Development of a Pediatric Balance Center: A Multidisciplinary Approach, presented in partnership with Seminars in Hearing

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- [Moderator] It is my pleasure to introduce today's presenters. Dr. Kay Bachmann is the coordinator of research for the Pediatric Balance Center at Cincinnati Children's Hospital and an adjunct assistant professor at the university of Cincinnati. Dr. Violette Lavender is the coordinator for the Pediatric Balance Center at Cincinnati Children's Hospital, where she also helped to initiate that program. With no further ado, I'll turn it over to you, Dr. Bachmann.

- [Dr. Bachmann] Thank you so much. Good afternoon everyone. I'm Kay Bachmann and really on behalf of myself and my good friend and colleague, Dr. Violette Lavender, we'd just like to say thanks to Audiology Online for giving us this opportunity. I largely credit Violette with the development of the Pediatric Balance Center at Cincinnati Children's Hospital 12 years ago. And since that time, we've gotten a lot of calls asking us, "How'd you do it? "How do we develop our pediatric balance center "at our center?" So thank you to Audiology Online because this seminar really gives us a chance to answer some of those questions for people who are looking to also do the same thing. Now you might hear us today talk about some specific manufacturers or specific equipment, some tools that we use, software, et cetera during this. But I assure you that neither Violette or myself have financial relationships with any manufacturers and we don't really endorse any particular piece of equipment or software. Now you might be someone who is just embarking on setting up your own pediatric balance center, or maybe you're a person that does vestibular evaluations on adults and you're just trying to consider whether or not you should open your doors to children. But either way after this course, you should be able to identify three team members that make up your multidisciplinary pediatric balance center list at least some potential referral sources, and you should be able to justify the need for pediatric vestibular evaluation and determine how realistic is it for you to start a pediatric balance center at your facility. Now when we first opened up our doors at Cincinnati children's and our Pediatric Balance Center, there was really only a handful of centers around the country, actually in North America total, that was doing vestibular evaluation on the pediatric population. And since that time, many more centers have

opened up as people have started to realize the importance of assessing the vestibular function of children. So maybe you're going to be one of those stars on our maps someday soon. But before you get started with a program, there's so many questions that have to be answered. And it can seem like a very daunting task when you start looking at all the questions. Such as who's going to be doing the evaluating and treating? How do I gain support for developing this pediatric balance center? What equipment do I need? How much is it gonna cost me? Where do I put the equipment? Who will refer patients to me? How do I get paid? Well, this can all seem very overwhelming and you might think, "Oh gosh, it's just too much, "I can't take it on." But I will tell you a great place to start is with your business manager. So your business manager is uniquely qualified. This is what they learned. This is their degree in college. How to write a business plan to answer all these questions.

So maybe your first question that you should answer is who's my business manager? So if you don't know who your business manager is, I suggest getting to know them very well because they can be very helpful when you're starting out. And then the next thing you're gonna need to do is educate. But not just yourself, you're gonna be educating administrators and you're gonna need to educate even physicians who still hold the common beliefs that children do not get dizzy. Or even if they do get dizzy, they compensate on their own. Or every time someone thinks of vestibular testing, they think of caloric. So you may get the response of, that children won't cooperate for the test. That's that's way too scary. And even if they do, what are the norms? What do normal kids look like? Well, believe it or not, testing children for vestibular dysfunction, it's not a new concept. But there were several pioneers in our field and they published several benchmark papers of starting in the 1980's, well into the 1990's and 2000's. And these papers actually studied and showed and reported that not only is it necessary to test the vestibular function of children, but it can be done. There are ways to test children and get really good, reliable results. And since those benchmark papers came out, the literature is growing, it's continuing to grow, and it has been ever since those papers came out. Now, people are starting to look at, how big is this problem

actually? Like what's the incidence of pediatric vestibular dysfunction in our population? What are the specific testing techniques that we can use with children to get good results? And there's also reports now showing the normative data for each of the tests that we can use with children. So the awareness of pediatric vestibular loss is on the rise. People are starting to really realize that this is something that should be done and can be done. Now so far what's been reported in the literature, is that in the general population, there's about a one to 5%, there's one to 5% of children in our general population that actually have vestibular loss. But of children with sensory neural hearing loss, we now know that up to 70% can have coexisting vestibular loss. And that makes sense, right? Because the cochlea is attached to the vestibular end-organ. So if there's something that's affecting the function of the cochlea or the hearing end-organ and nerve, that same thing could be affecting the vestibular end-organ and nerves as well. These numbers are probably underreported.

So the true prevalence is really unknown. It could be much higher, for a couple of reasons. You rarely hear the three-year-olds say to their parent, "I'm feeling kind of dizzy today." And you'll never hear that because children lack the vocabulary to express their feelings of imbalance or dizziness. And if they've had vestibular dysfunction their whole life, they're not really even aware that dizziness and imbalance is not a normal thing for everyone. In addition, parents that are actually seeing signs of imbalance in their child, they may just be blowing it off as the child being clumsy. So the prevalence is probably a lot higher than what's reported in literature. And it's important, there are a lot of important reasons for testing children. But one of the most important is to help determine the site of lesion, because once we can determine what the cause of the child's imbalances, we can start to determine the course of treatment. So we can get the children back out there playing and doing the things that a typical child does. We can also help rule out more significant diagnosis. Many of these children are worked up in neurology clinics, or just to regular physical therapy centers, sports medicine, to try to figure out why are they falling? Why are they clumsy or uncoordinated? So we can help kind of rule out even more significant diagnosis than

