Pediatric Grand Rounds: Beyond the Basics to Maximize Outcomes, presented in partnership with Nationwide Children's Hospital

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We are very excited to offer up a course from Nationwide Children's Hospital. It is called pediatric grand rounds beyond the basics to maximize outcomes. Presented in partnership with Nationwide Children's Hospital, there are a listing of all the presenters today and we're going to go ahead and get started with Doctor Gin Hounam. Thank you, fan. Thank you to audiology online for this opportunity.

And thanks to all of you for joining us today. I'm excited to introduce you to a small sample of our talented team here at Nationwide Children's Hospital. We're in Columbus, Ohio. We'd like to share how we use an evidence base to drive our journey to best outcomes. And today you'll hear from a few of our team on how we manage deaf and hard of hearing children where thinking beyond a standard approach to care as needed.

Rather than introducing the whole team here at once, I'll introduce them for you at the start of their presentation. So first up will be Doctor Holly Gerth. Doctor Gerth is one of our clinical leaders and practices within our dedicated inpatient audiology program. She will share with us her work with our population of infants with bronchopulmonary dysplasia through a multidisciplinary lens. Doctor Girth, you have the floor.

All right, thank you so much, Gina.

And I'd like to quickly share, Holly, that we don't have any disclosures, and I should also quickly review our learning outcomes, if you don't mind, before you start. Absolutely. After this course, participants will be able to examine clinical status indicators in patients with bronchopulmonary dysplasia that may better predict hearing test outcomes and trajectories. Examine medical and audiologic indications for Abiyah. Discuss auditory outcomes in congenitally deaf children who receive ABI.

Describe the impact that language and or cognitive level can have on diagnostic assessment of children with autism spectrum disorder. Examine audiologic indications for active transcutaneous bone

conduction implants. Discuss auditory outcomes in children with down syndrome who receive a bone conduction implant and describe elements regarding appropriate evaluation and management of speech and language disorders in children from multilingual backgrounds who are deaf and hard of hearing. Those are our learning outcomes. And once again, we will get started with doctor Hollyguer.

All right, thank you so much for having me today. My talk is on audiologic trends in children with severe bronchopulmonary dysplasia. So I want to start off by talking to you about a case study on baby girl La. Elle was born at 26 weeks gestation and she transferred to the nationwide children's NICU at just 21 days of life. In addition to her extreme prematurity, she had intrauterine growth restriction and weighed only 479 grams at birth, which is just at one pound.

She was diagnosed with severe bronchopulmonary dysplasia, or BPD, while in the NICU, and she spent 300 302 days in the NICU before she discharged home. So Elle had several hearing tests while she was in her NICU. At the time of her first hearing evaluation, she showed the severe mixed hearing loss in both ears. Considering how premature she was in all of the medical interventions necessary for her survival, we assume that this was a complication of her traumatic start to life. However, when you look at her most recent hearing test, you probably weren't expecting to see normal.

Hearing. Cases like hers are what sparked my interest and initiated this investigation into this significant improvement in hearing in this population. And that leads us to today.

Bronchopulmonary dysplasia, or BPD, is diagnosed at 36 weeks post menstrual age, and it's rated on a severity scale. At diagnosis, the severity of BPD is determined by the amount and type of oxygen support a baby requires. A developmental and respiratory outcomes for babies with BPD are heavily dependent on the severity of the BPD and the management of the BPD. As you see here, the NIH classifies patients with BPD into three categories. This presentation will focus primarily on the severe to extreme categories of BPD.

Here at Nationwide Children's Hospital, we have a special NICU dedicated to caring for patients with BPD. This is a 24 bed specialty unit. Unit does accept patients from across the nation on a case by case basis. We have had patients travel to Ohio from as far away as Oregon and California. The staff on this unit participate in a worldwide BPD collaborative to share data and protocols to help improve patient care and outcomes for this population.

The inpatient audiology team at Nationwide Children's Hospital works closely with the BPD team as we are completing newborn hearing screenings and diagnostic evaluations for many of the patients that are served on this unit. When seeing the infants on the BPD unit, we began to notice a trend that was different than what we noticed in the general NICU population. We began to notice that patients on the BPD unit were referring the newborn hearing screening so diagnostic ABRs were being completed. The ABRs were showing significant amounts of sensorineural or mixed hearing loss. Follow up testing over time showed an improvement in hearing, with eventual normal to near normal thresholds being measured on patients who had previously shown significant, significant sensorineural hearing loss.

Since we seem to be seeing this trend more and more, we developed some hypotheses to explain why we were seeing these changes. We thought perhaps the long term use of sedatives and paralytics, prolonged ventilation use, or significant middle ear dysfunction due to patients being in a supine position nearly 100% of the time could all be contributing factors, but we wanted to look at it a little bit further and determine if one of these factors or something else could be influencing the hearing in our patients. With BPD, myself and a colleague, Rebecca Macchi, reviewed over 45 articles related to this question and discovered that this phenomenon of improving sensorineural hearing loss is not unique to our center and that there are many hypotheses that exist, but explanations for the exact pathophysiology are still largely unknown. Some possible explanations you can see here include initial measurements of hearing loss that later improve due to prolonged episodes of hypoxemia or simply

delayed auditory maturation due to extreme prematurity in this population. So, following this literature review, we reached out to the BPD team for their input and feedback on this trend of improving sensorineural hearing loss.

The BPD team at that time introduced us to a new phasing system that they were using to score their patients. Collectively, we wondered if these BPD phases could be related with the improvement in hearing over time. The team agreed to look at this further with us so there are currently four pieces of the patient's clinical status that are used to determine the current phase that a patient is in. All the patients that were evaluated by audiology were then categorized into a phase by BPD staff. The four areas that were assessed include oxygen support levels, current steroid dosages, so lower dosages correlated with progression along the continuum, linear growth and then overall clinical appearance of the patient, which was assessed by reviewing physician notes and subjective perception of changes in the patient's status.

So the phases that were developed are briefly outlined here. The team uses a number of measures and looks at a lot of different aspects of the patient's care. In general, patients in phase one are very unstable. They have a high oxygen dependence, are receiving high doses of steroids, and are usually on iv sedatives and paralytics. In phase two, patients are still very fragile but are having increased interactive activity levels.

Their steroid doses, sedatives and paralytics are all being weaned. In phase three, the patient is quite stable and tolerates their care and developmental therapies and activities. Their steroid dose is low, if any, and they're making good linear progress. When a patient reaches phase four, they're ready to transition to home. If they're not already home.

They're happy and interactive kids and are generally medically stable, so there's no standard period of time that a patient spends in each phase. Some patients may spend a few weeks in a phase, while

others may take a few months to get through a phase. Each patient is unique in their medical needs, so each one has a unique pathway as well.

Now that we have that history and background information, let's look at a couple case studies of two of our BPD NICU babies.

As you remember, Elle was born at 26 weeks gestation. She transferred to nationwide Children's Hospital at 21 days of age. At her most medically fragile, Elle required significant ventilator support and struggled with edema with slow progress. When Elle was about eight months of age, she started to transition to sprints of nasal cannula use. By the time she discharged from our NICU, she was eleven months of age, corrected to about seven months old, and able to go home on zero, 0.8 liters low flow nasal cannula.

She spent a total of 302 days in our Nicu. Elle's case is further made interesting by the fact that Elle's mother has hearing loss and wears binaural hearing aids. This knowledge of a family history of congenital hearing loss may have contributed to our trajectory with Elle. Let's take a look again at her first ABr at ten weeks of age. Early in phase two, Elle's first ABR revealed severe hearing loss bilaterally.

Some literature suggests that prolonged intubation can cause edema around the eustachian tube, resulting in a conductive component. This may explain why, despite normal tympanometry, there was a significant conductive component at 500 hz. Regardless, l exhibited with significant hearing loss in both ears. At this point, we talked to the family about hearing aids, and approximately two months after this ABr, l was fit with hearing aids.

