American Cochlear Implant Alliance Task Force Guidelines for Determining Cochlear Implant Candidacy in Children

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- At this time, it is my pleasure to introduce the executive director of the American Cochlear Implant Alliance, Donna Sorkin. Donna, I'll turn it over to you.

- Thank you so much, Carolyn. It's always a pleasure to join AudiologyOnline. And today we're going to talk to you about determining cochlear implant candidacy in children. Next slide, please. We have no disclosures. And these are our learning outcomes. Next slide, please. This is as part of a series that we have developed to examine guidelines for determining cochlear implant candidacy. And we're looking at this in terms of four different populations. And I'm gonna talk to just a minute about that, next slide. And first I wanted to just talk to you a bit about the American Cochlear Implant Alliance and who we are. We are a membership organization that's just focused, on cochlear implants and access to care.

And our members are from across the care continuum, including educators and psychologists, social workers, and the people you typically think about, audiologists and physicians and speech pathologists. We have scientists we have adults and parents who have joined us for advocacy. Then importantly, we have a website that's designed for people who work in CI and those who are interested in CI. And that includes individuals who are in hearing healthcare in providing services, but not necessarily CI services. So we have content that's appropriate for all of those groups. We really try to be highly collaborative with other organizations and certainly AudiologyOnline is one of our favorite collaborators. And we certainly welcome your involvement in the organization however you wish to be involved, and I've given you our website as well as our Facebook and Twitter.

We're also on LinkedIn. Next slide please. American Cochlear Implant Alliance has as its mission to advance access to the gift of hearing provided by cochlear implantation, through research, advocacy and awareness. And we really combine those three areas in everything that we do. And in that regards, we try to address factors contributing to

the fact that we are highly underutilized as an intervention for people who could benefit probably 10% or less of individuals are using cochlear implants, who could benefit from them. And so a lot of what we do is designed to improve awareness regarding candidacy and outcomes. And that is our objective today to share information on how CI candidacy is determined for a very specific population, in this case, children who could benefit.

Next slide please. And so this is part of a four part series that we are collaborating with AudiologyOnline on, and as part of this, we have established four task forces that are looking at CI candidacy for different populations. And we started this as a board because we observed that although there's one of criteria from the FDA, there are a lot of different ways that people determine candidacy in these populations. And so we wanted to sit down in one place. What we feel is best practices, and we establish these four task forces to look at bilateral deafness, in SSD in adults and bilateral deafness, SSD in children. And so that is what we're doing. And we're very pleased that in addition to these webinars that we're doing, we have recently published in Ear and Hearing, two papers on the pediatric candidacy on bilateral deafness and SSD, including what will be presented today.

You can go to the next slide. So today we're looking at updated guidelines on pediatric cochlear implant candidacy, and I'm very honored to introduce our speaker today, Dr. Andrea Warner-Cycz, I'm sorry, I always go back and forth on, on the pronunciation of her name, but there's no question about the fact that she is an extraordinary researcher and clinician. And she's an associate professor in the Department of Speech, Language and Hearing at the University of Texas at Dallas. And she specifically investigates the effect of hearing loss on communications skills, social interaction, and quality of life in children and adolescents who use hearing aids and cochlear implants. And she also serves on the board of directors of the American Cochlear Implant Alliance. So with that, I'm turning the floor over to Dr. Cycz.

- Thank you, Donna. You're not the only one who has trouble with my name, so it's all good. I'm used to it. Thank you so much. I'm so excited to talk to you about new candidacy guidelines for children relative to cochlear implants. So I wanna give you the landscape of what we're gonna talk about today. So here's our agenda. We'll talk a little bit about cochlear implants, what they are and why we need them, some general candidacy guidelines. And then I'll talk more about some of the specific guidelines that we will, that we are recommending based on clinical data, published data. So basically a very data driven evidence-based practice for what we should be doing for children who are candidates for cochlear implants, and then some other considerations that we should have for our patients who are children.

So let's start with our introduction to cochlear implants to make sure that we all are on the same page. We know that hearing loss affects communication. So individuals who have severe to profound hearing loss may not have adequate auditory access to the sounds of speech, even with the use of a hearing aid. And for these individuals that hearing aid may provide some access to sound, but the access might not be adequate, meaning they might not have access to all of the different sounds of speech. And if we think about that in terms of frequencies, if they don't have access, for example, to high frequency sounds, that's going to create difficulties for them relative to grammar and possessive words for them to miss out on sounds as simple as S.