just vestibular dysfunction. Also, we can help with choosing the side for cochlear implantation. One of the big ones I always say is, we are alleviating the fears for the family. So half the battle is just knowing what is wrong with child or what's going on with your child. I think once we can actually diagnose a vestibular dysfunction or rule it out, then we can alleviate a lot of fears for those families. And as I said before, we want the children to be able to do the typical things that a child does, and do their, their daily living, their activities of daily living that they should be doing as a child. Running around a playgrounds, playing sports, hitting a ball, kicking a ball, running, and just having fun again. So I think we're kind of familiar. We're probably all familiar with the symptoms and the complaints of an adult that has dizziness. But you're not gonna see these with children. Children don't complain like this. But what we do see with children are gross motor delays, particularly in age to sit and age to walk. Children are falling, a lot of injuries from falling and just wiping out. Difficulty with reading acuity. If a child does not have a working vestibular system, they're unable to keep their eyes focused on the words that they're reading, particularly when there's head movement involved.

So if you think about a child that's in a classroom, looking up at the board and then looking back down at their paper to take notes, I mean, a lot of that is blurry for them because of a faulty vestibular system. And these kids are also not keeping up physically with their peers. Very difficult to keep your eyes focused on a ball while you're running. And if you're trying to kick that ball or keeping your balance while riding a bike. These kids are the kids that are sitting out, they're watching their peers have fun. They're sitting on the sidelines and they're really just not keeping up physically. And all of these can lead to other issues. So you can imagine the toddler that is unable to navigate their environment, unable to walk around freely. And when they can't do that and explore their environment, they miss out on making all those cognitive connections. And we can see a cognitive delay there. This can also lead to academic failure or put them at academic risk and with the difficulty with their reading and keeping their eyes focused on their work at school. Again, this puts them further at academic risk. And it can't be good for their mental health being behind in school, not

understanding a lot of their environment or navigating their environment and also not being able to keep up with their peers. So we're really looking at a bigger problem when we're talking about vestibular dysfunction in children. So you might say, "Okay, well who should I be looking at? "Kids can't tell me that they're dizzy. "But what population or what category of patients "should I be looking at to see whether they're at risk "for vestibular disorder or not?" So I wrote a few of them down here. Anybody with a cochlear malformation, EVA, partitioning defects, Mondini, this makes sense because your vestibular system and your cochlea are developing together in utero.

So any time there is any malformation in the cochlea, it's a good possibility there also could be malformations going on in the vestibular system as well. Cytomegalovirus. We now know what CMV does to hearing. And we monitor hearing all the way up until, throughout the first decade of life. But I think what's less talked about is the effect of CMV on the vestibular system. And just like in the cochlea, if there are, if there's something that's damaging that cochlea the cochlea or the hearing end-organ, it's very likely that there's gonna be damage in the vestibular end-organ as well, it's possible. So they're at risk for vestibular disorder. I mentioned a little bit before about cochlear implantation. We now know anecdotally from our physicians that cochlear implantation does put a child at about a 10% increased risk of getting a vestibular disorder or having a vestibular disorder just from implantation and the surgery itself. So those kids are at risk and there are syndromes that actually have coexisting, that go along with coexisting hearing loss and vestibular disorders. Anyone with an eighth nerve defect. So wispy nerve, absent nerve, auditory neuropathy, those kids are also at risk. Ototoxic drug use or vestibular toxic drugs in a patient population. Like our cystic fibrosis patients. They're at risk for vestibular dysfunction. Someone who's had a concussion is also experiencing dizziness, they may have some vestibular dysfunction and of course are migrainers.

- [Dr. Lavender] So I'm gonna jump in here and briefly go over some of the data that we've acquired over the last few years. It's a really interesting graph because when we

look at all the patients we've seen, or at least most of the patients that we had good data on from 2016 to 2020, what we found is that we could pretty much break it up into thirds. So the kids who ended up being central based on test findings, are represented in the gray, our patients who had totally normal testing, is in the orange. And then finally for our peripheral patients, they are in the red. There's a very tiny sliver up there that are undetermined where their findings didn't really point in one direction or the other, but they did have some findings. So what's interesting about this, is that when we break down just the peripheral patients, similar to what Dr.Bachmann described earlier, our patients with enlarged vestibular aqueduct syndrome are the greatest of our population.

So this graph only represents the past year's data. So this doesn't go back to 2016, this is just the past year. So our patients who came in with hearing loss, the greatest percentage of them had enlarged vestibular aqueduct syndrome. So I think it would be very fair to say that if you were working with audiologists in a clinic, that you could easily educate them about these disorders, that would be most obvious with also having vestibular loss as well. So the next group is cytomegalovirus. And what we're finding this group is on the rise because I think we didn't know who had CMV in the past, but now we're definitely aware of who has CMV. And they're able to treat those kids earlier and earlier. CHARGE association, almost all of those children are bilateral in our experience. The most common finding on the MRI or the CT scan for them is the absence of semicircular canals. So almost all of those kiddos are bilateral. Usher syndrome is another one. Obviously a certain type of Usher syndrome is associated with bilateral loss, any inner ear malformation such as Mondini dysplasia aplasia connexin. We don't really find that many kiddos with connexin in our lab who also have vestibular loss, but there is a couple. Branchio oto renal syndrome, and then I'm throwing a couple in the other such as like Waardenburg syndrome, an eighth nerve problem, those types of things as well. So that represents our data from the last year.