So about two weeks after the fitting of the hearing aids, a repeat sedated ABr was completed. As seen here, l corrected to four months of age at this time and had progressed to phase three. As you can see,

Elle's hearing improved significantly. About four weeks after this ABR, Elle was able to discharge home.

Fast forward. And at this time, Elle is now 22 months old. At this follow up hearing aid check, a hearing evaluation was performed using VRA. As you can see, Elle's hearing improved again. Hearing improved from a moderate hearing loss approximately one year prior to a now mild hearing loss in both ears.

Her hearing aids were adjusted and a repeat behavioral test was recommended in one to two months to obtain more ear specific threshold information.

One month later, VRA testing showed further improvement. At this point, hearing aid usage was discontinued. It was recommended that the family follow up for a repeat test in about three months to continue to monitor her hearing very closely.

L's next complete hearing test was obtained via sedated ABR evaluation in coordination with other sedated procedures. As you can see here, hearing was completely normal.

Over the course of three years, we saw Elle's hearing improve significantly. Her binaural air conduction PTA improved from 76 decibels to 20 decibels. We also saw her medical status improve from significant respiratory support while on a ventilator to now in room air. Here is a graph of her air conduction pure tone average improvement over time in relation to her BPD phasing. Elle was one of the first patients that we saw the significant change in.

Initially, we associated the hearing loss with many different factors. Extreme prematurity, long NICU stay, ototoxic medication, prolonged ventilation, family history of hearing loss. If there's a risk factor for hearing loss, Elle had it. But as we continue to evaluate her over time, we saw this unexpected trend of her hearing improving completely to normal. It really made us take a step back and evaluate how

should we best manage kids with hearing loss in this special BPD population.

An update Elle was actually seen for a monitoring hearing test only two months ago. She's now nine years old. As you can see, her hearing remains completely normal. Elle was one of the first cases that we noticed this trend with. As we began to evaluate more patients on the BPD unit and this trend appeared again and again, we began to approach these patients a little differently.

Let's take a look at our next case study. A so this is a a was born at 27 weeks due to maternal help syndrome. He suffered from significant respiratory distress and required substantial ventilator support. He received a trach at one month corrected age while in an Oregon NICU. He was on maximal ventilator support and high dose steroids when he was nothing, making any progress.

At about three months corrected age, A's family made the decision to transfer him across the country to the NCHBPD NICU. Over the course of many months in Ohio, a began to grow healthier and stronger. His respiratory support decreased, and he was able to wean steroids. He eventually began to sleep better and grow stronger. He spent a total of 538 days in our NICU.

The following slides will detail A's audiologic history while here at nationwide children.

So A's first ABR was completed under sedation at bedside when he was corrected to only five months of age. At this time he was in late phase one and very medically fragile and unstable. His ABR results revealed moderately severe to severe hearing loss in both ears. Due to the significant degree of hearing loss noted in A's fragile medical state, we decided to complete a repeat ABR in about six weeks to confirm the hearing loss.

Six weeks later, a had progressed to early phase two. Repeat testing at this time showed improvement in air conduction thresholds. Thresholds at 500 hz improved ten decibels, while thresholds at 2000 hz

had improved 30 decibels. Given the improvement in hearing and the caregiver report of improved response to auditory stimuli, a repeat evaluation in another six to eight weeks was recommended.

A third ABR was completed approximately two months later. A was still in phase two and his air and bone conduction thresholds had improved. Again. A repeat ABR was recommended for three months following this.

Three months later, a is now corrected to twelve months of age. He is in phase three due to the fact that there have been continued improvements in both A's hearing and his health, a repeat ABR is recommended in six months. At this point in time, we are no longer concerned about permanent hearing loss and we know that he has auditory access.

So A's final sedated AbR was completed shortly before he was discharged from our NICU. He was still in phase three and making good progress at this time. Unfortunately, he had abnormal tympanometry and a low frequency conductive hearing loss bilaterally due to a discharging. We recommended behavioral audiologic monitoring once he was medically stable.

As you can see, a had a significant change in hearing thresholds from his first ABR when he was in phase one and to his final ABR when he was in phase three.

A's binaural conduction PTA improved from 76 decibels to 27 decibels over 15 months, as seen here in relation to his BPD phases.

An updated chart review revealed that a did have a recent sedated ABR completed to monitor his hearing. He is also nine years old at this time and his hearing thresholds remain normal bilaterally.

This is not only a trend that we noticed in L and A. Here's a graph that shows many of the cases that we've had over the past few years. This data comes from nine ears. You can see the air conduction pure tone averages at the time of the first test in phase one or phase two showed significant hearing loss. By phase three, most patients were showing substantial improvement to near normal pure tone averages.

The bulk of these averages in phase three do still show a mild hearing loss. However, these were instances of low frequency conductive hearing loss and all had normal bone conduction thresholds. Overall, you can see the considerable change in pure tone average from the first test to the final test for all of these patients with BPD.

So, as was noted in our two case studies, we altered our protocol with these patients as we learned more and became more familiar with this population. First, we have stopped doing diagnostic testing in phase one. We initially were seeing patients in phase one because many were already sedated and paralyzed, making ABR testing feasible. It was a captive audience. However, we now wait until a patient is at least in phase two.

We will also now repeat abrs that show hearing loss every two to three months, and we do not fit amplification until we have had two stable ABR showing hearing loss. These patients with BPD are a difficult population, both medically and audiologically. I know I raised a lot of questions and points to consider today. We don't have the answers to many questions. The literature also supports the need for more research about the pathophysiology of what exactly is happening to cause the improvements in hearing.

We currently are actually in the process of completing a research study, partnering with ENT and neonatology colleagues to look closer at this population and their hearing changes over time. Regardless, it is important to be aware of the fact that this can and does happen in this population and

to really critically think about what that will look like for your patients in your practice. Thank you so much for your time and attention today. I'm happy to answer any questions that you might have at the end. Thank you, doctor Girth.

Thanks for sharing your approach to evaluating the clinical status indicators in these patients with BPD. Next up, we're going to hear from doctors Alicia Jain and Christine Schaeffer. Alicia and Christine are two of our department's advanced clinical providers and help lead our cochlear implant program. They will be sharing an update on auditory brain STEM implants, which is an intervention that certainly goes beyond our traditional toolbox. Alicia, you have the floor.

Right. Well, thank you, Doctor Hoonum. Like she had said, I am just going to talk a little bit today on auditory brainstem implants. This is definitely not a large population here at nationwide children's, but I do think that it's an interesting one and something to keep in your toolbox when you have some of those more challenging anatomies and kiddos. Starting off what is an auditorium braid stem implant.

In ABi, it can provide sound sensation to a patient with absent cochlear nerves. It can provide some sound awareness. Some cases you'll get sound recognition, and in some other cases, you can actually even get some word recognition. And it has shown to improve lip reading skills. So how does the ABI work?

So, like a traditional cochlear implant, it does have electrodes that are mapped. These electrodes are on a paddle, and these electrodes activate the neurons in your brainstem. And these activations of those neurons are creating sound sensations. But unlike a cochlear implant, where the electrodes are stimulating your auditory nerve, the ABI is bypassing your auditory nerve and stimulating the CNC in the brainstem directly. So, FDA approved indications.

In the United States, they are a little different. In Europe, but in the United States, it is for patients twelve years and older and diagnosed with nf two, that implantation can occur with tumor removal of the first side, second side, definitely something that is patient and surgeon specific. And it can be in patients with previously removed acoustic tumors bilaterally. So additional considerations or things to think about or patients to refer would be patients with cochlear nerve hypoplasia, inner ear malformations, ossification of both cochleas, a temporal bone fracture with a cochlear nerve avulsion, otosclerosis, and unmanageable facial nerve stim with a cochlear implant.