So making sure that they have access to all of those sounds is quite important. Also with hearing aids, they might have access to sound, but they might not have very good word recognition. So if they're only getting 50% of the words right, is that really enough for these children or adults for that matter to be able to function in the real world? And also it could negatively affect their quality of life, meaning that if they have trouble communicating, it also could make differences or difficulties for them in social communication and interacting with others, for individuals who do not have adequate

access with hearing aids, cochlear implants might be a viable type of technology. So one thing I wanna point out is that we think about these individuals, and I'm gonna focus on children, children who have hearing aids and they're doing okay.

But if we really think about it is okay really good enough, is that really what we want for our patients? And if we think about it, our patients number one goal is to understand speech in both quiet and noise. And that might mean considering a transition from a hearing aid to a cochlear implant. So we put this in very simplistic terms, we have somebody speaking in the bottom left, that sound goes into a microphone. The microphone goes through, sends a signal to the processor, which codes that signal for intensity, frequency and duration and sends the signal transdermally, so across the skin, to a receiver stimulator that has been implanted just under the skin. And that receiver stimulator sends an electric signal to an electrode array that has been surgically implanted in the cochlea, and that electrode array, if we look at the image on the far right that electrode array feeds into the cochlea and can directly stimulate the basal ganglia cells of the auditory nerve, The good news is that individuals with hearing loss can gain access to sound in a way that wasn't possible with hearing aids.

However, that signal is not exactly what we hear or how we hear with typical hearing, that is the cochlear implant provides a sensation of sound, but it does so with decreased resolution relative to intensity, or how loud the sound is. Temporal resolution, meaning the timing of sound and the rhythm of sound and spectral resolution or frequency. So I'm going to give an example of what reduced spectral resolution sounds like. So if we think about this in terms of a piano, a piano ranges from the low frequency or low pitches on the very left side of the keyboard to the very high frequencies on the right of the keyboard and a keyboard for a piano for a standard piano has 88 keys, we're gonna call them channels.

So think about how you can perceive music when somebody's playing on a piano. Now, I want you to consider how would that be if every two keys were fused together and instead of 88 keys, it spanned that same range of frequencies, but every two keys were fused together, it's gonna make it a little bit more difficult. And if we go one step further and we fuse together every four keys, then you would have 22 keys or channels spanning that same frequency range. And that's essentially the easiest way to explain what a cochlear implant is doing. We have that electrode array inside the cochlea, and it only has so much space for these channels for nodes, where it can actually stimulate the auditory nerve.

So I'm going to give a simulation of what it sounds. So keep in mind, this is a simulation and Donna can attest this might not be how she perceives sound, particularly after having a cochlear implant for a while, but we're gonna give a simulation just to see, give an example of what a cochlear implant could sound like. So this is reduced spectral resolution. This is a simulation of a cochlear implant with one channel. This is two channels. So we'll get a low and a high frequency. With four channels. You can hear a little bit more richness of sound. This is eight channels.

- [Computer] Holy cow.

- 16 channels.

- [Computer] Holy cow.

- 32.

- [Computer] Holy cow. And here's the unprocessed signal.

- [Man] Holy cow.

- So for old school baseball fans, particularly Chicago Cubs fans, that's Harry Kerry, who was an announcer for the Cubs forever. And I wanna do one more thing. I want you to think about how many channels of it took you to understand that he was saying, holy cow, I'm gonna play them through one more time. And now that you know, he's saying, holy cow, I want you to think about that and see if you can hear it with fewer channels. So I'm gonna scroll through them a little bit quicker this time. Oops, just kidding. We're gonna try that here. One channel. Two.

- [Computer] Holy cow.

- Four.

- [Computer] Holy cow.

- Eight.

- [Computer] Holy cow.

- 16.

- [Computer] Holy cow.

- And 32. So think about that once you knew what he was saying, you probably could understand with fewer channels the second time that I played them through, and think about that in terms of adults who develop their hearing loss post lingually to children who have pre-lingual hearing loss. So the children are learning the way that you heard it the very first time bottom up, and they're trying to figure or this out and trying to learn. And that's a little bit different than what we have with adults who might have

those cognitive linguistic skills to fill in the gaps. Now, what I would like to do is talk about general guidelines for cochlear implant candidacy in children.

And I love this quote by Roland and Waltzman. And they said the Food and Drug Administration indications and guidelines are just that, indications and guidelines and not law. They proceed to say that these indications can change, but they require clinical trials, which are often expensive and take years to collect good, reliable data and outcomes and safety during which time children are deprived of treatment. So the first thing I wanna do is talk about these FDA indications. In 1990, children with bilateral profound hearing loss were approved to receive cochlear implants that later changed to severe hearing loss. We had a decreased age in implantation where it went down to about 12 months and just recently went down to nine months as the youngest age for FDA approval of cochlear implantation in children.

