves one to five. And when it comes to the itty bitties, you know, we're really looking for that identification of wave five for thresholds. So, and, and you know, the, the waves change with development. When it comes to

corticals, we're looking for a P1, N1, P2 complex. And that also changes a bit for the timing, the timing of it.

For ABRS, it's earlier. So typically it's less than 20 milliseconds. Now if for those that are doing ABRS, you may be doing 500 hertz with a conductive component or something like that, and perhaps it can sometimes go beyond that, but it's really early. And then for corticals it's a much later response. So the N1ish happens around 100 milliseconds after the onset and the P2 is 150 to 300ish.

But again, this changes.

And you know, when I'm talking about this complex and what is that? What does that really mean? It's a complex is, you know, the nice word that we, that we would use our professional word for. It's one big hump bump. So these waves that when things are defined and really mature in the auditory system, we see nice cleaner waves.

But when we're talking about complexes, they're running together into a big hill. So, so that's something to keep in mind. When development is early, where in the brain are we talking about? So for abr, that is a test of the peripheral system. It's, we're looking at, you know, the inner ear and the brainstem response, and it stops there.

We're not looking beyond that. For corticals, it's a later auditory response that happens in the cortex of the brain. So it goes beyond all of that and goes a lot farther.

So this is really a working compilation of recommendations from many folks who are doing and attempting and researching and exploring the best ways to collect cortical data. This is not the end all, be all. Exactly. But this is what we're working with and what we've kind of narrowed down to at this point. And to be honest, some of this might change as we're learning more.

But at this point, this is my best summary of the settings. And I wanted to share this so you have it. You know, with the current knowledge that we're working with and all of this. When I'm saying equipment setup, I'm talking about doing this on your ABR equipment. It's your electrophysiology equipment that you already have in clinic, assuming you already have it.

So for that montage, like I said, it could be on a one or two channel system. We don't need 16 channels or some kind of, you know, more complex research system. You can do it on the clinical system. The montage is high forehead. You could do vertex.

But we have had some discussions in our group that the high forehead seems to be more reasonable for these infants, and we're getting better responses. But also they tolerate it a little bit more. It's easier to put on and it's more doable, more clinically doable. And then mastoid and your ground, the ground can be off on the side of the forehead, a low forehead, your. Your ground just needs to be somewhere on that baby's head.

For the transducers, we can use earphones or we can use sound field for the stimuli. As I mentioned, speech bursts or tone bursts, they are manufacturer files. You just have to ask if you don't already have them in your equipment. Different manufacturers have different protocols or files that they can give you and share with you. It's not like, you know, when, with ABR and tone burst, I don't know if, if any of you, I'm, I'm sure many of you have actually tried to set up your tone burst with your rise and fall time and your, you know, what, what envelope you're going to use.

And, and we're like creating this tone burst in a particular way to have it match normative data and, and have it get elicit response. Well, we're for this, looking at speech bursts. We're not shaping it in that way. The, at least the ones that we have. We've.

They're just files that have been generated and given to us. I'm not creating a speech burst myself. That's a little too much for me. But somebody is, and I appreciate those people. So for presentation level, we're not looking for.

For little ones, we're not looking for thresholds. We're looking at super threshold responses. And really, we've. We've been talking about, like, if you're gonna start doing this at a high level, Starting with the 75dB, it could be 55. It just kind of depends.

As I said, we're looking for a big positive hump followed by a negative dip around 150 to 300 milliseconds.

When. When we're talking about the time window on this. One of the things that's a little bit different from ABR is that we want our window to actually start 100 to 200 milliseconds before the stimulus onset.

And that just kind of helps to give a better baseline of the patient noise. It helps with the noise floor and then running it out to approximately 600 milliseconds, some say as late as 800 milliseconds. So this is a huge long window. But there are manufacturer limitations. Some of them don't let you go as long as that.

But the idea is to get as much as long of a window as possible because the response can come at different places. For the amplifier, filter and stimulus settings, we've got a few different things here. So high pass of half to 1 Hz, but as low as possible is what's recommended. Low pass of 30 hertz. In some of the adult data, the recommendation is 15 hertz, but the, the concern with 15 hertz when we're talking about infants is that it actually can end up smooth.