While we were starting our program here at nationwide children's, we had a few additional considerations, just because our population is tends to be a bit younger. So when we're evaluating patients, prelingual patients, our primary age target would be for patients anywhere between 18 and 24 months of age, up to three years of age for that optimal auditory skill development. And we have no upper age limit for our peri and post lingual patients. We prefer that they have no medical contraindications, no diagnosed cognitive or developmental delays, strong family support, and reasonable expectations.

So what are some of the performance expectations that you can expect from an ABI recipient? So, what we would expect from all of our ABI recipients is detection. Good detection of medium to loud environmental sounds at comfortable listening levels, and detection of conversational speech at those comfortable listening levels. So what we hope would happen is that our ABI recipients can experience improved perception of the rhythm and volume in speech, which helps with some improvement in speech recognition and lip reading and limited improvement in the recognition of environmental sounds. And in some very small cases, some ABI recipients will actually experience open set word recognition with a lot of help and therapy.

So what does our surgical team here at nationwide children's look like and who does it comprise of? So it comprises of our neurosurgeon, our neurotologist, an interoperative monitoring specialist. So we do have a monitoring specialist that will monitor the cranial nerves, very specific cranial nerves, and also completes the EABR throughout the surgery. And the audiologist is also in the surgery, and we are assisting with the EABR. So what is the purpose of the EABR?

The EABR is actually completed twice. So it will be completed during surgery, and it can actually help the surgeon. So we can complete it. And if we're seeing a lot of maybe non auditory side effects or no responses to stimulation while the surgeon is doing the surgery, they can actually move that electrode paddle. To try to help us capitalize on as many electrodes as we can, we want to be able to have optimal placement in order to stimulate as much of that cochlear nucleus complex as possible and to, like I had said, ensure that it's not creating just non auditory side effects for the patient.

And like I said, we will actually complete a second sedated EABR about six weeks later. And this can. This is typically done right around that initial activation. And the purpose of that is to ensure that when the scar tissue has started to grow over the paddle, which. Which is what we would like to see, but that the paddle hasn't shifted, and that all the electrodes that we were using in surgery are still usable and not creating any complications for the patient.

So our typical follow up schedule here at nationwide children's, we do that. Like I had mentioned, we do the sedated EABR about four to six weeks after surgery. To be honest, we do tend to run closer to six weeks, and then we do an initial activation in the outpatient clinic. And it's within one week of that sedated EABR and that initial activation. We do have a team that is kind of ready to go.

So we do work in the ENT department here. We do share a floor with the ENT department. So prior to that activation, we do let the physicians know and the ENT nurses so that they do have the crash cart available if anything catastrophic were to happen. But we do have people on call per se to ensure that

everything goes as planned. We see them one week post, one month, three, six nine and one year post, and then additional appointments.

Obviously, they vary by patient, but we'll either see them biannually or annually after that.

So I'm going to go ahead and jump into some case studies here. I'm going to do two different case studies with very different results. So we're going to start with case one is in July of 2018, we saw a three year old female who was very recently adopted from China. Her adoptive parents knew that there was most likely a hearing loss present. However, she had never been tested, so they had no idea the degree or the cause or anything.

And so when she was seen at nationwide children's, we completed an ABR and a CT and MRI at the same time. She had a no response ABR, and her imaging indicated a common cavity with the absence of normal cochlea, vestibule and sscs bilaterally. And she also had atresia of the IAC, the 7th and 8th cranial nerves. And so she had her Abi surgery a little less than a year later. After much talk and debate, her parents decided to go forward with that.

So at her initial stimulation, she had 14 active electrodes. And I should mention that on the paddle, there are 22 electrodes like you would in a cochlear, America's cochlear implant. However, 21 is the maximum number that you can activate. And her cochlear themselves, they said that if you can have about half of the electrodes activated, then that's successful ABI surgery. So for her to have 14 electrodes, that was a very successful surgery.

She's wearing the AbI. 8541 is the internal with SCP 1000 external. We are using a speak strategy for the slow rate, a wide pulse width, and a maximum of eight. And for her, we set her C levels at her EABR thresholds. At that time, she wasn't able to give us a lot of behavioral responses, and we just did not feel comfortable going above those EABR thresholds that we knew were safe for her.

And so there were a few appointments in between that went well. But at her six month post activation, she was actually able to give us some behavioral results. So we were able to measure some sea levels using a faces chart. We used a very basic happy face, sad faces chart, and she was able to indicate what was comfortable for her and what wasn't. So at that time, we did deactivate about four electrodes just based on her responses or lack of responses.

So electrodes with no responses we would deactivate. And the ones that made her uncomfortable, her data logging was great. She had detection levels in our booth between 40 and 65 decibels, and she was able to detect all of the ling sounds with auditory cues only, I should add. So we'll jump ahead to her one year post. She's still doing well.

She is in pretty intensive speech therapy at this point. Our data logging is great. Ling detection is between 20 and 40 dbhl in our booth. She is able to actually use a picture board to point out all of the ling sounds using auditory cues only. And her parents report to us that she is consistently responding to environmental sounds, specifically.

Louder lawnmower, microwave thunder. And she can spontaneously say I love you. Which, by the way, we did here in office and it was, was a very nice moment. We'll skip ahead to two and a half years post. She is now in a mainstream school.

She was utilizing an ASL interpreter and a DM system. She was able to now behaviorally measure all of her t and C levels using CPA. And her pure tone and link detection were between 20 and 30 decibels. So we're rolling along and so skipping ahead. We have seen her, you know, a few times in between and everything has gone really well.

So skipping ahead to four years post. She has her ten active electrodes, which have been very consistent data logging. She's wearing it full time. She has actually switched schools, but is still mainstreamed. And she's using an ASL interpreter and her teachers are using the mini mic with her.

She's still able to behaviorally measure all our t and C levels, but now she is actually able to repeat four out of the six ling sounds with auditory cues only. She recognizes her name with auditory cues only. She was funny enough unable to complete any ESP testing for us, so not sure if it was just maybe not her day. She was not able to complete our ESP testing, but the family is now working with the school district to incorporate cued speech into her curriculum. I should mention, she is falling behind in her reading skills.

And the family does feel that cued speech would be an important part to her to improve her reading skills. So that's still a work in progress. I know in the state of Ohio, I think we only have one, potentially two people that are certified in cued speech. So it's been a difficult road to find someone consistent for her. But we're just curious to see that if they do get that incorporated where she goes, because she has done fantastic with her Abi.

So now, giving you all of that good news, we're going to move on to case number two. So this is actually a male. He referred his newborn hearing screening, and at that time, his Abr indicated profound sensorineural hearing loss. MRI indicated hypoplastic, potentially absent cochlear nerves. So because we were not entirely convinced that they were absent, we did do a cochlear implant on one side before we jumped to an ABi.

The cochlear implant was unsuccessful. And so about a year and a half later, the patient received an ABi. At that time, his parents were given the it maze, and he scored a zero out of 40. What I do want to point out is that he was in a very high risk social situation and he was not receiving consistent speech therapy or access to ASL. He was not in any early intervention programs consistently at that time.

So at his initial activation, we had 13 active electrodes, which, again, is a great number of electrodes to work with. We were able to measure his C levels slightly above his EABR thresholds. He was actually quite a good reporter for us, us. He's a very happy little boy. And so he was.

When we saw the smile fade or he would turn into mom, we knew that he was a little uncomfortable, and he was very consistent with those behavioral responses. We observed no non auditory side effects. So you can see here, we went from initial activation to a one year post. So the patient did come back for one appointment in between, around three months post he was seen. He had missed his prior appointments.