I do wanna point out it took 20 years for this to decrease from 12 months to nine months. Everything started with bilateral sensory neural hearing loss, and very recently approval of single-sided deafness of cochlear implants for single-sided deafness and asymmetric hearing loss, which as Donna pointed out earlier is one of the papers that also came out earlier this month and will be a featured session on AudiologyOnline. And on the left you can see, that's just showing that now it's severe to profound hearing loss for children. The Food and Drug Administration, or FDA has approved cochlear implant systems for four manufacturers, three of them are approved for children, and you can see them here. And just so you can see there are similarities and some differences as far as the FDA approval for the three devices approved for children.

So you can see that some of of them are approved for nine months, some for 12 months, and all of them for bilateral profound, you can see here that cochlear has been approved for severe to profound. So they're generally the same guidelines to the FDA,

but there are some small differences that I just wanted to point out in this slide. You can see that some of the text also is in red, and that is showing the indications for hearing loss that is not bilateral. So looking at more single sided deafness, and those are things that were approved within the last year or so. So keep in mind these FDA indications. And I do wanna point out it's bilateral profound hearing loss, possibly severe to profound hearing loss.

We have speech recognition. And if we look at that less than 12% up to less than 30%, so think about how poorly that child would need to do with their hearing aids with speech recognition. So I just want you to think about that when I move into these specific guidelines, which is our next topic. And one other thing is look at these guidelines and let's think about them in comparison to the European guidelines, which for European guidelines, it's for children who are defined as less than 18 years of age, they have bilateral or unilateral sensory neural hearing loss, moderately severe to profound, and compromised functional hearing and or no benefit with a hearing aid. Now we're gonna move to the specific guidelines that we are recommending for pediatric cochlear implant candidacy.

And we are going with what we're calling a 50/70 plus guideline for when to refer for cochlear implant candidacy for children. Let's start with our evidence-based recommendations for when to refer, and we will continue using this throughout the presentation. So the thought is that clinicians should refer their pediatric patients for evaluation if they meet any of the following criteria. So the 50 stands for appropriately selected word recognized scores, less than or equal to 50% correct. The 70 means unaided pure tone thresholds less than or equal to 70 dB HL, and the plus represents poor functional performance, limited progress in either language or auditory development and or poor quality of life. I really want you to keep in mind that not all children meet every single one of these characteristics.

So please view this as an and or, that is, the word recognition parameter and or the threshold parameter and or poor functional performance. If we think about pediatric cochlear implantation, it requires a village literally. So we have a huge interdisciplinary team that is crucial for a child to perform the best and get the best care. So it is a much broader team than what we see for adults who are getting a cochlear implant. So if we start with the three, the three core parts at that interdisciplinary team, that includes the cochlear implant surgeon, the audiologist and the imaging specialist, 'cause all of those are really important for getting that device in and activated. We have other specialists, including the speech language pathologist, crucial to developing that speech and language and promoting that, ECI, or early childhood intervention.

You can see here, psychologists, social workers, therapists, teachers of the deaf. So getting more people involved and we can even go further than that. So there might be other medical specialists, such as a cardiologist, neurologist, a neurodevelopmental specialist, the pediatrician needs to be on board, possibly a pediatric anesthesiologist and also a geneticist. Particularly if that family is hoping to have other children in the future and finding out what the cause and the etiology of that hearing loss is. So we have a broad team that is very important to determining cochlear implantation and the appropriateness of that for different children. We also need to think about besides the team, we need to think about factors that are specific to that unique child.

That is there are things that have to do with the demographics in their lifestyle. What are the family's goals? What are their expectations for that child? What is their assessment of their child? So very important for us as clinicians to ask what the family's primary concerns are and the main reasons that they are pursuing a cochlear implant, they also can help us to determine areas of strength and concern for that particular family. We also need to think about resources, how much support does that family have? Are they going to be able to attend appointments? Do they have the

transportation to do so? Can they take the time off of work to get their child to the appointments?

And so thinking about what resources are available for that family and or what resources can we do to help them get those resources that they need. In addition, we need to think about the child and family commitment to the cochlear implant process. It is much more difficult when the family and the child are not on the same page or when different members of the family are not on the same page, relative to the technology and the therapy that they want to use for their child. And finally, let's talk about the hearing history. It is very important to know if the child is doing well with their hearing aid retention, if they're using their device daily for a extended period of time, at least 80% of their waking hours to know what their home language environment is, are they able to provide a rich model of spoken language and abstract spoken language for their child?

Do they have the support and education? And a lot of times that's viewed as maternal support, a maternal education, but I think we need to expand that and think about for both parents, for all caregivers, do they have the support and the education to provide those resources for the child Audiologic assessment spans from hearing history all the way through the functional auditory performance. So this is very similar to what we see in adults. And we're gonna go through these five characteristics or components of the audiologic assessment right now. So let's start with the hearing history. We always should start with hearing history. This includes the progression, the appropriateness of a cochlear implant. And it's important for us to know, you can see a list here, the onset of hearing loss, how long have they had a severe to profound hearing loss?