- [Dr. Bachmann] So now that we know who we're looking at, okay great, so we can diagnose a vestibular disorder in some of these populations, or at least know who's at risk. These kids will compensate on their own due to neuroplasticity, right? Well, that is an old thought. Because the latest research out of Boys Town has shown that children with vestibular loss do not naturally recover to levels of their healthy peers, particularly with activities that utilize vestibular input. So what should we do for these kids? Well, there's a lot of literature showing the benefits and success of vestibular rehabilitation in both adults and children. So what they have found is, or what they've shown is the earlier the intervention starts, the better it is for the child, so that they can keep up with their peers and we can sort of mitigate the problems associated with vestibular dysfunction. So who should be on your team then?

Let's talk about the key players and their roles. Hopefully I've convinced you that it is a worthy undertaking that we need to be testing these kids. There are a lot of them out there that actually need a vestibular evaluation so that they can be treated properly and develop along the same timeline as their peers. But who's gonna help you do that? So let's talk about these key players. So on our team and what I would suggest is having at least an otolaryngologist, audiologists, physical therapists, and you could bring in tertiary specialists, maybe occupational therapists, psychologists, neurologists, and you definitely need someone who's gonna coordinate all of these people on the team. But probably the most important person on your team is gonna be the patient and their family. So we need, they need to be the center of our team, and we need to be able to work with them. They need to be able to have buy in with all of us and communication with every team member and feel comfortable with what the team is recommending. I love this definition of teamwork for healthcare. So and I'm not gonna read it to you but there's some really key pieces in here. The team needs to be made up of professionals with complimentary backgrounds and skills. We don't want team members that all have the same skills and background because that's not gonna be as helpful to the patient. So what we want are people that have complimentary skills and backgrounds, so that we can have this collaboration and open dialogue with each other, and then we

can all share in the decision-making, based on our skills and our recommendations and knowledge, as to what will be the best outcome for the patient. So on our team here is a picture of our multidisciplinary pediatric vestibular team at Cincinnati Children's. We have three audiologists, which are shown on the top, in the top row here that's myself, Dr. Lavender and Dr. Castiglione. And then starting at the bottom left we have Dr. Greinwald. He is our otolaryngologist on the team and our medical director of the team. And then we have three physical therapists. They all have their doctorate and special certification in vestibular rehab. So let's talk about the role of each of those team members. So as audiologists, our role is really in the diagnostic piece of the team, the diagnostic evaluations, and what you need on your team are audiologists who not only have knowledge and training in vestibular assessment and diagnosis, but really it's key that they be able to work with children.

So we are all pediatric audiologists on our team, and we have a ton of experience working with children that as you know, the testing is can be quite long and we need the children to be able to work with us. And we need to be able to get them to do what we need them to do in order to get the information from them. We have one designated audiologist, who's actually gonna be the touch point for the patient and sort of guide them through the entire multidisciplinary process, helping coordinate their appointments, and they can answer any questions that the family has. So they're gonna be the contact person for the patient. This particular audiologist on our team also coordinates the entire team. So they're gonna schedule the team meetings, also lead the team meetings. And then if there are any further recommendations or additional referrals that the family needs, this audiologist is going to follow up with the family. They are the family's touchpoints. So they'll follow up and let the family know what was discussed at the team meeting The physician on the team. It's kind of important to have a physician on the team in my opinion, just because, not only for billing purposes, I mean there's some insurances that really require a physician to sign off on what some of the testing is. Not necessarily at our center, but I know that our center is not like every other center. So it just depends on your own place of practice.

But you need a physician who's knowledgeable about vestibular pathology and treatments. The physician really manages the patient's medical care. So if there's any pharmacological intervention or medical intervention that's needed, the physician that comes under their role. But also their physician is uniquely qualified to make additional referrals. So if we're in a team meeting and we determine that the child would be best helped by maybe seeing psychology or neurology, that referral can be put in right away, and there doesn't have to be a time lag for the referral. So this is best patient kit, best practice, to have best patient care here. But I will tell you that the communication, the open communication between the team and the physician, this is the key to the success of the program.

So being able to contact the physician whenever we need that physician to make a referral or make any additional recommendations let's say, that's gonna be key to the success of the program. Our physical therapists are not just your average run of the mill physical therapists. I would recommend if you are starting a program, to have your physical therapists go ahead and have specific training in vestibular rehabilitation. There are specific training courses throughout the nation for PTs and OTs. If you wanna go with the route of OTs, that's fine too. But there are some hands-on training, so not just lecture-based, but also hands-on vestibular rehabilitation training for them out there. The thing that's important about the physical therapists that are specializing in vestibular rehabilitation is they actually have the ability to evaluate the patient to see what is the nature of their balance dysfunction. Is it something musculoskeletal? Is it some other motor dysfunction that the patient is having, or is it truly vestibular dysfunction? So they're actually able to make that distinction. And we can't forget about support staff. They're so important to the program. Now this could be a dedicated individual or team of individuals that are gonna be able to be trained so that they can triage the patients needs through the Scheduling Center. They can check referrals, they can help coordinate same day appointments, particularly for our patients who come from quite a ways away. And we have a lot of patients that are actually coming from several states away. And so it's important for those patients to be able to

have coordinated appointments on the same day or two days in a row, et cetera. This person is actually the right-hand helper to the coordinating audiologists. They work very closely together. So once you've got your team together, where are you going to do this vestibular evaluation? The space comes at a premium and a large medical center. It's not easy to find space in an existing building, and find a room that could actually house your vestibular program. But I will tell you, in our program we span three different divisions. So we're audiology, physical therapy and ear, nose and throat. So not much has to be done to the physical therapy space, because all of their mats or equipment, the rehabilitation testing and all of their equipment is housed in physical therapy. In our center, we put our vestibular evaluation rooms right in the department with physical therapy.