And at his three month post activation, his mother reported that he hadn't been wearing it, but she wanted to try again. And, you know, it had only been three months, and we did the remapping and had scheduled him to come back in a few months, but did not see him again until his one year post. So when we did see him, mom said that he had recently been starting to wear it more often. I should also point out that this is about the time that he started school. We still had 13 good active electrodes.

His data logging was not stellar. We put him in the sound booth. He had an Sat at 30. Ling testing was looking pretty good, and his it mays jumped from a zero to a ten out of 40. So at that point, we thought we were making some pretty decent progress with him.

But about now is when trouble started brewing a little bit. We saw him for a two and three year post without incident. Similar results to the one year. His data logging was still pretty low, but was still giving us pretty consistent results between 30 and 45 decibels in the sound booth. So at his four year post, activation.

His parents came in. We had recently repaired a processor for them, had a repaired processor, and they had come in for a troubleshooting appointment, telling us that the new processor wasn't working. They saw the green light, but he wasn't responding. And so we connected it to the software, and the software couldn't find the internal. So at that point, we contacted cochlear, who came for an integrity test and confirmed a device failure of the ABI.

So what are our next steps? So, explant re implant was discussed, but there was a lot of hesitation among our team, first off, being that it is dangerous. It's not like explanting and re implanting a cochlear implant, as this has implanted itself on the brainstem. From an audiological standpoint, we were very hesitant. His data logging had been historically low.

They hadn't been to consistent therapy. They hadn't come to appointments consistently. The school is actually reporting his behavior is better without the processor than it is with the processor. And at this point, he was in a hearing impaired school. He was learning ASL.

He was utilizing an AAC device. So we felt that he was really in a good placement at that point. He was developing language. And so we had talked to parents about all of our concerns, and they did eventually choose to explant and re implant. So he was explanted and re implanted.

And at his reactivation day, he arrived to the appointment, and it was a bit jarring. He had significant swelling at his incision site, and he just kept signing, it hurts, it hurts, it hurts. So we did. We connected him to the computer. He had 17 out of these 21, 22 open electrodes.

We did not create any maps. We walked him over to ent immediately and directly from the office. The ENT, they admitted him to the ER, and he received a shunt that evening. So we had tested him as an inpatient following his shunt placement a couple of weeks later, and he still had 16 open electrodes. No maps were created at this point.

And so we said, go home. The physician said, I think that maybe go home. I think the swelling will go down, which it did. And the swelling did go down. So we saw him about a month post shunt replacement, and at that point, all of the electrodes, pretty much all of the electrodes were open.

We did not create any maps, and it was recommended to discontinue the Abi use. And at this point, he was, and still is, in grandparents custody. And the grandparents were fully on board with this. And we were able to work with the grandparents to get him into the. To get him enrolled at the Ohio school for the dead I, which is where he currently still is, and he is utilizing ASL as his primary language and really making a lot of good academic progress.

So some clinical takeaways, just something that I know, that we all know and we all talk about. But when you look at these two cases on paper, when you look at the audiograms, when you look at the imaging, they're pretty similar. So why are their outcomes so different? So, again, things that we've talked about and that are so important that I just want to drive home. Family buy.

In case one went to speech therapy weekly, the whole family learned sign language. They were really working with the patient, streaming to the patient's processor, just getting any auditory input they could at all time realistic expectations. Case one, like I said, the family, the whole whole family learn sign language. Whereas case two had some barriers to that. They had some barriers to learning, some barriers to care that were different.

We had consistent therapy with case one, consistent device use, and early access to language and ASL. So there are some different contributing factors that caused both cases to be so different and end so differently. But I think that as clinicians, that's something. It's not just what does your audiogram look like? It's a whole big picture of success and just something that is part of what we need to think about when assessing these patients.

I just want to say thank you for listening, and I am open to any questions that you may have. Thank you, doctor Jane, and thank you for this update on auditory brainstem implants. I'd now like to introduce you to Doctor Lauren Darynka. Doctor Durinka is a pediatric audiologist on our team who also serves as our evidence based practice coordinator. She facilitates our work in journal clubs, grand rounds, and clinical outcome groups.

Lauren is going to walk us through the use of bone conduction implants in special populations. Thanks, Lauren. Thank you, Gina. And thank you all for giving me the opportunity to talk about one of my favorite populations today. I want to start by just giving a really brief overview of active transcutaneous bone conduction implants.

And then we're going to kind of travel through how we can think about going beyond ear tubes and maybe using some of these bone conduction devices for our patients with down syndrome who have chronic middle ears and those fluctuating conductive hearing losses. First, why do we even do these implants in the first place? While they're safe, we have much fewer adverse events than previous iterations of bone conduction implants, such as percutaneous abutments, where we saw a lot of revision surgeries, skin overgrowth, and infections. They're effective because we're taking that stimulation and going directly to bone underneath the skin, rather than going through skin and other tissues, such as we would with a passive transcutaneous bone conduction implant or a soft band, then we're able to get that direct stimulation and better high frequency access. Feedback reduction is a huge one, especially if you've ever worked with foam conduction devices in the past.

You know, that feedback can be a real struggle. And because we're taking that transducer out of the external processor and putting it underneath the skin, we're able to reduce feedback to essentially nothing, unless we have to give it a lot of power for some of our mixed losses, and they're comfortable. Again, we're making that transducer super light or that external processor super light, because we're

taking the transducer out of it and putting it underneath the skin. So even some patients with sensory aversions will tolerate these a little bit better.

So these are the two implants that we are implanting here at nationwide children's the med El bone bridge and the cochlear Ossea. Just to give a brief introduction to these two devices. The bone bridge uses a floating mass transducer, which is a transducer that actually sits down in a well drilled out by the surgeon, and then it uses a magnet to create a vibration that's transferred into the bone with screws on either side. The assia is using a piezoelectric, which is actually an electric pulse that the transducer is actually converting to a mechanical vibration. And then that transducer is screwed into the bone as well.

So that's what transmits that sound into bone. Both of these devices have a decent fitting range for bone conduction or a sensorineural component. So up to 45 decibels hl for the bone bridge and up to 55 for the ossia. So a decent amount of sensorineural loss allowed for these devices. I want to talk about three different cases today of patients that we've seen here at children's.

You're going to find them to be fairly similar, but I think they each bring something to the conversation. The first is ad she is a 17 year old female with down syndrome. She does have some degree of intellectual disability resulting from her down syndrome. And of note for her, she also has Moya Moya syndrome, which, for those of you that don't know is a narrowing of the blood vessels that supply blood to the brain. Her otologic history is quite extensive.

I'm not going to read through all of these for the sake of time, but just to note that she started with us in 2009 when she was two years old, and that was when she got her first set of pe tubes. Her otologic history kind of follows kind of the same course as any other child who has a chronic middle ear or middle ear dysfunction, where it's just tubes after tubes after tubes. So she finally got her 7th set of tubes in 2023. Of note, there was a long pause in her care from 2021 to 2023 because she did have a stroke in 2021, and that delayed the placement of that last set of tubes.

Her audiologic history is what you would expect for a child with that chronic middle ear dysfunction. Lots of fluctuations depending on the status of her middle ear.

That continued throughout the course of her history with us from 2009 to 2023. In 2021, we were able to do a good test on her and got a mild to moderate conductive hearing loss. And that stroke happened right after that test. So that's when her care was delayed. And I just kind of wonder, like, how long did she go with that hearing loss and that persistent middle ear dysfunction when she wasn't being seen and didn't have access to that tube surgery?

This was her audiogram after that 7th set of tubes. So in May of 2023, and she had a possibly blocked tubes at this time. They were just put in, so they had not extruded yet, but flattened pantograms on this date. And you can see a pretty significant hearing loss there for both ears. This was the first time that she was referred to otology or to audiology for more than just an audiogram.