How long have they been used their hearing aid? It should be hearing aid use and the etiology of their hearing loss. What we know from research is that there are poor outcomes with a longer duration of deafness with inconsistent hearing aid use with the

presence of syndromes or genetic etiologies. And also with perinatal problems such as cytomegalovirus, Kernicterus, or higher levels of vitellorubin, hypoxia, and also atypical cochlear anatomy, things like a narrow internal auditory canal or common cavity. Relative to physiologic assessment. This is a staple of cochlear implant candidacy, and it can include an array of procedures, but I do wanna point out that electrophysiological measures aren't necessarily a measure of hearing. So we do need to take that into account.

It's important for us to routinely evaluate tympanometry for middle ear function and make sure that there is no dysfunction, acoustic reflexes and otoacoustic emissions might give us a window as to a way that we can rule out auditory neuropathy spectrum disorder, or at least to know that that's part of the etiology of their hearing loss, and an auditory brain stem response test is really important for us to determine the degree of their hearing access, to determine if they are a cochlear implant candidate. Now I do have ASSR, or auditory steady state response on here. And this is something that can measure simultaneously in both ears. It's a great measure for severe to profound hearing loss. However, I do wanna point out that it might not have as much additional value for cochlear implantation.

The standard audiometric assessment that we're all very familiar with is a way to let us know the child's behavior in response to sound. Ideally, we want ear specific thresholds. So we wanna know how each ear is doing individually, and that can be assessed in whatever ways appropriate for the child's age. We want frequency specific thresholds, ideally between 125 and 8,000 Hertz. And we wanna know if they meet that audiometric criteria for candidacy. Again, a referral tip is to refer if any of those thresholds exceed 70 dB HL, meaning across the board that the thresholds are greater than 70 dB HL. So at least a severe to profound hearing loss is a really good metric for when to refer for cochlear implant candidacy.

Speech recognition testing also is incredibly important. And remember that this is in the best aided condition, in order for that to happen We need to know that the child is wearing appropriately fit hearing aids. The hearing aids are functioning, so they're validated and verified and that the child is wearing their device. So the OCHL study the outcomes in children with hearing loss study, which looked at children with mild to severe levels of hearing access has shown that children who wear their devices at least 10 hours per day, have better language than those who wear their device less than 10 hours per day. So making sure that the child is able to wear that device, they have retention of the hearing aids and they're wearing it at least 10 hours is really important for us to truly determine if the hearing aid is providing enough access to sound or not.

And I do wanna talk a little bit more about the speech recognition testing, and this should be done with the pediatric minimum speech test battery. So this is a test battery that was put together with Kristen Uhler, myself, Renee Gifford, and an array of clinicians, researchers, manufacturers. We had over 60 people come together and come up with this protocol for the best way to test children through about age five to six. And you can see here that it ranges from the parental questionnaire shown in the black, the dark gray is showing a discrimination test called VRISD, or visual reinforcement of infant speech discrimination. So it's a way to test discrimination. In the light gray, we have closed set measures, closed set speech recognition measures such as the early speech perception tests and the PSI.

And all of the white blocks are showing open set speech recognition ranging from the multi-syllabic lexical neighborhood test all the way up through the pediatric AZ bio presented in noise. So you can see there are tests that are testing words and sentences, and also quiet and noise. The goal for testing is to get one word measure in quiet, one sentence recognition measure in quiet and one sentence recognition measure in noise. So with all of that, what I want you to take away from this is that we do have an established test battery for children. And your referral tip here is to refer if

their word recognition scores are less than or equal to 50% correct. And that could be at whatever word recognition test is appropriate for that child.

In addition to speech recognition, we can talk about functional listening assessment and there are various measures. So they're all listed down here in red. This is a non-exhaustive list, but these are examples of ones that are typically used for children who could be cochlear implant benefit candidates. What I love about this is that either audiologists or speech language pathologists can administer these tests of functional communication, and they are ways to assess how the child hears the super-segments of speech. So the prosody of speech, are they getting that intonation? Do they get meaning from that intonation? Can they identify speech as speech versus non speech? Can they discriminate for consonants and vowels? And some of them will also assess in specific listening environments.

So is it a quiet environment? Is it one on one? Is it a group setting? Is it noise? And so it gives us a way to how that child is functioning in the real world. So your referral tip based on functional listening assessment is to refer a child who has poor functional performance. So if they seem lost in conversation, if they don't do well in noise, these are things that we need to know. So this could be that they're not performing well. It also could be that they have poor quality of life. Maybe they're having trouble interacting with their peers, and this is something else that we need to pay attention to. I would be remiss if I didn't talk about the importance of the medical evaluation.