It smooths out the response, but you might get a lower amplitude or potentially not see the response come in. So for infants, it seems like 30Hz is better for the low pass for gain. It's interesting. With ABR, we've all been using 100,000 for our gain, and that's what seems to work for abr. But this is different.

And it turns out that when we do that, it might actually burst out of the window and peak in such a way that it turns into noise and it disappears. And so you could end up accidentally losing your response and your responses. What you're seeing and collecting could end up being too noisy. So it's really interesting. We've messed with reducing the gain down to 50.

And when we do that, our Responses have been more clear, and we've been able to see things that we were missing with 100. So that's something that's different that for ABR, we just don't touch. We haven't needed to touch for the rep rate. So, you know, if you're doing infants and thresholds, you might be collecting at 51 per second or 39.1 per second, or, you know, a really slow rate. That feels like watching paint dry is A.

An 11.1 per second. Well, welcome to Corticals. This is 1.1 per second at the fastest. So for infants, the. The idea is slower is better so that the.

The neurons can recover.

I have to be honest, I have not tried the 0.25. That means one burst and then you wait four seconds before. Before your next one comes. And, you know, there's not enough time in my day for that. So it's this balance.

But it is. The 1.1 per second is. It feels slow, but sometimes for the younger ones, it might be too fast for sweeps. Fortunately, at this really slow rate, we're not going up to 2000 sweeps.

We are collecting fewer. So it depends on the patient activity. We thought that we needed to collect a total of 100, but you could collect a total of 60. You may do 20 at a time. 20 sweeps in one run, 20 in another run.

Because with children and infants, they're. Their activity waxes and wanes. They might be okay, and then they're not okay, and then they're. You never know. So collecting smaller, shorter runs with fewer sweeps might be what you need.

And that is better than trying to collect 100 sweeps in a run. But we also want to replicate and, and what we're doing is collecting and then different from abr, those runs that we have, we sum them all together, and I'll show you that in a little bit. And then there's an. Jitter is something that was recently added into our clinical equipment. And the one that I just have and I'm working with and in clinic here is the ihs.

We have other equipment in our Boston and the inpatient unit. And you know, there's different equipment, but I am using the IHS duet and they just added in the ability to turn on jitter. So jitter varies the inner stimulus, interval timing, and what that does. And the general idea is like 10% variation. The.

That reduces the neural refractory. So when we talk about. Sometimes people will say habituation, because the response, you'll see the response and it goes away. It's not really habituation, but it's. It's that neural fatigue that happens.

And if it's jittered, it changes and it can. It can help to maintain the integrity of your response without having the neurons firing and getting too tired to be able to continue on. So let's talk about the transducers. We can use inserts, we can use super oral headphones, and we can use sound fields. So I don't know about you guys, but my ABR equipment did not come with a speaker and, and the ability to do sound field.

So we've since added a speaker, a separate standing speaker with an amplifier and a cable to connect up to the box. We had to get it calibrated with the stimuli that we were using that adding a speaker system might not be possible. Possible for you to start. It's not something that you need right away. But it's also, it turns out it's not relatively.

When we're talking about audiology equipment, it's not crazy expensive, it's doable.

But it depends on the clinic budget, of course. But you could start out with just the inserts that you're using for abr. That's okay. When testing patients, you can test them unaided with or just not having any device with any of these transducers, you could test them aided, but you need sound field to do that. You can't pop in a hearing aid and then also put your insert in.

That doesn't quite work. So you do need sound field if you're going to do aided testing. And then for cochlear implants, you can do that through sound field, or some of the manufacturers have direct electrical stimulation through the implant itself. Word of caution, though. With CIS and cortical potentials, it's possible that there could be a false positive response with some of the equipment.

It might be an artifact from the internal device itself. Now, I'm throwing that caution out there because this is currently being. It's a working hypothesis and it's currently being looked into. So just caution when you're doing and interpreting corticals with cochlear implants.

So an ideal patient state, well, awake, attentive, reasonably calm and quiet. That sounds easy, right?