So we did a hearing aid or bone conduction evaluation for her, and I decided to discuss bone conduction options, given that she still was experiencing fluctuations in hearing and persistent drainage with patent tubes. The family elected to try an ad here first, but it didn't work out great for her. They were kind of hesitant to do a surgery because of the Moya Moya syndrome and her history of stroke. But with the ad here not working out very well for her, we decided to go forward with a bone bridge. She was implanted in December of 2023 and activated in January of 2024.

This is her post activation or one month post activation aided testing. You can see some nice scores for ling detection there. And then she was able to give us some picture pointing, and we got a nice SRT in the normal range. Our second patient I wanted to talk about, she's a 22 year old female with down syndrome. Also has some intellectual disability that is coincides with Herc down syndrome.

Her otologic history is going to look very similar to our first patient, chronic middle ears. She transferred care to us in 2014, so she was already 14 years old when we first saw here. Saw her here at NCH, and at that point, she had had nine sets of PE tubes. She was referred to us due to concerns for cholestiotoma, but at that time, there was not a cholestiotoma. So they continued to monitor her until a cholesteatoma was confirmed in 2021.

She did have a tymp mastoidectomy surgery and ossicular chain reconstruction in 2021, and then she also was found to have mastoiditis again after that surgery and had a mastoidectomy in 2022.

Her audiologic history, when she transferred care to us, we were already seeing some what we consider what we think was probably more of a permanent conductive hearing loss. After her history of chronic middle ear dysfunction, she never really had a normal hearing test, but it kind of fluctuated depending on the status of her middle ear. After that surgery in 2022, we did note a pretty significant hearing loss, and that was the first time she was referred to audiology for amplification. So this was that hearing test in 2022. This was right after her tymp mastoidectomy and a sicklear chain reconstruction.

It was after this that the mastoiditis was discovered, and so they decided to go ahead and implant a bone bridge. At the time of her mastoidectomy in 2022, her activation was really fun. I activated her in January of 2023, and she just lit up. She was dancing and singing and telling us that she loved the way it sounded, so that was really fun to experience.

This is her one month post testing, very similar to the first patient that I talked about. Nice access to sound with that ling detection, and she has a little bit higher cognition levels than our first patient, so she was able to give me some open set word recognition, and we got some nice scores there as well.

The last patient I want to talk about is just a little bit different, but I wanted to highlight a patient who might be a little bit more challenging than the first two that I discussed. This is a patient with severe

intellectual disability, also down syndrome, but he also has a diagnosis of autism. He is in generally fairly difficult to test behaviorally, doesn't give us a lot of feedback, and is essentially nonverbal, with a few words here and there.

His history is slightly different just because we didn't care for him until 2020, when the family moved from North Carolina to Ohio. And his course of otologic history was pretty routine with us. So he didn't have a whole lot of stuff going on at the time, but he did have a history of PE tubes and ear infections. When he came to us in 2020, we learned that he was fit at Duke with a sound arc, a baja on a sound arc that he was wearing about 3 hours per day. And Ant said he kind of was hit or miss on whether or not he would tolerate it.

He was in the care of his aunt. We did do a sedated Abr in 2021 because he was difficult to test behaviorally, and his baha was starting to age and was out of warranty. So it was kind of this conversation of what to do next. Next. And the family was considering doing a bone conduction implant.

These were the results of his ABR. So he does have some mixed component, but essentially conductive hearing loss there. The family eventually decided to proceed with a bone bridge. It took until 2023. Aunt was very hesitant.

He is strong willed, and she would not sure that he would keep it on. And then he was activated in March of 2023. This is his one month post testing, so again, difficult to test behaviorally, but we were able to get a nice reliable sat at 20 with VRa, the aided ling detection. I'm not sure how reliable that was. He was fatiguing, but he did give us some responses, which was nice to see.

I think what we have to think about is defining success a little bit different for these more challenging patients. What was successful for me about this patient is that he was wearing his bone bridge 9 hours a day, which is a market improvement from the 3 hours a day that he was using his sound arc. His aunt

reported that he loved streaming, and he was even able to give us some feedback about how the device sounded. He repeatedly asked for loud, and so we were able to turn it up a little bit for him, and he continues to do really well.

So, in conclusion, all of those reasons that I said why we would do these devices in the first place held true for this population. We had no adverse events for any of these three patients. They were effective, so we were able to improve access to sound and compensate for those persistent fluctuations in hearing that these patients were experiencing. And they were comfortable. So these devices were worn and even preferred in the case of our last patient, who's wearing his 9 hours a day.

I wanted to talk about this population because I think they can be such a challenge for our field and for our Ent partners. They often fly under the radar because there's so many complexities involved with their cognition and their middle ear status and their sensory aversions and all of these things that I feel like they tend to just kind of go unnoticed in terms of amplification. My question for us as a field of audiology is can we challenge ourselves to consider bone conduction options for patients who have down syndrome, and especially give them the option to consider a bone conduction implant? And can we work with our ENT partners to determine appropriate clinical practice guidelines for when and how we should consider these bone conduction options for patients with down syndrome who have chronic middle ear dysfunction? Can we get the same outcomes that these patients had but sooner?

Could we do that for future patients? So I will leave you with those challenging questions. This is something we are still actively working on here, and I will update you if, if I come up with anything else. Thank you all so much. Thank you, Lauren, for your discussion, your case presentations, and for those thought provoking questions.

Those were great. Next, I would like to introduce you to Doctor Ursula Finlan. Doctor Finlan is our director of audiology research and facilitates the transition of staff clinical questions into IRB approved

studies while also managing her own research portfolio. Doctor Finlan is here to share with us new considerations for testing children with autism. Doctor Finlan, thanks Doctor Hoonum.

Appreciate the introduction. As Doctor Hoonum said, I am here to look at a new way of looking at this very challenging population, and I would be remiss if I didn't recognize a couple people along the way who have helped me ask some questions about children on the autism spectrum. First of all, Doctor Kelly Epperson. In 2019, she was a student at Ohio State and did a capstone that kind of kicked off this project. And then doctor Lindsey Kovac Spectold, who up until recently was at Nationwide Children's Hospital and reinvigorated this project.

And then I wanted to definitely give a huge shout out to current staff who are currently working on this project and the data that I'm going to be sharing with you today. So we know determining hearing status in children is challenging in general, but we have various test measures that can accurately determine hearing status in children. But we used the test battery approach and we can use electrophysiologic as well as behavioral measures to understand what children are hearing. All these measures require some degree of participation and or tolerance in the awake child. And when we consider developmental considerations in children, when we are trying to determine thresholds, we can think of it as a continuum of participation.

So on the left hand side, we have auditory brainstem response. On the right hand side, we have standard audiometry, and we have all of the different types of testing paradigms that we use as pediatric audiologists across this continuum. And we can think of it as. As needing the least amount of participation or tolerance or a lower cognitive load all the way to the most participation or higher cognitive load. And so we often use visual reinforcement audiometry and conditioned play audiometry.

We can use tangible reinforcement, operant conditioning audiometry, although not to the letter of how it was developed back in the sixties. But certainly we use stickers on a piece of paper, one by one, to

reinforce responses in children all the time. But these are the typical ways that we try to elicit thresholds in children, and they all use different amounts of cognitive load to evaluate what thresholds are. Now, when we think about hearing determination in children with autism, we know it's challenging, and that's because there are developmental considerations. Children with autism often have developmental challenges, and sometimes that means the three year old you're seeing is not functioning as a three year old.

Sometimes they're actually functioning quite well, and sometimes they're low functioning. They have sensory considerations. So their sensory processing might be inhibiting how they can respond or what they can tolerate in terms of headphones or probes in their ears. And then it's a spectrum, right? So that three year old could be functioning as a nine year old, or they could be functioning as a six month old.