So we're very close because in our space really overlaps. We sometimes use the same equipment they're using and they use some of our equipment as well. The ENT, their rooms don't have to change at all. They go ahead and evaluate the patient in their basic clinic rooms that they already use. But I will try to convince you that, we built our own space and we designed our own space. That was a luxury. Most people don't have that, and we understand that. But I will like to con convince you that you don't need a huge space to do a good vestibular evaluation on a child. Basically your minimum space requirements at bare minimum, You need a room that can accommodate a chair, a chair that can recline and also rotate like the one shown in the bottom left-hand corner of this slide. Manufacturers now have these chairs. These are a two for one. You can do a VNG in that chair as well as, as well as rotary chair. All you need is a rolling cart, you can put a lot of equipment on a rolling cart, like your laptop, your caloric irrigator, vHIT goggles, the electrode box for the vents, and then you can mount your TV or computer monitor on the wall. Down at the bottom of this slide is just a little schematic that I drew. This shows, this is a very small room. I mean you could even do this in a 10 by 10 room. With the reclining chair in the middle, you got your TV on the wall over here, you've got your rolling cart with other equipment on it. And one thing that I think is really key and important when you're setting up a pediatric balance

center, which is different than the adult balance center, is that little kids have come with an entourage. They have family members, mom and dad, maybe grandpa and grandma coming with them, several siblings. So you really need to have room for family members in your pediatric balance center. With COVID, I have a like a little asterisk here by that, because with COVID we're only allowed allowing each child to have two adults with them during the testing. But you can't just think about COVID. Once we get that under control and get a handle on that, you need to be thinking about the long-term pediatric balance center. So you really need to make sure there's enough room for family members in your pediatric balance center. And with that, I'm gonna hand this over to Dr. Lavender who will take it from here.

- [Dr. Lavender] Okay, thank you. Okay, thank you for having me. I'm gonna show a few pictures here of some pediatric balance clinics. I'm gonna thank Melissa Kane at Children's Hospital of Philadelphia and Kristen Baisley who helped me out with pictures from Rady Children's. These are adorable pictures of other clinics where they've really made their space their own and friendly for children. So right now I get to go through equipment with you. Hopefully I can explain this well enough. I'm going to actually go through the equipment in order of importance for a pediatric vestibular lab. So rotary chair in our opinion is invaluable because a lot of the kids tolerate it really well. They have pediatric size goggles. We say the ages that you can test in the rotary chair are birth and up. It's a test of overall VOR function. So whenever we have students come in, I always tell them that getting an like an SHA test or the overall VOR picture at different frequencies is kind of like getting sound field audio. You don't really know which ear is always responding, but you can get an overall picture of their vestibular function. Similar to VRA, where you can get an overall picture of their hearing function using both years. Some of the limitations that we have again, is that it's not ear specific. We'd love it to be, but it's just not. And it's very difficult for objective data in the tiny, tiny little ones. So I would say the under three population that won't wear goggles, you can put electrodes on these kids. And I'm gonna talk about that in just a minute. The cost is anywhere between 90,000 and 180,000. And the reason that it's so

varied is because you can get one of those chairs that's a chair B and G combo deal, or you can get a comprehensive chair that also does like off vertical axis rotation and multiple planes, those types of things as well. So for infants and toddlers, the benefit of rotary chair is that we can put the room camera in and actually look at their eye movements. So maybe I can't always measure exactly what their pupils are doing, but I can say yes when they go to their right, there's right beating nystagmus. And yes, when they go to the left, there's left beating nystagmus. So again, I can make some inferences on whether or not there a total bilateral weakness or that they actually have some function. We have actually found some limited success, really hardly at all, with putting the child on a parent's lap.

One, you're actually testing the mother and two, sometimes the kids are squirmy wormy and the mom's getting sick, so it's just not a good scenario. So we actually found a lot of success though using a five point car seat. So the kids are really used to an infant car seat. We don't go in the rotary chair. We actually have the mom buckle their kiddos in hand them some snacks, and then we say we're gonna go for a ride. And mom is standing there the whole time. We also, like I said, allow for snacks. And sometimes we tell the parents they can bring their baby blankets in or a passy or whatever makes them feel comfortable. And like I said, the parents can stand there the whole time. For our medium age kids, like two and a half to five, the toddler crew, we actually have small goggles that they can wear so we are able to measure. We can use a booster seat or a car seat. And most of those kids are getting at least the booster seat. And sometimes the children get really nervous because they're in the dark, even though their mom's there. So we often give them something sensory to hold, something to keep their little hands busy so they're not touching your goggles. Some examples would be like those balls that have the little nubbins all over them, those sensory balls. And sometimes we even give them a bump the light these like little light up one toy. And every time we take a break and we open up the cover, we let them play light show in the booth with us. The next most important test I would say would be VEMPs. So the nice thing about VEMPs is that you actually have some objective data

now and your specific data, and again, it's noninvasive and most of the kids tolerate it very well. If you can do oVEMPs and sit ups, you can actually extract information about the utricle and saccule pathways and the motor neurons to both the neck muscles and the ocular motor muscles as well. The limitations are, with oVEMP, because it requires participation, the children may not like electrodes right by their eyes, so for the little ones, we don't really even start doing oVEMP unless you have a super cooperative three-year-old. That's the cost there. So for infants and toddlers, you can see in this picture. This is a position we love putting the babies in. The mom puts her foot up and she kind of keeps his shoulders pinned back against her legs. So the natural reaction is rather than let your head fall backwards, is to hold your head up. And to keep the child interested while holding their head up, we blow bubbles, there's actually bubbles in this picture if you look closely. We can light up toys, we can let them drop a ball in a bucket for us. We have other toys that you like push number one and something pops out. Push number two and something pops out. But it's a good way to the kids engaged. And we only really need like about a 30 to 45 seconds recording. And for our older kids, now we can do things like use a cartoon.