So this picture is actually one of our audiology babies. She came in to do a photo shoot and for me to do some practice stuff with some abr, and she was having none of the abr. And so it turns out she was actually primed and ready for cortical. But that's not how I wanted her, I wanted her sleeping, but she's so cute. So this is how it goes.

They're, they're not in the state that we want them to be in. They're always in the opposite of what we're looking for.

Okay, so this is what I heard repeatedly when asking around, okay, well I'm trying to learn about corticals. What do I do? And I kept hearing from people, just do it. If you can do abr, you can do corticals. And you know, I've kind of been saying this.

Let's compare to abr. Here's how you do abr. Here are the things. Now, I had so many logistical questions. Do I need an EEG cap?

You know, I've shared some of this with you, but this is what I was going through. I'm like, do I have to do a 16 channel thing and get a cap? What do I need? How's this going to work with my two channel system? What am I going to do?

Where do I get these stimuli? I don't have anything in my equipment that says cortical. And do I, am I using? Oh, maybe, Maybe if it's time locked and I'm doing speech, maybe because I'm a pediatric audiologist, I am so skilled at doing monitored live voice with my rhythm skills that maybe I'm going to time lock my ba ba ba. Oh, that was too fast.

It wasn't at the 1.1 per second, but maybe that's what I need to do. I don't know. I had no idea what I was doing when we first started this. Fortunately, I had some help from other people and I really was, you know, I need the nitty gritty of this. I can read an article and it can tell me, you know, this is a good thing to do, but I need the nitty gritty.

Like actually, how am I going to do this in my clinic? So that's what I'm trying to share with you guys today. So this is what I had babies for ABR that came in and they were sleeping and sometimes I would

finish early and I was like, you know what, I'm just going to do it. And so sometimes I would try, but I have these sleeping babies. Well, that's a calm baby too.

I don't know, maybe it'll work. So we'll see.

So as I said, let's, let's just do it. In the clinical world of relying on evidence based practice, doing something new seems so risky. And at Boston Children's, we really searched and reviewed these published articles and the information that we could find on Corticals. There's research that supports the use. And even the British Society of Audiology has a protocol with a lot of great info and detail.

But as you're reading it, it'll say things like, well, and in children or in infants, it might be a little bit different from this information. So it's, this is where we are.

And, and so then when we try to put it into practice, well, that's where we get stuck. Translating research and written information into real clinical practice is hard. In the literature, it says corticals. Well, they seem straightforward. It's a huge response.

You can do it. Just do it. And the implementation in a busy pediatric clinic, it's a lot more complex. So let's talk about some of the challenges that we encountered, how we address them, things that you might encounter on your own end. And hopefully this can kind of help you through just thinking through some troubleshooting.

So different areas would be challenges with provider and clinic just in general, and then collection challenges and some interpretation challenges. So why is it hard? Well, it's uncomfortable to learn how to do a new audiologic test. This is normal. So I would like for you to now go back to your chat or your emoji responses, either way, and type in the.

If you remember like one feeling word or an emoji that, that you recall from the first time you did probe mic measures or the first time you were making ear mold impressions on somebody or administering. Oh, these, these are so great. Administering the recorded CNCs and scoring for phonemes. What about doing ABR Skin Prep on an infant? Oh, my goodness.

I love these emojis. I'm feeling all of those things and that I'm guessing that Jack o lantern was a bit scary. Yikes. I'm seeing. These are great.

Yes. So, you know, in those, in all of these situations, we really have, we've really had, you know, a supervisor who was guiding us or somebody who was there and teaching us and talking about it. But many of us have not had formal training in graduate school or externship for Corticals because it's not as widely accessible. And, you know, some, some places are doing it. Most of us don't have coworkers or mentors who've been doing this for years and can show us how to think, set it up, and how to work the nitty gritty of it and how to interpret and what to do when we get stuck.

So how do we shadow and get hands on training or do a practice lab when we are also really busy providing all of our regular service and care to our busy clinic that's already in existence. Where do we turn to for help in collection and interpreting? What do we do with all the messy waves that we're getting? It's a learning curve. We have to collaborate and support each other.

It requires team effort, and it's definitely not to be done alone. And just a reminder, it's not testing in isolation. We're using the whole test battery.