And what happens is that this makes this a more predict, more unpredictable population than even our typical developing peers. And we all know that kids are unpredictable to begin with, but this population is even more unpredictable than our typical peers. So in addition to that, it's really important to figure out what these children are hearing, because we know the comorbidity of hearing loss in children who have autism is higher than typically developing peers, upwards of 5.3%. We know that we overestimate hearing level in these children in about 40% of them, and their test retest reliability is super poor. And that complicates our ability to confirm hearing thresholds over time.

So this is a super challenging population, and we've been able to have a lot of really great resources provided to us over the years by a whole bunch of different experts and different avenues. For instance, we have magazine articles about tips for testing children with hearing. Children with autism. And then there are different types of research articles that we can see using visual supports to facilitate testing in children on the autism spectrum. There was even a great Marion DoWNs lecture several years ago at

the academy conference.

And even on this very platform, we had a great expert in Erin Schaeffer, who did 20 questions about auditory issues in children with autism spectrum disorder. There's been really great resources, and most of them surround how can we change our paradigms, or how can we make our environment more appealing or more safe for children to be tested well. But at nationwide Children's Hospital, we couldn't help but wonder, in the great words of Carrie Bradshaw, what else do we have access to in our EMR that we can potentially get help in helping us test how we are assessing these kids with autism? And so what we wanted to do is look at whether the language scores that we have access to, can they help us predict whether we can determine hearing status in children with autism behaviorally? Can their cognitive scores allow us help us predict whether we can determine their hearing status behaviorally?

And is there a relationship between language or cognitive scores and the amount of information we can obtain in a single behavioral evaluation? So, way back in 2019, I did a Capstone project with Doctor Kelly Epperson, and we looked at language and cognitive scores, and then we created this audiologic continuum score. And what that means is we looked at every single hearing test that these kids had completed, and we looked at the amount of audiometric data that we were able to obtain, every threshold in how many ears, how many temps, how many Oaehen, and we were able to derive a score for that child at that time. And then we looked at, ultimately, what kind of testing did we need to actually determine what their hearing status was? What did they, could they do a behavioral test, or did we have to go to stated ABr?

And this is a scatter graph of the kids who we had to use ABR to eventually establish their hearing. And those are the kids in the open circles. And kids who could do behavioral testing are the closed circles. And what you can see is there's a pretty clear demarcation in terms of audiologic score. Obviously, the more information we could get from them in a behavioral test, the higher the score.

But what you can also see is that there's a very variety of different language standard scores that these kids could achieve. And some of the kids who had relatively low language scores could do behavioral testing. But there were very few kids that had higher language scores that could, that could, that needed to actually have an ABR. For hearing testing. So, overall, what we found was a significant, moderate positive relationship between language standard score and the audiologic continuum score.

So overall, what we deduced was the higher the language score, the more audiologic testing the kid could complete, which is not surprising to us. Right, that's. That's how this works typically. But what that showed us was that if children already had a language testing score in their chart prior to a hearing test, that could really guide us with the choice of testing method that we needed to use, and it could also guide our clinical decision making in whether we did testing repeatedly before we move to a stated AB ABR, or if we could say we're not sure that we're going to get much more, we should probably just refer to an ABR instead.

Moving on after that, we wanted to expand this and look further into many more kids in our history of testing kids with autism. Doctor Lindsay Kovacs wanted to revive or reboot this project, and she presented some pilot data at AShA in 2023. We have data that is ongoing. Right now. We have 570 kids with various ages.

And so what I'm presenting are preliminary data points. Right now, we have 388 kids. So 68% of our children have language or cognitive scores that are within six months of their first audiogram. Not surprisingly, this population is overwhelmingly male, and a lot of these kids, 94%, pass their newborn hearing screening. So we don't have a whole lot of risk for congenital hearing loss.

But we know that kids can get hearing loss at any time during childhood. So we still have unknowns in terms of how many kids have sensorineural hearing loss when they come into our clinic. We are documenting level of support, which is a measure that our childhood developmental clinic and many

other clinics across the country report as a part of an autism diagnosis. And you can see that almost half of these kids are level of support, three, which is requiring substantial support. So they're pretty challenging kids.

And ultimately, 58% of these kids could be tested behaviorally. 15% needed sensitivity ABR, but 27% were lost to follow up, which is a huge problem in this population. When we see a child and we need another test or we need to go to a stated ABR, there is a concern that we're going to lose that family because either we can't get them back for follow up testing. There might be some social barriers or social determinants of health barriers, but also they might not find utility in getting a hearing test. And we know that we're losing kids that might actually have a hearing loss that needs to be managed.

So we do need to think outside the box as to how we can be more effective with that, and one way is to make sure that we're being the most efficient in testing them. So I'm going to be reporting the cognitive testing because we have more cognitive testing scores. So far in our data collection, 285 kids have cognitive testing, and 42.8% had cognitive testing before their scheduled audiogram. So that means a lot of these children have information in their chart before they even walk in our clinic that we can use for clinical decision making, most of them had a Bailey or a developmental profile. Four.

So these are testing that. These are tests that are mostly parent report. Depending upon age, at some point, the Bailey does turn to some measures that have kids show them what they can do. But lots of this is parent report testing. On the box and whisker plot, you can see that for kids who ultimately needed Abrdeen are in the red box, and behaviorally tested kids are in the gray box.

And you can see the mean and median cognitive score. Standard score for kids who could be tested behaviorally is significantly higher than those kids who ultimately needed ABR or said in another way. Children with lower cognitive standard scores may require stated ABR to determine hearing status. So, so far, these are what the data are telling us, but I wanted to apply it clinically for you. So I'm going to

show you two clinical cases that will illustrate how you could apply this in your everyday.

So this little kiddo is Adam. He's two years old, and these two cases are from the kids that we've already entered into our red cap for data collection. Adam came to us at two years old. He had not had his developmental evaluation yet, so we saw him before his developmental evaluation. He passed his newborn hearing screening, and he had an audiogram with us.

We were only able to get sound field VRA, but he was able to get three frequencies with the normal limits. He had normal tympanograms and present dpoes bilaterally. So that's a pretty good test. So we were pretty comfortable with saying that he had hearing adequate for normal speech and language development. And our follow up recommendation was to come back in a year for ear specific testing, because for us, a VRA sound field test, although great, is not enough to discharge completely.

We do want to get ear specific information. But six months later, he had his cognitive evaluation, and he had a Bailey score of 85. So his cognitive functioning was completely age appropriate. But he did meet criteria for autism, and he was a level two need for substantial support. So we can tell from his cognitive score that he is able to do testing, and we were able to get a really good test.

But in contrast, Max here came to us at four years of age. He had a developmental evaluation two months prior to his audiogram, and his DP four score. His standard score was a 40, and they could not do any language testing. He was nonverbal, but he couldn't actually engage in any of even nonverbal communication evaluations. So he was pretty low functioning.

So when he came into our clinic, we knew that he had an autism diagnosis. We knew that he was a level three, very substantial support. So when he came into our clinic two months later, we tested him via VRA with a team test, so two testers, and we could not condition him to be able to provide consistent responses. And then we tried the same type of testing one month later, and then pretty

quickly went to a sedated ABR, and ultimately his hearing was completed completely normal on that ABR. But knowing that he had such low cognitive functioning, we knew that it was going to be very difficult for us to be able to have him effectively respond consistently.