And that includes the patient and family history that we're always used to taking. It could also involve some genetic testing and imaging. So on the right is the image of a colleague of mine who has bilateral cochlear implants. And so it's important to know that imaging is also part of the evaluation process. It's important to know that integrity of the cochlea, and it could be performed either using high resolution CT scans or MRI. Vaccination recommendations are also important. So there is an increased incidence of

bacterial meningitis, and that is more likely to be associated with temporal bone anomalies. And so we wanna make sure that we're protecting our patients against that. Here are the vaccination recommendations, again, just so you have this in your back pocket for what is recommended, not only standardly, but the additional recommended vaccines based on age prior to cochlear implantation.

Now we know that our partners, our speech language pathology partners are super important to helping these children get to where they need to go. And their assessment is vital. Their tests can either be norm or criterion reference. So we could have some standardized measures or informal measures. There's a list of some different speech and language measures at the very bottom of this slide. And what's important for us to know is to track their development over the course of time. So here, if we look at the image on the far right, we see auditory experience a month. So let's say that this is how long they've had the hearing aid. So their hearing aid experience ranging from in this image from zero to 12 months of hearing aid experience on the X axis.

And if we look on the Y axis, that's a way that we can measure their speech and language growth. If they're getting month over month progress, meaning for every month that they have the hearing aid, they're getting one month of growth and or progress in their speech and language, everything's gonna fall along that dark gray line, that's diagonal in the image, if they're performing, if they're closing the gap. So they're making more gains like two months of gain for one month of hearing aid experience, they're gonna be in the white section, which is amazing. That's where we would love for them to be, they'll be in that white section. So in that they are making good progress with their hearing aid.

However, the ones that I'm most concerned about are the ones that are falling in this red triangle. And what that means is that they have the hearing aid, they're getting that experience, but perhaps they have the hearing aid experience of three months and

they're maybe only making one month progress. So what we really need to do is track their development over time. And if they are not making at least month over month progress, we need to consider that they might be cochlear implant candidates. The other thing I do wanna point out before I leave this slide is that we do have to count for nonverbal IQ as well. So just keep that in mind, because we do have a lot of children with hearing loss who have additional disabilities.

So making sure that we're also accommodating nonverbal IQ in our assessments. Our referral tip for speech and language assessment is that if any child isn't making limited progress, that is they are not making that month over month progress with our hearing aids, then it is time to refer for a cochlear implant. If we talk about speech assessments, this is similar to those functional assessments that we're looking at the super segmental features. How well are they producing those sounds, is it clear production? Do they have a breadth of sounds that they're producing or are they always producing labial consonants like B, P and M that their consonants are mostly central or front vows like uh or ah.

Or so we wanna know, are they having an array of different sounds that they're producing? Are they only producing isolated sounds or are they producing them in conversational speech? And also do they have predictable speech patterns? For example, do they have a slower speaking rate? Are they more likely to have prolonged vowels? So they're more likely to have an ah versus just an A like a single syllable. Look at their nasality. So there are a lot of aspects of their speech that we also need to pay attention to. If we think about their language milestones, we know that children who have difficulty with auditory access, that they may de demonstrate deficits in their spoken language, and this could reflect inadequate amplification, and appropriately fit hearing aids, decreased hearing sensitivity, inadequate daily device use of their hearing aids or possibly additional diagnoses.

So we need to make sure, as I said before, that their hearing aids are validated and verified, and that they're wearing the hearing aids before we can determine if the hearing aids are providing adequate access to the sound for them to develop the speech and language and communication skills that they need. What we know about children who are cochlear implant candidates, is that they tend to show delayed spoken language milestones that is later babbling onset that maybe their vocabulary size and diversity is not the same as their typical hearing peers that is, they have restricted receptive language and or expressive language. And also that this could have a negative cascading effect on their ability to put words together and affect their grammar, affect their social pragmatic skills and possibly their development of figurative language.

So these are all things that we need to think about when we're looking at standardized measures and trying to determine if this is a child that we need to refer for cochlear implant candidacy. I'm gonna spend a little bit more time on this slide, 'cause this is something a lot of times as audiologists, we're so focused on the hearing part or maybe like our speech language pathology partners, but there's so much more that we need to think about. It's not just about the hearing. It's how are they functioning in the real world and what are things that might present barriers for them? And this is something I really want to drive home is that counseling and therapy are a huge part of the candidacy process.

