

NCHAM

Webinar Series: Hearing and Congenital CMV: Overview of Screening, Diagnosis and Interprofessional Care for Infants and Children with cCMV

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>> ALYSON WARD: Good morning, you should be hearing audio right now. If you are not receiving a strong audio signal, adjust the volume of your settings on your computer or your headset. If you still do not have audio you may need to sign off Adobe Connect and maybe even your computer and come back on. Hopefully that will get you a stronger connection. In the meantime, I'm going to ask you to rate your audio transmission so we have a good sense of what people are hearing. So please go ahead and enter in your audio quality.

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(Standing by)

>> ALYSON WARD: Good morning, thank you for joining us for the fourth webinar in our series of CMV Research and Innovation webinars. We will be starting the webinar shortly. In the meantime if you're not hearing good audio, you may need to adjust the volume on your speakers. Or log out of Adobe Connect and come back in. If you still are having issues, please contact Daniel. His number is listed in the bottom of the text box that you see on your screen here. As well as the lower left-hand side.

(Standing by).

>> ALYSON WARD: We'd like to get a good sense of who is joining our webinar today, if you could please enter in what represents you best for our presenters and for the conference planning staff, that would give us a good sense of who we have joining us today. It looks like we have a good mix. We have some audiologists, some EHDI coordinators, educators, families. Excellent.

Okay. I'm going to go ahead and push the record button. This meeting --

>> OPERATOR: Audio recording for this meeting has begun.

>> ALYSON WARD: This webinar will be recorded as I just mentioned and will be posted on infanthearing.org and CMV.usu.edu within the next few days. We are -- my name is Alyson Ward. I work at the National Center for Hearing Assessment and Management. Located at Utah State University. We are the National Technical Resource Center for early hearing democracy and intervention programs for all of U.S. Canada and U.S. territories. We are also the primary directors of the CMV Public Health & Policy Conference. And this webinar is sponsored by both NCHAM, CMV Canada and the National CMV Foundation. To just do a few housekeeping items please do not select full screen mode on Adobe Connect. You'll lose some of the functionality of the program and then we will be doing questions at the end of the webinar and I will open up a Q&A box.

So the CMV Public Health & Policy Conference, right now we would be in Ottawa Ontario. Unfortunately COVID-19 kept us from doing that. But we do feel really grateful that we have identified some amazing presenters to conduct the webinars this week. And we have also been able to reschedule the in-person schedule. So please save the date for August 22nd through 24th. In 2021. Again it will be in Ottawa. And just like we do at the conference, we like to start with a parent story. Because we really feel that these stories represent the why we do what we do. So this morning I'm going to introduce Jasmine Webster. And Jasmine is from Birmingham, Alabama she's the mother of two amazing boys she has an 11-year-old and 4-year-old Jackson who was diagnosed with CMV since her son's diagnosis she has tried to make sure that everyone knows about CMV and how it can affect a pregnant woman and her unborn child so Jasmine if you would unmute yourself and tell us a little bit more about your story in Jackson, that would be great.

>> JASMINE WEBSTER: Hey, everybody. My name is Jasmine. I have two children, both are boys. My oldest is 11 and my 4-year-old is the one who has the CMV diagnosis. I found out that my son had CMV when I was three months pregnant due to low amniotic fluids and placenta problems. They did an ultrasound and found several calcium deposits on Jackson's brain.

My original due date was December 10th, 2015. I was induced and delivered on November 6th of 2015. Jackson weighed 4 pounds and 5 ounces and was immediately taken to the NICU. We only stayed in the NICU for two weeks to finish the course we made it home before Thanksgiving and we continued to take the Valganciclovir for six months I was so nervous being a mom to a special needs child because I didn't want to

do anything wrong. There were no type of support groups or any good information about CMV. I was worried about what people were going to say about me and my child has CMV. Because when you Google it, herpes immediately pops up. So I didn't want anyone to assume that I was the reason why my child was sick.

So as Jackson got older, I started doing more research. And his journey became very like super -- much more difficult. More medications were added. More specialty doctors. Appointments, therapists and so much more. Since my years of taking care of a child with CMV I like to advocate and let everyone know how differently CMV can affect everybody during pregnancy and when your child is born. I wish there was more information that could -- I could give to help people become more educated about the disease. And you know do support groups. When I compare Jackson's CMV to other families, I realize each child does not suffer the same from the beginning of my research I did learn that hearing loss was one of the most common side effects with CMV. I also learned that with the CMV diagnosis that insurance doesn't really cover a lot of equipment and medications that are needed for your children so it causes kind of a financial burden on some families. As a mother it's very hard to kind of see my child take up seven to ten different medications three times a day and still not know whether I'm helping him or making him comfortable where he can play and learn more. I struggle with trying to treat him as a normal child. As far as playing with his brother and uncle and other kids. And him not getting sick where he'll be in the hospital and shut down.

I really have high hopes for him.

On the good side, as of right now, Jackson will be five in November. We are practicing walking in a gait trainer. We are practicing communication on an Eyegaze. We also attend special education preK. And we are currently on a seven-month hospital free streak. And I'm looking forward for it to keep going. And that is all.