So we kind of didn't beat around the bush very long. We did our two tests and then went right to a state ABR to make sure that we could assess what his hearing is, establish it, and rule it out, or rule it in as contributing to what his developmental delays were. So, overall, the clinical takeaways that we have from this project are really, we need to just use all the information we have in our EMRs to support our efforts in this population. If these kids have language or cognitive scores available in close proximity to our appointments, it's really helpful, and it can actually help you plan for what testing approach you use and for your follow up plan. And if there's any indication of low cognition and or low language, and you've at least tried a hearing test once or twice behaviorally, without success, you shouldn't hesitate to try to refer to a stated ABR if you have that ability in your area, because the likelihood of you getting really, really effective testing done when you have a child who has really low cognition is challenging, and it might prolong management of a hearing loss if you can't establish that in a quick manner.

So thank you so much. I really appreciate your time. Thank you, doctor Finlan, for your insight into using clinical information beyond our standard approach to consider the impact that language or cognitive level can have on diagnostic assessment within this population. Thanks. Finally, I am excited to introduce you to two very talented and important members of our team who are not audiologists here at nationwide children doctor Caitlin Cummings and Lauren Yoshihiro.

Doctor Cummings is a bilingual speech language pathologist and clinical researcher at Nationwide Children's Hospital and Lauren Yoshihiro is one of our dedicated speech language pathologists who works with our deaf and hard of hearing population providing specialized intervention and oral rehabilitation. Together, they will share with you the way we approach speech and language evaluation

and intervention needs for our deaf and hard of hearing children from multilingual backgrounds. So please share with us. Great. Thank you so much Gina, and thank you to everyone for this opportunity to present today.

Like Gina said, Lauren and I are speech language pathologists and we're excited to discuss some issues regarding, well, interdisciplinary issues regarding evaluation of speech and language and bilingual who are deaf or hard of hearing. And for our presentation today, we are talking about bilingualism as children who are acquiring two or more spoken languages, meaning English or Spanish or English or Arabic, for example. All right. With efforts to uphold nationwide children's hospitals commitment for the diversity, equity, and inclusion of its employees and patients, this presentation content aligns heavily with the DEI values that our hospital promotes. Specifically that quote, everyone has a fair and just opportunity to be as healthy as possible.

This requires removing obstacles to health such as poverty, discrimination and their consequences, including powerlessness and lack of access to good jobs with fair pay, quality education and housing, safe environments and healthcare. We hope that listeners today will be able to leave the discussion with some broadened understanding and view of the challenges, but also opportunities that are involved when focusing specifically on the unique needs of patients and their families who may not have a solely english monolingual background. We encourage listeners to remain committed in word and action to provide a place of serving that is welcoming, inclusive, and supportive for patients, families, and team members.

So, as many of you know, there is a strong need for early identification of hearing loss management and ongoing intervention for children who are deaf and hard of hearing. Research suggests optimal development for spoken language and cognition when hearing loss is identified as early as possible with respect to any comorbid diagnoses that may impact overall development. Maximum outcomes are

shown when hearing loss is identified and consistently managed by six months of age. Studies also show that early speech and language skills are prerequisites to cognitive development. Therefore, late auditory access to language could, in addition, negatively impact cognitive development with poor or inconsistent access to speech or sound.

We anticipate significant delays with any language development despite maternal or paternal education levels, resulting in language deprivation. Lastly, consistent and ongoing intervention and re evaluation has been proven to be the most effective for parent education and to maximize audiologic and list linguistic outcomes for children who are deaf and hard of hearing with any degree of hearing loss or comorbidity.

So bi, or rather we should say multilingualism. This is actually a very normal process, and it is very common, and it's really more of the rule rather than the exception. We think globally and across humanity the percentage of school age children who are learning English in addition to other languages. This is estimated to be about 40% in just a few years. And the majority of people in the world speak more than one language.

There are many ways to define bilingual, but we are referring mainly to when individuals receive regular input in two or more languages during the early dynamic period of communication development. And of note is that linguistic diversity really is everywhere. You don't just have to live in large coastal cities, right, like New York or Los Angeles to encounter it or have to work with it professionally or clinically as a SLP or audiologist. For instance, Columbus is the capital of Ohio. Our second most common language here is Spanish, and we have one of the largest somali speaking communities in the country, as well as large Nepali, Mandarin, Cantonese, and Arabic speaking families.

And these populations are reflected in the top five languages of our hospital and interpreter requests as well.

There's not enough time to do a full course on the theories of bilingualism, but just wanted to point out three main elements for you here as humanity. The brain is not inherently monolingual, meaning that we have our l one, first language, another language, or maybe l three, even a third language. We hold them cognitively, separately, but they do interact and influence each other in different ways. Also, over time, it can take a long time for children to develop cognitive academic linguistic proficiency in a language. So just because a bilingual child speaks English well with you during a conversation, that does not necessarily mean that they're fully fluent or that they still don't need support with English as they acquire it more in their science or social studies class, for example.

And on the bottom, it also depends on if a child is exposed to two languages right from birth, simultaneously, sequentially, later on in childhood. We even have children that experience language nutrition, and they lose skills in a language if they are, for example, removed from their linguistic community or don't have ongoing access to formal academic stimulation, right, in another language. So all of this is very typical, and there's lots of heterogeneity, and they all have slightly different trajectories. Determining where a child is on this spectrum can be difficult, but difficult doesn't mean disordered or delayed. It's very common to not be a perfectly balanced bilingual a child can have better skills in language in one aspect of their l two, but maybe have stronger skills in another area of language in their l one.

For our population of interest today we're going to use the acronym DML to refer to deaf or hard of hearing learners who are multilingual. And some studies report up to 35% of k through twelve learners that are in deaf schools or receive instruction from teachers of the deaf are DMLs. So a very large portion. And it's unfortunate because there seems to be an ongoing assumption that for these children, monolingual is best because it would focusing just on one language would be easier. But this really is not reflective or aligns with the current body of work that we have on multilingual children as well as

dmls.

So in summary, the majority of research that we have illustrates that bilingualism is not detrimental in and of itself to speech language development for these children. Some studies and chapters cited below, for example, have compared language scores between bilingual and monolingual children with hearing loss, and the children that received dual language support outperformed the monolingual learning in expressive and total language scores. In addition, comparing some pronunciation features between bilinguals and monolinguals with cochlear implants and the bilingualism itself is a variable. There was no difference. So heterogeneity is the name of the game here.

And this is very important because overall best practice indicates that providers should really encourage use of the home language and have a discussion with caregivers about what language they need and or want to use or languages in their home and daily activities with their child. A recent study by Wright et al. 2023 found that most providers, slps, audiologists, teachers of the deaf, said, sure, bilingualism is great, but they found that audiologists were eleven times more likely to report that it could cause linguistic confusion. And teachers the deaf were also eleven times more likely to report that, well, it'll reduce proficiency in one language or the other. And I will say that even within the speech language pathology field, there still is lots of misinformation and people aren't trained.

So overall this is a great opportunity, interdisciplinarily speaking, to have more training and get more up to date evidence based information to share with parents and caregivers. Right? So being culturally linguistically responsive, it's really a mindset. Rather than a list of tests, we have a couple of norm reference measures for speech and language for children in some languages, but they're very scarce. The modalities listed below are more appropriate for speech language assessment that include more dynamic measures.

For example, rather than taking an english test, for example, that wouldn't be appropriate. So we're trying to get away from pitting a DML against a monolingual model as if the monolingual is some sort of gold standard. That's not really the case. We more so look within the child and look at their strengths and weaknesses and where they might be showing more impairments with their communication skills.

So three good things to take away across all providers. Number one is completing a thorough language background interview. So rather than just clicking a drop down box right, English and Spanish is spoken at home. Documenting and asking some more specifics about how many languages, when was the child exposed, which one do they seem to use more? And if languages were used in assessment can go a long way toward documenting the acceptance and recognition of multilingualism with patients.

Number two, is any high quality, valid speech language evaluation. Maybe the team members you collaborate with, as audiologists are on your. Your hearing team needs to have a plan for how to look at all those domains of language there within each language, including visual languages, if needed. And then finally, the name of the game here is multiple assessments and sources. So we cannot translate one test to another.