So where do we start? Well, let's start with normal hearing, just like we did in audiology 101 in grad school. We started with coworkers, students, families. We started on each other. Maybe you don't have anybody else there.

Maybe we do it on normal hearing. Children. Or maybe that's the next spot that you go to. What you don't start with is the most challenging patients.

That's who we want to start with because that's where the value is. But we have to get there. And, you know, how do we get there? We have to take steps. So for we can have a baby that is set up.

It's an older baby who's come in for an ABR and they're having a hard time sleeping. Well, that means that you have an awake baby who's hooked up with the same electrode montage. Maybe you just pop in that. That just switch your stimulus. Try it that way.

You might have them in for a first VRA session when they're still young and they're trying to learn it and you're not getting a lot and they're too awake to do an abr. Right. Like, these are the times when it could be valuable. But instead of starting with the idea of getting four different stimuli in each ear unaided and then aided, we're going to start with just adding one into an existing patient that already is in our schedule and they're already set up for something else.

Start with inserts. Most of us don't have sound field, as I mentioned. You can add it when you're ready for it. It's okay to not know what you're looking at. You can collect it, try it, and try it again.

But we can also ask colleagues after the fact.

We have to remember that the most useful interpretations come from discussing results in context of the broader child and the broader care plan. And then the last thing that I threw in here is billing when appropriate. So it's important to know that you have to be able to interpret and report to be able to bill. But you cannot bill for a neurodiagnostic code like this. This is the code that we would use.

If we're just doing corticals, you cannot bill with that. That with a threshold abr, for example. That's one or the other. So. And to be honest, I've not built this yet.

I've done it and been figuring it out, but I'm still in the learning process. And at some point, at some point, I'll be ready to build us, which is the end goal.

All right, so what do we, how do we prep for success? Well, before the testing, the. It's. It's important to know that the prep really can make it or break it. On pediatric testing, the quality of the recording for these, it's deeply affected by the patient's state, their regulation, their movement.

And the goal is to have attention without wild activity and noise. But we can do this just like we get all of our other pediatric testing. We're going to get there. So there are some things that you can do before testing and during the testing to optimize the end results, setting the expectations. Clearly, I wouldn't go in and say to a family, oh, so let's try this test.

It's going to give us information about how they're hearing. But I would start with, I have some testing that I'm trying. It might give me some information. I don't know. I'm trying to learn how to interpret.

That's what I've been saying to families. But, you know, I cherry pick on the particular spots when I can do it and have the time. I'm, I'm really trying to optimize the timing of it and comfort for the patient, minimize movement and distraction, which is hard. But you can use an assist sometimes. Like if you already have an assist, who's helping you with an early VRA or coach, the caregiver, whoever's lap they're sitting on and planning the stimulus priority, helping to choose, how am I going to do this?

What's the order? What do I want to start with? What's going to be the most helpful? We'll talk about that. So during the testing, we want to choose the stimuli strategically, keep that session focused on what we're doing.

Replicate. You do need to try to replicate. Documenting the child state during the testing is helpful because then you can go back and say, you know what, they were really active or, oh, they got a little too sleepy here. Is that what happened? I don't know.

Flexibility is important when the child is done, we are done. So when it's no longer meaningful, we just have to stop. It's like testing with natural sleep, abrs and vra. We're prioritizing one piece at a time. And the one piece of information that we're going to get is that one piece that I'm collecting right now.

I'm assuming that my test session is going to end. They run the show and we have to be flexible. Maybe we get more. It's great when we do, but that's not always the case. So here are some collection tips on it.

So, as I was saying, doing a combo session of like, trying to add in corticals while I'm doing an abr.

This is that cutie that we saw earlier who came in for an ABR previously. This time we brought her back intentionally for cortical pictures and trying to, to do some things. As you can see, I have another audiologist in there distracting and playing and, you know, doing all these things. This second tester, the goal is to keep them quiet and actively attended attending to what you're doing. You know, we don't want them really playing a lot and, and being wild as children do.