We need to know if the parents are aligned with the goals, are they actually ready? Are they wanting the cochlear implant? Or is this something that somebody else is pushing for them? And this really goes back to that original question. What are your goals for your child and what would you like to see them do? How would you like to accomplish that? What are your goals for seeking a cochlear implant? This has to do not just with the technology, but also with the communication approach. That is, a lot of times when we think about this, it's viewed as this road that diverges that you either using visual

language represented by the VL in the image on the top left or LSL listening and spoken language.

And that it's one or the other. And I think sometimes that can cause a lot of stress for these families. If they have to decide right now, which communication approach am I going to use now, and am I gonna continue that? And a lot of times parents may feel that whatever they decide now is the one that they have to stick with, but that's not quite true. It can change depending how the child develops. If they're excelling, maybe they can start some visual language, but maybe they don't need it later and they switch to spoken language only. So rather than viewing this as a diverging road, what I really want you to do is view this as a gate, that this is something they can go in and out of.

And it can shift as the child's progress emerges as their skills emerge as the family skills emerge and figuring out what is best for that particular family is the most important thing that we can do. And not just what's important for that family, but what's important for that family throughout time. I also wanna draw attention to the child's social wellbeing and psychosocial wellbeing. And one thing that we can think about is, are there barriers to participation? Are there things that might make it more difficult for the family to get to the appointments? Perhaps they need help with transportation or they have other children and they need some help with daycare. So are there things that we can do from maybe a social work point of view that would help them?

Sometimes they need help completing paperwork or finding the state resources or local resources that are available for them. And those are things that psychology and social work have that they can really provide for these families. Sometimes also I do wanna point out one other thing is coordinating appointments. A lot of times these children have multiple appointments. And so trying to figure out the most efficient way for the families to get their children, their child, to these appointments regularly and on

time. And finally therapeutic intervention. A lot of times we will wait until the child that they're in a crisis mode, but really making sure that they are going to be enrolled in therapeutic intervention. And sometimes this means, they're in speech and language therapy, even if they're not getting tons of input from those hearing aids, they are learning the social skills.

They are learning the routines that are important in therapy that are going to help them develop more. If they do end up getting a cochlear implant. Another thing that we need to think about with these children is thinking about their nonverbal intelligence. What is their neurodevelopment like? What does the child's strengths and limitations and how does that determine not only the communication mode that I spoke about earlier, but also what is the most appropriate type of therapeutic intervention that we can provide for these children? And the best thing that we can do is to get them enrolled in therapeutic intervention in a way that it is regular and consistent, whether that's in person or teletherapy or a combination of the two.

So the referral tip here is if a child has poor quality of life as I mentioned, if there are struggles for how they're developing, whether that's in a social context or with how they're holding themselves. So some type of poor quality of life, that should be part of when we refer children for cochlear implant evaluations. There are some other considerations that I would like to talk about. And the first is that some of these children are gonna have other exceptionalities. I do wanna point out that having something else going on, whether that's a child who's on the autism spectrum. If they have cerebral palsy, those are not things that prevent cochlear implantation. In fact, somewhere between 30 and 40% of children who are deaf or heart of hearing have another comorbid condition or a secondary disability that could include intellectual disabilities or learning disabilities or something that has to do with a developmental delay.

For these children, if we think about what to expect for hearing aids and or cochlear implants, we expect for them to have lower mean performance levels, a slower rate of skill acquisition, and greater variability in their communication outcomes relative to children who do not have other exceptionalities. So if we keep that in mind, something I wanna think about is that what does that mean when we're trying to determine how they're performing? So traditionally we rely so much on speech recognition and spoken language, and that's our traditional, our metrics that we're using to determine if a child is performing well. But what I really want you to think about are some of those nontraditional measures, and this is something like I said, this is true for hearing aid users or for cochlear implant users that maybe for these children who have other comorbidities that perhaps, so we need to look at device use.

Are they wearing the device? How is their affect when they're wearing the device? Are they more socially engaged with the family? And so there are a lot of other ways that we can view success with children who have other issues going on in addition to difficulties with auditory access to sound. As you can see from what I've presented that FDA criteria or their indications are a good way to start, but that's not necessarily reflecting what's going on in the clinic or what has been, what we have evidence for from a research perspective. So for children who do not meet those FDA guidelines that is considered off-label implantation, that doesn't mean that it can't be done.

As I indicated before, it's not against the law. And it's a way that we can best serve our pediatric patients. So there is a study from a few years ago, and here, if we look at the figure on the right, we can see some different metrics. So what percentage of physicians would implant adult or child, if they were off-label, meaning they did not meet those FDA criteria. And you can see that that's about three fourths of the physicians implanted adults and children off-label, relative to children, so as I said, this came out a few years ago. So that was 12 months used to be the metric for FDA criteria. And it's now down to nine months, but at the time would they implant a child

less than 12 months and you can see about half of them did and asymmetric hearing, meaning they didn't have a bilateral severe to profound hearing loss.