So we actually have the algorithm with the intelligent hearing system computer that we have, where it actually plays a cartoon on the TV. If they keep the contraction and hold their neck muscles appropriately, the cartoon plays. If they don't, then the cartoon stops. So the children learn very quickly how to appropriately hold their neck contraction so that they can keep watching their cartoon. We also have other fun ways to do it, again, bubbles videos, iPad, those kinds of things, anything to just keep their head held up in that position or in the case of oVEMPs eyes looking up in that position so we can measure. And for some of the kids, you can just get a quick measure on each ear. So you're only really looking at the presence or absence of oVEMP, and you can at least get some information that their ear is working or it's not working. VNG. So while we all in audiology in the world of pediatric audiology, would love to get rid of VNG, it's been around forever. There's just still a place for VNG. Typically we can start this around ages five and up. We're testing things like calorics, ocular motor pathways,

positional testing for BPPV. Those are the types of things we can gain from a VNG system. The limitation is it's obviously very difficult for kiddos to keep their eyes open during calorics. Some of them get very scared or nervous. Again, we don't even really start this until they're five and if they're cooperative at five. Sometimes I do wanna say, we love to do the warm caloric irrigation screening if everything's looking good, but some of the kids do not tolerate a warm bath. We always say we can tell the point where children move from pediatrics to adults because adults love everything warm. And if you have ever worked with adults, you know that they're like, "Oh, I hate the cold air in my ear, it's so irritating." But the kids actually do really well with the cool air in their ear. So sometimes we have to do a monothermal cool irrigation, which we know in the literature is not as effective as the warms.

But once again, we're looking for presence or absence, were we able to turn on that pathway on this ear? Were are we able to turn on the pathway in this ear? The manufacturers do have small fitting goggles, which is nice. And there's normative data in the literature for most of these subtests. We definitely know that the ocular motors can be a little bit shifty from research that's been done. Sometimes there's extra extraneous eye movements. So just be cautious when you're doing really little kids with optokinetics and smooth pursuits, for example saccades. And the other thing I wanna tell you is, as you choose your system, make sure that it is able to track a large pupil. Pediatrics have very large pupils, and sometimes if you get the wrong system, you're not able to actually track their pupil. The next test I wanna tell you about is video head impulse testing. Up at the top you're gonna see a couple of their manufacturers that are out on the market right now. There actually is another manufacturer that is in Europe, which actually uses a touchless tracking. So they don't wear anything on their face and a camera faces their eyes while you move their head. So it sounds really promising in the pediatric population. Hopefully we can get it over here soon. But we can test usually ages three and up just based on the Goggle participation. We are able to get information from all six semicircular canal planes, which is really nice. And the limitation is the goggles slip. Because they're so large, and they have little tiny heads,

and their hair is so silky and soft. Unfortunately, the goggles just slip. So we have to make some accommodations to make sure that they don't fall down. There's really no touchless options available in the United States right now. So hopefully we get that soon. The cost is on the low side compared to the all the other equipment. But as we know, there's still not a code, a CPT code for video head impulse testing right now. So if you're kind of prioritizing your information, this gives us information which is awesome, there's just no CPT code at this point for a vHIT. Some of the accommodations that we've made for vHIT for children is a use of a small sticker. And this is Melissa Kane's photo, I love it. But this is similar to what we have to. We put a strip of Velcro on the wall, and she just put different size stickers on the Velcro and you can pop a sticker up there and have the child describe it and talk about it. And then you can switch the sticker and do another one. And that way they keep their gaze interested and forward on the sticker the entire time. And that's all they need to do. They just look at a sticker while you quickly and swiftly move their head in the different planes of the semicircular canals. There is normative data available. And our own center we published data a few years ago on all six canals. And what we found is that the lateral canals are the easiest and most reliable to test.

So if you're doing little ones and you have limited time and cooperation, at least you can get something on them that's pretty reliable. And the data shows that it looks very similar to adult gain data, which is nice too. So really no extra, any assigned movements are really showing up in our pediatric data. We also are working on a study where we can show a cartoon. So we actually have a piece of Velcro on an iPhone and we pop that up onto the Velcro's a strip as well. So that way if the kids are not focused on the sticker, they can actually watch a tiny video on a screen. The kids can sit on their parent's lap here. So this kind of helps anchor them down so that they're not swinging around and moving. We also can use a footstool to kind of keep their legs from swinging because we don't want any movement except for their eyes. So if you add extra movement into their body, and again, these are tiny little children. So if you move their head quickly, sometimes their whole body will move too. We really wanna

anchor them and stabilize them. Another way we could do that is just having them sit crisscross applesauce on the stool. We also use a foam or a washcloth or even a low ponytail to kind of hold the goggles from slipping down. So posturography, we can test ages three and up on this one, there is normative data in the software for three and up. And we're looking not very much at site specificity, but we can look at their static balance. And the cost, this is an expensive piece of equipment, actually now because of reimbursement, we really haven't done so much CPT, so much posturography lately, but our physical therapist typically does it. And that helps her with her treatment plan as well. It's very easy to test. There actually is a CPT code specifically for just SOT. Now if you don't wanna do the motor control and adaptation subtests as well, and you just wanna do SOT where the normative data is for the little kids, you can just go ahead and do SOT and just bill for that.