It's just kind of how it goes. But we also don't want them just zoning out. So we have found that it's kind of like this line, you know, when you've got some, some attention for vra, it's like the, the attention gap between VRA and play. You want them over attending to you where maybe you wouldn't get a VRA if they actually were able to do that, but they're not so active that they're playing, like doing condition play. Now, that being said, some people have recorded corticals while the patient is sleeping.

It's possible, but it's not always guaranteed. It's not guaranteed no matter what we do, as it turns out. But we might get some information. I do like to think of if a patient is not going to tolerate DPOAEs, they're unlikely to tolerate doing these evoked potentials. So when we talk about developmentally delayed populations, one, one comparison that I like to think of is patients that have autism spectrum.

If they're not going to let me put an OAE probe in, I'm not going to try to then later try to connect electrodes and inserts or electrodes and sound field. I have to put electrodes on. They're not going to tolerate that either versus somebody who would or I, you know, this example I have Here is somebody with cerebral palsy who, who might be more relaxed and is there and maybe they're not able to participate in vra but they would tolerate having those on. So you kind of have to think about that.

When it comes to stimuli selection, what do we start with? Well, that depends on the goal. What information do you already have? What questions are you trying to answer? It varies depending.

It's like doing an abr. When I say I'm doing an abr, that doesn't tell you what I'm doing, doesn't tell you my stimulus. Stimuli selection. Am I doing a threshold or am I doing a neurodiagnostic? Am I looking for retro cochlear or am I looking for cochlear microphonics?

What am I trying to do? What's my goal? It's like doing speech testing, SAT SRT and using that for diagnostics versus having an amp or CI determination and, and trying to select my, my testing. Am I trying to say, you know, give some counseling and say, you know, they're really not hearing these sounds at a unaided quiet level versus oh, I'm trying to, to check and see what's their, their speech understanding with their hearing aids on compared to without the what. The tests that I'm selecting depend on the situation and what's my, what my question is so you can look at that and I, you know, I put these here.

These are kind of a general idea of what we've, of what we're looking at and, and kind of how we're looking at them. Different systems might have different stimuli available there, there are speech bursts. The G to ma suh the man I ru speech speech shaped stimuli say that 10 times fast. It's low, mid and high frequency. They're not specific phoneme.

They're, they're just speech shape stimuli. And then there also are tone burst or tone pips. 1000 Hz often is used for response clarity. It seems like though that is reported as being easier to, to see when we're doing corticals.

So let's look at some waves. Finally we got to some waves here. Okay, so this is, this was collection during an abr. So I had a five month old patient who has moderate sensorineural hearing loss in both ears. She was bottle feeding.

I fed her with some new ear molds. She was still feeding and she had her hearing aids in and I, and I had her hooked up. I was, I was going to do an ABR just to, you know, it was going to be her last Natural sleep abr. And she wasn't sleeping yet. So I said, can we just angle her towards the speaker over here?

And she was sitting on mom's lap facing out with the bottle in her, electrodes on, her hearing aids on. And I just played here on the left. This is A T at 75 with both of her hearing aids on. I ran these out. She was so calm and I, I did two runs.

I don't remember how many sweeps I have here, but honestly, she was so relaxed. I probably collected 40 sweeps, maybe, maybe 60, I don't know.

And then I added these two together and this thick line on the bottom is the waveform that I'm interpreting. And then I have a good same thing, Ran one, ran a second and then summed them

together and I'm interpreting this bottom wave. So for this, I think these are clear responses. I mean, these are. This is like amazing.

I'm so excited there. There's this huge down slope. Interestingly, right here, this is a little pam. So that post auricular muscle artifact pops in there for infants, often with the T. So we'll see this. And you can see on the timing if you, if we were doing an abr, how she's sitting up, leaning against mom.

Her, her little posterior muscle is right in there and it's popping up in my ABR wave would kind of go up at the end because of that. But on cortical it shows up, but we don't see it in the gut. I think sometimes it can show up in gut is what I understand. But now for this one. In hindsight, it probably would have been more valuable if I had done an aided at 55 or.

Well, yeah, if I had started with aided at 55 because I kind of threw it in there because she wasn't asleep yet and then took her hearing aids off and did another one unaided. At 55, she's got a moderate hearing loss. I could have potentially seen a response and a no response. That would have been more valuable. But it depends on what the goal is.