And again, that's about 25 to 30%. So what we can see is that children who do not meet that FDA criteria are still able to get cochlear implants and benefit from them. Even if they have a younger age at implantation, if they have more residual hearing, meaning they have more, maybe they have a moderate to severe or profound hearing loss. If they have better recognition than what is portrayed in those FDA criteria from that table that I showed you earlier. And or if they have single side deafness. And like I said, that is another one of the papers that recently came out and one of the talks that will be in AudiologyOnline. So our recommendation is to use this 50/70 plus criteria to guide your decision on whether to refer a child for a cochlear implant evaluation.

There are numerous factors that affect or influence cochlear implant candidacy in children. So the document that we recently published is specifying the audiologic criteria that is word recognition poorer than 50% correct, unaided audiometric thresholds greater than 70 dB HL, in addition to the plus. So the poor quality of life, the limited outcomes or limited progress that they're not making that month over month progress. However, we really need to think about beyond just focusing on our auditory part and really looking at are these children failing with their hearing aids and that's a horrible word to use, but are they not performing as they could be performing if they're using hearing aids and could they possibly benefit more from using a cochlear implant.

And for those children, those are ones that could be referred for cochlear implant evaluation. So with that in mind, in addition to the 50/70 plus criteria, I wanna point out a few other things I'd like to think about those ear specific considerations. So possibly the children who have asymmetric hearing that maybe they have a hearing loss in both ears, but maybe both don't meet that severe to profound criteria to consider the technology in the contralateral ear. So if they have a cochlear implant on one ear, will

they benefit more from having a cochlear implant in that second ear or a hearing aid in that second ear, if possible, and also their level of residual hearing. And these are factors that are really important for speech recognition and noise for music perception and appreciation as well as sound quality.

The second image where it says last resort is I really want to impart on you that cochlear implantation should not be a last resort. Please do not wait for these children to fail with their hearing aids and then say, oh, well, maybe you should get a cochlear implant. Rather think about that earlier implantation leads to better outcomes in children. Third, implementation of and commitment to an oral habilitation program is necessary for these children to benefit. And then finally, what I'd like to point out is that there are no inappropriate referrals for cochlear implantation. So if a patient doesn't meet those cochlear implant candidacy criteria, the evaluation will provide an opportunity for counseling and a baseline for monitoring their progression.

Early intervention in the form of implantation or improved amplification options is paramount, but missing an opportunity to improve their auditory access and their quality of life can be extremely detrimental to their long term hearing health. So with that, I'd like to turn it back over to Donna, to close us out before we have our Q&A.

- We are ready now to take questions from the group and our wonderful colleague, Carolyn Smaka will be leading that, but I did want to, if you could go down to the next slide, encourage you to check on our website for additional information on cochlear implants and related issues. We have a lot on insurance, for example, which is a very common topic that comes up, also information on steps to a cochlear implant and other resources that are available for parents and actually people of all ages. So check us out for additional information to supplement the amazing talk that Andrea did today. And we're so appreciative for your very clear presentation, one of the best that I've seen on this topic, an I'm not being biased because I know you, I think it was really

very clear. So we do have some really great questions in the chat and we can start with those and see if people wanna add to them.

- Thank you, Donna. So yeah, some of these were put in early, may have been answered, but I think the clarity will benefit us all. So the first question is from Danielle, she asks more specifically about the 50/70 criteria, for the 70 dB HL guideline. Is that pure tone average, or is that any of the thresholds are 70 or worse?

- So that's a great question. And I think that was something that I wasn't super clear on. So thank you for pointing that out. With this it's pure tone average is what we're normally looking at is a pure tone average for unaided thresholds greater than or equal to 70 dB HL.

- Thank you.

- Fabulous question.

- So Jessica asked, do you have suggestions to adjust expectations in terms of month to month progress for children with below average nonverbal IQ?

- Ooh, that is a great one. I think that's something that as clinicians we really have to think about is what do we expect for them? And I think that just makes it a bit more challenging. I think that's when we're gonna look at some of those other areas that may be non-verbally, what are their behaviors as far as response to sound, their vocalizations, their behaviors, but as far as specific measures, I think that's going to be something that's kind of, it's watching, it's not as clear cut. It's so much easier when we can just say, how are their words progressing? How is their vocabulary, their speech production? And that one's a bit trickier. So as far as specific measures for that, something that might be really helpful, something like the CASSELS, which is the

Cottage Acquisition of Speech, Language and Listening or learning scales through Sunshine Cottage, and that might give like more of a criterion reference that you can kind of see are they progressing in other developmental realms also. So maybe some informal measures might be more useful in something like that.