Like, language wise, we can't just translate an english test. But those other measures and modalities, ways of approaching language assessment, are more appropriate for speech pathologists to give the best information to other members of the team when making these complicated audiological notological decisions.

Okay, so we're gonna think about holistic bilingual abilities. Testing should be dynamic and really just wanted to plug here the ongoing need to invest in skilled clinicians for speech and audiology, for receiving more training and discussion on this issue.

And just that there are many variables within each child. So, just as we know, the variables listed there can affect the outcomes of speech and language outcomes of children with hearing loss. It's the same with each bilingual child. So having a hearing difference can make language learning harder. But having a bilingual life or reality, that does not make it twice as hard.

It is a reality that should be reflected in discussion and assessment.

Okay, so passing to Lauren here for second part. So now just applying what we were able to find within research. Starting in 2022 to 2023, the hearing program at Nationwide Children's Hospital had an increased need for the evaluation and management for patients from spanish speaking families with either newly identified or known hearing losses.

As a rough glance over the past year, we evaluated about eleven children. The majority of our patients presented from spanish speaking families born within the United States, with Honduras and Venezuela. Following here is just some further information that really illustrates the wide range that we saw, including a range of ages, hearing statuses, comorbidities, and exposure to Spanish and English.

So we were presented with the situation and we started to ask the question, what is expected to triage these patients? How do we evaluate them? How are we providing recommendations, and what are we doing to follow up with this unique population?

So, prior to 2023, we would receive referrals for new patients either from a PCP or ENT, and we would triage those referrals based off of their linguistic needs or their audiologic needs, so they would either see a specialist from our bilingual team or a specialist from our hearing program. It was rare that these patients were connected with both specialties, and collaboration was difficult, which resulted in lengthy scheduling processes and delayed access to their care. After identifying the need for improved management of this population, we developed a pathway to manage and evaluate their language skills

with consideration of their hearing loss.

To our knowledge, there are no current published protocols for dual specialty evaluations and the management for multilingual children with hearing loss. So we then moved on and reviewed and compared our current protocols for bilingual evaluations and our total communication evaluations. As these protocols are based on research for each prospective population, we then proposed a dual evaluation method of care, which would include an evaluation with both a bilingual speech therapist and a speech therapist from our hearing program. We would include a certified medical spanish interpreter, and we would often include social work in this evaluation process.

During these evaluations, the hearing program speech therapists would provide will use a spanish medical interpreter to obtain a birth and medical history and any information regarding their audiologic status prior to presenting to nationwide children's Hospital. Along with any concerns for speech and language development, the bilingual SLP would then typically complete an articulation or a language evaluation involving static and dynamic components in Spanish or English. The hearing program SLP would then consult with the bilingual SLP in real time to interpret data within the evaluation to then provide immediate feedback and recommendations for ongoing care.

Following these evaluations, we report findings during our weekly hearing program team meetings and then collaborate with schools and social work when needed. Our next step in this process is to complete biannual or annual reevaluations for these children based on their age or level of need.

So, summarizing here just on the left, we are within these dual evaluations and for DMLs, this population in particular, looking more for features on the left that would suggest more of a true pathology or speech language delay. For example, deficits need to be present in all languages, significant parent concern, and looking at maybe how poorly a child can respond to increasing cueing or scaffolding levels. So leaning more toward that indicates more of an impairment versus features on

the right, things that are more typical of bilingual development. Having only those features on the right really would not suggest delay or disorder in and of itself. Right?

We're looking for more of the red flags on the left. So in starting to wrap up here. In conclusion, a recent study completed in 2023 revealed an overall lower confidence rating for spanish speaking mothers with children with hearing aides. They noted difficulty accessing information and support, or felt that information was incomplete or not comprehensive, either with or without the use of interpreters. So it's critical for us to remember that despite a family's linguistic or cultural background, they deserve equitable access to healthcare, especially as we continue to see changes across the country as more families arrive to United States from other countries, we look forward to developing this protocol further and discussing how collaboration across specialties can maximize care for this unique population.

And we don't have time to discuss other nuances or skills related to working with interpreters. Perhaps in future presentations, but we would like to note that we've also developed some new ways to collaborate and request interpreters to work with a bilingual SLP as well as a hearing program SLP that has really been instrumental as well, maybe in a future presentation to talk more about those details. So thank you very much again for this opportunity to present and yeah, with all providers and disciplines. It's been great continuing work in this dual specialty program that we've developed and continue to work with our audiology and ENT colleagues. So thank you.

Thank you. Excuse me. Thank you, Caitlin and Lauren, for sharing this unique population with us and how we can think beyond to help meet the needs of our patients. And thank you to all of our participants for your time today and to our experts from nationwide children's for their time and the talent they provided today. We are getting close to time for today's session, so we can now open the floor for questions.

If you have a question, please type them in the Q and a area below. We are happy to stay on a few minutes to answer them for you, so just feel free to type any questions in that box if you have them.

It looks like we have one question, and Ursula, I think this question might be for you. It says, for the autism population. What would you do. If you have a child who you suspect has autism but doesn't yet have a referral or any testing, but you really think needs it and you don't have anything to go off of to help you with testing, what would you do in that situation? I'm sure that's a really common situation for many of us in pediatrics.

So, yeah, that's a great question. So the first thing I would do is obviously, if you feel like there's any concern for autism, I would have, I would highly recommend contacting the pediatrician who referred for the hearing test and making sure that your concerns are known. And be bold and say that you have concerns for developmental delay and ask if there's a plan for referral and have a conversation with the parent saying, I'm seeing some concerns for development. Do you have these concerns as well? Or you can even say, are you concerned about development?

And if there's, you know, sometimes the parent will say, yeah, I'm a little concerned about this, that and the other thing. And if you ask the parent to give some more information about that, you can actually sometimes reinforce to the parent that they can ask for a referral themselves. And I, you know, sometimes it just is something that they need reassurance that they should and can ask for a referral from their pediatrician for a developmental evaluation. And you don't have to specifically say autism, you can just say, I'm noticing these developmental differences or they're not saying as many things or they're playing differently than other kids or whatever have you. So either empowering the parent to ask for a referral or saying, I might suggest to your pediatrician to seek out a referral for a developmental evaluation.

And that'll be part of my recommendation. So you can even tell the parent that that's going to be part of your recommendations. But from a standpoint of asking or trying to figure out what you can have to help you in your evaluation, if you have a medical record that allows for you to see the pediatrician's notes, most pediatricians will use some sort of screener starting at usually 18 months. If not at, if not 18, then at two years of age. Sometimes it's the McHat, sometimes it's a different type.

I don't think they use the cars as much any longer. But the higher the score on those types of screeners, the more obvious the issues are. And so sometimes if you see some of those screeners in your pediatrician notes, and it'll usually interpret it as like zero risk or not zero risk, low risk, moderate risk, mild risk. The higher the risk that probably the more challenging your evaluation may be. It's not a hard and fast rule.

We all have those kids who have it says low risk, and you're sitting there going, there's no way this kid doesn't need this developmental evaluation. So it's not a hard and fast rule. But you could look in their last pediatrician notes to see if they've done an autism screener and what it says and try to use that as a proxy if they don't have any other testing. So hope that helped. It does.

Thank you so much, Ursula, for sharing your thoughts on that. So we are actually at time now. So again, just a thank you to everyone who attended and again to our presenters for their expertise. And I will turn this back to Vaughn to provide the closeout information for you. Thank you.

Thank you to all these great speakers today. It was very interesting. And this is just a reminder to everyone about the exam. So please take a look at that and we will go ahead and end for today. Thanks, everyone, for joining us on continued and I hope you join us again.