The goal for this was for me to figure out how to record and I was practicing. So the goal was, for me, it wasn't for the patient care, but now I've done it and oh my gosh, I was so excited. It would be more useful for patient care. Now that I know and had I done it in a way that would have been useful, I feel like I can interpret this and I could make a little documentation on that. I was already doing an abr so it wouldn't change my billing.

But if I had done this in isolation, I could have used that neurodiagnostic code. So here's some interpretation tips. So we're really looking at presence versus absence.

It's not latency intensity function like with abr. You want to see it replicate with consistency across runs. The idea is a reasonable morphology. Now, I love this because what does that mean? Well, we're trying to figure it out, but what that means is a big hump.

The timing latency shifts earlier as they get older, and the morphology becomes more defined with age. So early on we're seeing these bigger humps. And then eventually with auditory maturation, it will define into a peak P1, N1, P2. But right here, we're calling this a complex. It's probably the P1 and P2, P1, NP.

Yep. That all of them together in just one big hump. This is probably, you know, this is actually the timing of the abr, but I think there might be some electrical. This was post CI activation. So for this patient, this was before the CI.

It was a T at 75, before CI, and we didn't know what we were looking at when we were originally looking at it. We were zoomed in and all these humps, we thought, oh, that might be it. I don't know. Is that it? Because.

And this was a patient that had auditory neuropathy.

After six months after activation, we see this huge response. And this is when we said, oh, that's a response. Well, turns out that's not a response. Hindsight's 20/20, but I didn't know. And at the time, I would have said something like, it's equivocal.

I don't know. A response. A clear, repeatable response is not present at this time. It's okay to say that. So here's a first VRA attempt on a kiddo that I got an SAT and maybe one or two frequencies in the sound field.

And they ended up, you know, they didn't do a whole lot. I had an assist and I said, hey, let's do it. And so they were sitting up, awake and engaged. And I got this GUH at 25. Send a thumbs up if you see a response.

And a one of those crazy faces if you don't see a response. For this on the right side, we've got some thumbs up coming through. Okay, fantastic. Fantastic. Yes, I.

So many thumbs up. This is great. So I see this big response.

And now after getting this guh at 75, awake and engaged, this baby was so active. And then had wiggled down into tummy time on dad's lap and was super busy swinging. What do you think about this? Thumbs up if you see a response and crazy face if you don't see a response.

And this. Yeah. So this baby was. He was vocalizing. We've got a crazy face.

We've got some thumbs up in there too. And you know, this baby actually was. They took the electrode cord and was just like playing with it and was starting to mouth it. I'm like, we gotta, we need to end this. This is.

We can't have them chewing on an electrical cord. That's not okay.

I think that this is a response. So even though we have this wild noise and this when you're doing abrs. If I had an ABR like this, this is. Ah. It takes a lot to get used to this.

But there's it. What came out of it was replication and this huge response. This is that post auricular muscle artifact. A really nice spike.

Here's one that. This is ABR. So I've got 5001-000200-04000, 8000, all at 20 DBE HL normal responses. I finished early with time to spare. It's a six week old baby.

Most people doing corticals aren't doing them until they're like three or four months old. But hey, I like to push boundaries and let's just do it. So I did it.

The baby was still sleeping. Okay. On the left side here they were sleeping but they were relaxed. I was hoping the 75 was going to wake them up enough that they could. That I could see something.

Thumbs up if you see a response. Thumbs down if you don't or crazy face if you don't. We got some thumbs up. Yeah. I think this is a great response.

We've got a. Some not so sure. Yeah, I've got this other recording up here that's like. Well, that's. This one's not great.

I took these two good ones. I don't. I think he was getting wiggly upset or maybe it just disappeared, I don't know. So on this side then he was awake and just plain mad. What do you think about this one?

Responses. Thumbs up if you see a response. Crazy face if you don't. Crazy faces. These are great.

Crazy faces. Yeah. Yeah, that's. I think this is how he was. Crazy face.