So for vestibular rehab, there are lots of different tools. I'm not gonna go into all of these, these are not my specialty. But our vestibular rehab therapist has told us that these are some of the standardized tests that she used. She also use things like cloud pillows, rocker boards, bikes, for different balance tools. And of course she uses computerized dynamic visual acuity, which is part of our old posturography machine. Let me just back up our posturography machine, the one made by NeuroCom is no longer available. I believe the replacement comes from Burrtec, and they do have the SOT. It kind of has like a virtual reality feel to it. Next we're gonna talk about questionnaires. So there are three different questionnaires that I know of, or two I should say, specific to vestibular symptoms in the pediatric population. The pediatric dizziness handicap inventory helps rate how much the dizziness is affecting the children. And the symptom questionnaire kind of helps quantify if it's what the diagnosis could be in the end, based on just answering some questions about their symptoms. Finally the ages and stages. That is a questionnaire that you can give to patients. It's divided into three subsets. There is the fine motor, the gross motor and the speech sections. And you can look to see if your patients are on track with their different milestones, month by month, up until age six, which is really nice. We simply

pull out the gross motor section and have the patients like, especially our hearing impaired patients fill that out, so we can see if they're on track with their motor milestones through age six. So the big question is, how am I going to get patients into my center? What I can tell you is, the majority of our patients come from our ENT department and our neurology department. Interestingly, we started a program with our school, local school for the deaf a few years ago, where we taught the audiologist how to screen the patients. And she started screening all the kiddos there that have hearing loss, and she started referring over to us. So that became a referral source for us. Audiology we laugh internally here because our audiologists are, they don't always refer to us. But a lot of times they go and tell the ENT this patient needs a referral. So it does end up coming through ENT. But our audiologists we always say, "Oh, we need to beef up those referrals," but we have trained our audiologist to do some screenings. And they're really good about, like I said, telling the ENTs, "I think this patient might need a vestibular screening."

So when you build your referral sources, there's multiple things you can do. We worked with our marketing department and came up with like a flyer for example, it's a two-page glossy flyer, or front and back I should say. But you wanna start building your relationships. And with education, you can go to your schools, your internal hospital departments such as cancer research or, ours is called CBDI, which is blood, cancer, yes, blood, diseases, institute, thanks Kay. But we can also work with our pediatricians, our local ENTs, our administrators, all of these people we can reach out to with education. We can create PowerPoints and go and talk with their lunch break, there's different things we can do to work with these different groups so that they can know what a vestibular center would do for their population. You can also teach vestibular screening. So if you go into the literature, there's different ways we can do that. You can do a head impulse test, you can do a standing on one foot. You can do asking questions, you can look at Kristen Janky's research on what are the motor milestones that you need to look at, but you can simply teach these easy screenings so that people can screen their children such as your audiologist on your staff or

locally. And of course, you can advertise on your website or send out the flyers. This flyer that we made goes out to local pediatricians and ENTs in the area. So we're gonna talk about the logistics and how we implement everything. Alright, so as you prepare to open your clinic, you want to have a defined leader. And I will tell you, our leader here at Cincinnati Children's is fluid. We have a leader who builds us up in research. We have a leader who keeps all the equipment up-to-date and make sure that we're getting the appropriate trainings. We have a leader who runs our meetings every week and sets the agenda. So for us, our leader is not one person but many, but it's definitely that we have roles that we are defined in, in leadership. Next you wanna identify your team. And dr. Bachmann already described who your key players are. So as you're building your center, you've defined your roles, you want to identify your team.

Finally, you wanna figure out a good meeting schedule. Because it's just not enough to have all these key players and these individual evals. You wanna bring it all together so that your whole team is on board and that you're meeting regularly so that you can talk about your patients and the follow-up. And make sure that you even complete the loop with how are the patients who have been in vestibular rehab for three months, how are they doing? So that you have that full cycle there for you. Alright, so as you prepare to open, there's a few things that we need to know. One is we need to collect normative data. So it's really important that as you open your center, while there is normative data in the literature, everyone is different, everyone's equipment is different. The way you test is different. We wanna make sure that you know how to use your equipment and you know what results you're expecting to get. You're gonna wanna order lots of prizes and stickers. So as you're building your center, you're going to look and say, "kids love prizes, kids love to be bribed. "This is a long test." So it really does help to have an arsenal of fun things for the kiddos, ready to go. You wanna find coworkers who have energy. So as you can probably tell, Dr. Bachmann and I love our jobs, and the best part is we get to work with children all day. But you definitely wanna find people who are pediatric audiologists. I've been in centers where they've assigned

people to go work in the vestibular lab. And that never works out. Because people do not, just because you're an audiologist doesn't mean you're a pediatric audiologist. And just because you are a pediatric audiologist, doesn't mean that you're a vestibular audiologist. So you have to find the right balance of person who can really commit to having a two-hour appointment with these patients. And team testing. So one thing we believe heavily in here is team testing. So it's just not enough for us to go and test these patients alone. We really wanna have one person dedicated to working on the computer and one person dedicated to working with the patient. So it's very important that you don't overlap. So if somebody is working on the computer, they're gonna be looking at the data, they're gonna be pushing the buttons. The other person can completely give themselves to the patient. That way there's a trust there with the patient. The patient trusts the person who's working with them, and they're not running back and forth to check equipment or goggles or anything. It's just, it's a situation of trust.