- Excellent. The next question from Emily, she asked, have you seen hybrid electrodes used for pediatric patients?

- Oh, that's a great question. It's one of the issues with the hybrid electrodes is if their hearing drops. So let's say they have really good hearing in the low frequency. So just to make sure everyone's on the same page for the hybrid electrodes, for that electrode it is shorter. So when it goes in, it's really just covering those high frequencies and doesn't go as deep into the cochlea. So it doesn't quite reach those mid or the low frequencies. So that's what the electrode array is. So that's the internal component of the cochlear implant. The concern with using the hybrid electrode array with children is that if they're hearing decreases, then that means another surgery to take out the hybrid electro array and put in its standard electro array.

So at least I can tell you what they do at our center, is they're more likely to implant a standard electrode array for the children who have good thresholds in the low and maybe mid frequencies, and very poor thresholds in the high frequencies. They're more likely to use that standard electrode array and use surgical techniques that that will help with hearing preservation. However, the external component is more of a electroacoustic device, so they can use it as a hearing aid if needed and the cochlear implant stimulation in the high frequencies. And that way, if the child's hearing changes, they can switch the external device to one that can stimulate the full frequency range in accord with their auditory thresholds. I hope that makes sense.

- That does, but that is so fascinating. That's why I love these webinars. I mean, what a blend of evidence in your personal experience and these great questions from participants. So we have a few more here. Let's see here. Anna asked can a child with auditory neuropathy be implanted.

- 100% yes, absolutely. So one of the issues with auditory neuropathy is that the signals having difficulty getting from the cochlea to the auditory nerve. So one of the beautiful things about a cochlear implant for these individuals is a cochlear implant electrode array can actually take over that connection and stimulate the auditory nerve and improve that temporal synchrony. So that is one, definitely a group that is perfectly good candidates for cochlear implantation. Great question.

- Tara asks for the word recognition guideline for referral, if child's going less than a equal to 50%, is this using any of the tests on the minimum pediatric test battery in quiet?

- So as long as it's age appropriate, we're looking for an age appropriate word recognition measure. So, yes.

- Great. Then I don't know if these two apply more to adults or not, but I'll add them in here. What assessments or questionnaires do you administer for how lifestyle demographic issues may influence the outcome and who administers those?

- That's a great question. That is one that's gonna come from your case history. So as far as if there's, I don't know of specific questionnaires for that, those are just general hearing health history. And just when you're having that conversation, it's just a general case history. So I dunno that there's something specific for that, but you do wanna find out about the auditory history, if there's any important developmental history that

would help make that decision. But I don't think there's a specific questionnaire or survey for that.

- Speaking of assessments, I did put the link. You mentioned the products from Sunshine Cottage. So I just put a link in the chat for everyone there. And then we'll take one last question from Karen. She says, I have patients who have cerebral palsy or other disorders that limit them to a high low chair with headrest and they have cochlear implants. It's been so difficult to keep the magnet on, as it falls off when their head turns. Do you have ideas on how to keep the magnet on so parents are not so frustrated with their choice of a cochlear implant for their child?

- Oh my gosh, that is an amazing question. And it is something that's so clinically relevant. There are some things that you can do. I'm gonna point out one thing that for children who have cochlear implants. So the cochlear implant sits about back here. So if they turn their head just so everyone's aware, they turn their head and they're in a chair that can that knock the device off. And if the device isn't connected, then they're not gonna get the stimulation of their cochlea. So just so everyone's clear why this is such an issue. So one thing that can be done and this can be done, some of the surgeons will do this is rather than having it back here, they might move the receiver similar a little bit forward so that it's not as vulnerable to falling off.

Other things that can be done. I would say with girls, but now I can say with anybody, there are things that you can do with the hair that might do it. Like, I know braids are something that can help kind of keep it in place that it doesn't get knocked off as much, some toupee tape. And there are a lot of devices on Etsy that are available that might help with that retention as well. It is a great question and it is a huge issue for children who are in chairs or something like that, in wheelchairs.

- Thank you for all of those questions. Thanks to our participants. Sounds like a lot of you guys are working directly with cochlear implants. Please check out the ACIA conference. I'm sure a lot of you are already going actually, and at this time, I just wanna thank you so much Dr. Warner-Cycz and to Donna, and I'll just turn it over to Donna for any final words.

- Thank you so much everyone for coming on and please join us for two remaining talks that we'll be doing live on adults and children with SSD and adults with SSD. And please also check out the recorded courses, both in this series and a lot of other courses on cochlear implantation that we have done with AudiologyOnline. So again, thank you so much. Thank you to our partners, AudiologyOnline for hosting this in the most competent way possible and see you all next time. Thank you.