There are some thumbs up in there. I, I don't if. You know, it might have been, but then it wasn't repeated. And remember we need to repeat Some and then interpret the sum. So that part's important.

But at that point we stopped.

So I have. I have a little more in here that I just wanted to leave for reference. This is another normal one. They're six week old again, normal abr. I think I'm.

Let's see here. Here's another. Okay, so this is. This is the. What do you think about this?

Thumbs up or crazy. Crazy face? I don't know. We've. We're getting some thumbs up in there.

Yeah, so. So this one was interesting. There are lots of thumbs up. So my interpretation of this and you know I was. I've just been doing these for learning for myself and I added it on to the end of my abr.

I can't say I didn't feel confident saying that this was a response. I see this here, right. Like it's repeating, but it feels like there's this extra noise. And I'm at 75 for a baby that has normal hearing. I don't know.

I don't. So I think in this one, I personally would say it's not reliably present at this time, but I just don't feel confident in it. Maybe that is it. I like to see something big. I don't know.

This is where it's hard.

Here's one with bilateral an. All right, so over here on the left side, this is high level click rare and con, high intensity. I. Because there was this questionable, I don't really know hump I did. I went down 10 just to make sure that that goes away.

There are no waveforms after this. Reversing cochlear microphonic. That's here. And this, this is a no stem run. Okay.

This baby, I'm not showing it here, but this was bilateral an. So now let's try to figure out corticals would be so useful here. So I run these. This is the GUH at 75.

I ran these four waves. I summed them in different ways to try to figure out. Well, it depends on how I put them together. Thumbs up if you think there's a response. Crazy face if you're not sure or think there's no response.

Yeah, lots of crazy faces. That's what I was saying. I don't know what I'm looking at. It depends on how we put it in there. I don't know.

Crying face. Yeah, these are. It's hard. And this is the kind of patient where it'd be most useful. But then look at this.

At 75, this. What do you Think about this one, guys. Oh, thumbs up. Yeah, thumbs up. This is great.

So this was replicable. Got a big, nice wave here. Lots of thumbs up. Love this. Yeah.

So it feels like, you know, this. I feel confident that this baby's probably hearing this. At 75, I don't know about the guh. Okay. Well, then I was trying to go down and I couldn't replicate, and so I stopped.

Now, I have to say, I do not recommend starting with bilateral ANSD like I did. This was one of the very first cortical potential tests that I did because this patient came through as we were trying to figure it out, and before I had tested even any one of those normals or any one of those beautiful ones. So this is not the way to start. Even when we're getting more practice with it. This is hard, but, you know, sometimes there's information that can come out of it.

But this one, I was not giving information to the family because I didn't. I was still sorting things out. That was my comfort level.

So key takeaways. It's important to have realistic beginnings. Be cautious of using Corticals as a standalone tool. Testing without a clear question or goal in mind, it's. It's really not a good idea.

You need to have goals, practice. You don't want to over test a child over interpreting challenging waves. We don't want to over interpret that. Read a response where it's actually noise or ignoring the collaboration. It's really.

It's really important to be flexible. Give it a go, try it out. You know, do what you can. You don't need to launch a perfect comprehensive cortical service on day one. But you.

If you can do an abr, you can attempt cortical testing.

Now we have time for questions. Thank you so much, Dr. Gomes. This was fascinating. I love Electrophiz. And this was.

This was really great to see how you're. You're working it into your practice. I loved it. As you said, if anybody has any questions, now is the time. We're a little over the top of the hour, so if anybody has to leave, feel free.

But if you would like to ask, now is the time to go ahead and ask those questions. I'm just going to give us a second. Would you advance one more slide? And I'll just run through the final information for everybody. All right, so thank you, everybody, for attending, and please go back to audiology online.

Give us about 10 to 15 minutes to finish wrapping up all the attendance reports and then go to go into your account, go to pending courses, take the exam, it will sit in your account for seven days and then it's done. So you only have the next seven days to do that. I am not seeing any questions at this time, so I'm going to go ahead and wrap us up. And thank you so much for sharing this information with our audience. It was a wonderful presentation, so interactive and I really, really enjoyed it.

So we hope you'll come back on Audiology online in the future. Thank you so much.