- [Dr. Bachmann] Okay so let's talk about, sort of how it works in our center. So as we can see, we just go through the different boxes here, starting at the left. When the referral's placed, we received that referral by the scheduler and the scheduler will, if they notice the family's from ore than an hour drive away, the schedulers will, the scheduler will have to work on getting that family the appointments for the same day and coordinate all of that. What typically will happen, once that scheduler notices that families from far away, the audiologists, the coordinating audiologists will be contacted, and the audiologist will then contact the local physician for all of the needed referrals. If there's only a referral for audiology vestibular evaluation, then the physician will be contacted and we can ask the physician to put in a referral for physical therapy, vestibular evaluation as well. At that time, the family's then scheduled for the same day, PT and audiology, both for vestibular evaluations, the physical therapist looking more functionally at the patient, the audiologists we're doing more of the diagnostic piece, more data-driven, and then if needed, the ENT will also be scheduled for that patient as well. At the red star here, that's where the evaluation takes place. So the

patient comes in, they have all their evaluations, And then about one to two weeks later, the team meeting will take place. So the team will meet and talk about that patient. And what findings each one of our disciplines found with the patient and what our recommendations are. If there are additional recommendations or referrals needed, Then the coordinator of the team will call the family. Remember they're the touch point with that family, and they will contact the family and discuss what occurred at the meeting and if there are any additional recommendations.

- [Dr. Lavender] Okay, and so finally I wanna one more time go through why the meetings are so important and exactly what we're doing when we see the patients. And then we'll have some time in a few minutes to answer any questions that you may have, and we're happy to email with anyone as well. So I'll go through this last slide here. And like I said, we're open for questions after that. So the first one I wanna tell you about, is why we established meeting times. So it's really important to have all your team members agree on a day and how frequent you can actually do these meetings. So at first, we really, really wanted to meet every week. It was very important to us to do that. Unfortunately, it just doesn't work with everyone's schedule in our facility to do every week. And it was really hard to find a time and day where we could block patients out and really be in the same location, we have like 11 clinics around town. So what we agreed upon is that we would meet every other week, every other week during our lunch breaks and discuss the patients. And now because of COVID, I think one of the has that has come out is that now we meet remotely. We didn't before, but now we do. The other benefit of establishing the times with all the disciplines, I think it's important to have all your disciplines there. You really wanna make sure that you have all those layers for that intelligent conversation for this patient. You want your PT vibe, you want your, say from the ENT physicians, you really want, if you can bring in a neurologist and a special patient, sometimes that's important too. But regardless, you definitely wanna have all your key players there for your meetings. Next you're going to establish care coordination. So it's really important as we said before, to establish, well I'm sorry. So first I'll say you want that team member who's leading the

meeting. So Micheal, who is our awesome audiology team member, she's the one who coordinates all of our meetings. What she does is she puts together an agenda where she has the patient, their medical record number, the date they were seen by PT, the date they were seen by audiology, the date they were seen by ENT, who referred the patient over, and then what the findings of their evaluation were. And then this is all nice and put into a document that's like on a spreadsheet. And she shares this with us every week, so that we have an organized way. And the last column is follow-up notes. And so this is her place where she actually puts in, what is the plan of action going forward, and we make sure that we actually check the box. Yes, we did call this family. Or yes, we did send them to neurology or yes, we did go ahead and send them the ophthalmology. But this is a nice organized way that we know exactly who's on the agenda every week, and who are we discussing at each team meeting. And then either the team leader, which is Micheal or any of us, might contact the family for further treatment. So maybe I made a great connection with mom that day, and it's my responsibility then to reach back out to mom. Or maybe Kay here, found out that, as she was working with the patient, that she understood that what her daughter was going through this patient's daughter was going through, was similar to what her daughter has gone through in the past. And so she made that connection and therefore, they wanna go ahead and follow-up together. So it's just really good patient care to have this good communication with your patients. And establish a follow-up plan. So it's so important as a team that you check in with each other.

So for example, maybe Gretchen our physical therapist has been working with a patient for six months now, and it's just not going anywhere. She's like, "Oh, I'm just really stuck. "They haven't moved far in their process." So she brings them back. She asks Micheal, "Please put them on the agenda, "I wanna discuss them on Thursday." So then we rediscussed this patient, and it's a good opportunity for us to say, "Maybe she actually needs some migraine medication. "Maybe this is beyond "what just physical therapy can do alone. "Maybe she needs some additional help." And so our physician may say, "You know what, "maybe I'll start her on a trial of Inderal "or maybe

I'll start her with this, "or maybe we need to send her to neurology "or the headache clinic." So I definitely think it's really good for the success of your team to check in with previous patients that you've seen. I know for us, sometimes we were following up with these kiddos with CHARGE association and what we found is that all the patients lacked was information. The parents were never told that they're severe developmental delay that these kids were having was because all of the senses from their vestibular system were impaired. So these parents never knew this and they required education. So rather than bring them in for big appointments, sometimes we just bring them in for a check-in with our physical therapist and she makes it an extra long appointment because she knows there's a lot of information to share there. So that's just kind of our situation that we have at Cincinnati Children's. I can tell you over the years we've worked with other centers, and they've taken this like little model that we have, and they've made it even better, which is so awesome and amazing to see. I can tell you for one, and I'm just shouting out to CHOP here, that they have one day a week where they have a whole clinic, where the ENT is in the clinic, the PT in the clinic and the audiologist, they're all there on the exact same day in the same location. And then they rotate these patients around throughout the day to see different disciplines, and they discuss them right there on that day. So the patient goes home and actually walks away with the plan of care from every discipline, which is awesome, such a great idea. Unfortunately we don't have the ability because we have so many locations here, to get that all together on one day, but maybe in the future, I love the idea. So I think we are ready. I'm gonna grab Kimberly or Elizabeth, whoever would like to jump in, but I think what are ready to take some questions if anybody has any.

- [Moderator] Yeah, absolutely. Thank you guys so much for a great presentation. The first question that I have is just what's the greatest piece of advice you can give, as somebody who's getting started in opening a pediatric vestibular clinic, and maybe a better way to phrase that question is, what's the thing you wish you would've known before you guys started that you can tell us now?

- [Dr. Lavender] Alright, I will jump in first here. I think it was said in our talk but I'll reiterate it. If you don't have a great physical therapist, a pediatric physical therapist working with you, then you may not, you may wanna reconsider opening because it's one thing to be able to diagnose these kids with a problem, but almost all of them end up going to physical therapy. This is not like the adult population where they're getting steroids in their ears, or they're going to be on medicine for the rest of their life. This is a different group of kids. We wanna rehab them and get them back out to playing. So I would say if you don't have a great physical therapy combo or collaboration in your area, it doesn't even have to be at your center, it might be with someone in the community, then really reconsider what you're doing because it's like I said, you wanna just complete that piece for them. Diagnosis to treatment.

- [Moderator] I love that, yeah. How do you talk to parents about, about the diagnosis of vestibular impairment?

- [Dr. Lavender] Okay, I will jump in on that one. So we definitely set that up from the beginning that we were supposed to be the ones who delivered our piece of information. I know some centers, they let the ENT determine what the course of action is, but we've really set it up so that we are the ones telling the answers at the end. And I will tell you, one thing that's worked for us is we often say at the beginning of the test, "our job today is to rule in or out, "the presence of an inner ear problem. "So we're really gonna be focusing in "on what the inner ear is doing." So that's how we start the conversation. And so then when we go through the results we say, "So today we told you that our main job "was to rule in or out the involvement of the inner ears. "And we can tell you "that the good news "is your child does not have an inner ear issue "based on our testing." So that's just how we start it. I always think it's important to send the big message upfront. We don't usually go through all the individual tests, per se, but we often get the big picture message. Contradictory, I would say, if they did have a problem I would say, "Again our job today "was to look at the big picture of the inner ear "and how it's functioning. "And what we can tell you "is that we actually did find an

issue "with your child's inner ears today, "specifically the right ear." So just as an example of what we would say. Did I answer the question okay?

- [Moderator] Yeah, I think so. I think that gives really some practical helpful advice for people. Another question that just came in, developmental milestones seemed like an important component. How often is that information in the EMR and how often does the audiological evaluation discover the missed milestones?

- [Dr. Lavender] Okay, so I think that in a lot of cases, the parents will often tell us, "Oh, he walked at 16 months," and I think 16 months is on the upper end of normal and so parents often don't worry about that. Or what we found a lot of times is that the patients are already in physical therapy because they're not walking by 18 months. And so it is our job to sometimes help get them to the correct physical therapy. It's one thing to go through strength training and balance therapy, it's a whole nother thing to get therapy that is addressing the fact that you're missing an entire sense. So sometimes our kids are in physical therapy and then our audiologists say, "wait a second, "your child's in physical therapy, "oh, and they have a hearing loss, "mm-hmm, maybe we should get a vestibular eval." And then after we see them and confirm that there's a bilateral loss, a lot of times we'll say, "You need another evaluation, "I know it sounds like a lot." Then they'll see our physical therapist, and she'll help work with their other physical therapist to coordinate a treatment plan, to add extra goals, to address the lack of vestibular input.

- [Dr. Bachmann] Yeah I'd like to jump in on that as well. So if you're just starting out, I mean, this is a key question that we have on our vestibular history form. So we always ask every parent, "When did your child walk?" "Were there any developmental delays at all?" And based on the research that's come out of Boys Town with Kristen Janky's work showing that children with hearing loss in particular that did not sit before at seven months of age. So if they sat later than that, and if they walked later than 15 months of age, that those are delays. So those are gross motor delays and those

children are at risk for vestibular disorders. So it could be as easy as a question. If you have the audiologists in your practice or in your center, just ask the questions. When did your child sit? When did your child walk? And do you have any concerns? Parental concern was also a big one for determining who is at risk for vestibular disorder. So those are just three easy questions that any audiologists fitting hearing aids on children can just ask.

- [Moderator] Thank you so much for today's talk Dr. Bachmann and Dr. Lavender. We really appreciate everybody who participated in today's course and asked great questions. We look forward to your feedback on the course evaluations and hope to see you in a future course on Audiology Online and specifically in the seminars and hearing course. Our next one is next Wednesday, that we'll be talking more about pediatric vestibular assessment. This concludes today's course, and have a great rest of the day everyone.

- [Dr. Lavender] Thank you.