>> ALYSON WARD: Thank you so much Jasmine. I'm really happy to hear that Jackson is doing so well and he has a mother that's ready to fight for him and advocate for his every need. So thank you for sharing your story.

>> JASMINE WEBSTER: Thank you.

>> ALYSON WARD: Okay. We are going to move into the presenter presentation today. Hearing and congenital CMV "Overview of Screening, Diagnosis and Interprofessional Care for Infants and Children with cCMV". This is going to be presented by Albert Park and Angela Shoup let me introduce them quickly and then I'll turn the time over to them. Dr. Angela Shoup is the Executive Director of Callier Center for Communication Disorders and professor of brain and behavioral sciences Communication Sciences & Disorders at the University of Texas Dallas she's also a professor of otolaryngology at the University of Texas Southwestern Medical Center. Dr. Shoup has published articles and textbook chapters on audiological procedures and implantable hearing aids. She has been an invited speaker at the national and international meetings. She served as President of the Texas Academy of Audiology,

Chair of the ethical practices committee for the American Academy of Audiology, Chair of the American Academy of Audiology foundation Board of Trustees and is a member of the Board of Directors of the American Academy of Audiology she is currently serving as the President-Elect of the American Academy of Audiology and as Vice Chair of the National Academies of Practice and Audiology. So she definitely has a lot of accolades behind her.

And then Dr. Albert Park is the chief pediatric of otolaryngology at the University of Utah he's the Principal Investigator for an NIH funded multi-institutional clinical trial to determine whether the antiviral drug Valganciclovir can improve hearing outcomes for children with congenital cytomegalovirus a study for childhood hearing loss he also established a CMV Working Group comprised of pediatrics genetics, infectious disease, otolaryngology, audiology, neurology Department of Health and ARUP laboratories to streamline clinical and research initiatives in this field. I do have to say really quickly that I'm so proud of myself for saying otolaryngology right so many times.
(Chuckles).

>> ALYSON WARD: So I'm going to go ahead and turn the time over to Dr. Park and Dr. Shoup. And take it away.

>> ALBERT PARK: Alyson thank you so much for giving us the opportunity to present at this great conference and it is disappointing that we're not altogether but I think this is a great forum to share some of the exciting work that's being done by both Dr. Shoup and myself. I also wanted to acknowledge Mrs. Webster's presentation. I think that really hits home in terms of why we're here and what we're trying to do to advance and improve the care for these children.

I did have a question though for Mrs. Webster because I think I must have missed this but I wasn't quite clear if Jackson also has hearing loss, too, could you clarify that.

>> JASMINE WEBSTER: No, sir, he does not he's actually fortunate enough to not have hearing loss so we do check his hearing every six months.

>> ALBERT PARK: Wonderful. Thank you for sharing that. And I think you bring a really important point about for families in terms of seeking knowledge and education. Unfortunately a lot of times we go to Google and that's not necessarily the best way to really learn about these sort of conditions and this has certainly been part of the emphasis for this meeting as well as what we're here for.

So I'm just going to go ahead and proceed with our presentation. I'm going to talk hopefully relatively briefly to set the stage and have Dr. Shoup talk really about some of the really great diagnostic and screening modalities that are available for children to assess hearing. And then I'm going to try to finish up with some of our recommendations that I think you'll find relevant.

So let me just figure this out. So I'm just going to go ahead and advance -- does that work -- did that work okay.

>> ALYSON WARD: Yes that works perfectly.

>> ALBERT PARK: So the objective of our presentation is really to share with you

the impact of congenital CMV on hearing and Dr. Shoup will talk about screening and diagnostic tests for hearing and then I'm going to talk a little bit about some screening modalities because I think this is really an exciting time for us with respect to what's happening with early identification and then maybe talk a little bit about some of the pearls that one can do because once you diagnose a child with congenital CMV then the next question is how to provide the best care, evaluation and treatment for these children and we'll share some of our insight on that. So in terms of the impact, sensorineural hearing loss is by far the most common sequelae from congenital CMV infections. It's the most common if you look at all hearing loss especially congenital hearing loss it's the hereditary genetics has dominated the research and unfortunately CMV hasn't been emphasized until recently until now there's been a much greater understanding and interest in this and again I think this is exciting this is happening it does make up a significant portion of children with hearing loss maybe up to 20% of all children who present with hearing loss could be attributed to CMV. And the CMV screening I think is really important. In terms of the issues that many of these children often present with no obvious signs or symptoms of infection. And thus, the need for hearing testing exists.

So I'm going to let Dr. Shoup now talk about some of the screening and diagnostic modalities that are available. And I think the take-home message -- I don't want to steal all her thunder but one thing I want to share and emphasize is really any child of any age should be able to undergo a diagnostic hearing test. That was really a problem I think sometimes on occasion we come across this in our practice that kids are not getting tested when they really should and again I'm going to leave this to Dr. Shoup to discuss further.

>> ANGELA SHOUP: Thank you again for having us here today. And I do apologize this is going to be a bit of a review for the audiologists in the group but I'm hoping that this will help some of the other professionals understand a bit more about the process that parents undergo when their child is having hearing screening and then has to return for multiple additional tests.

I'm also hopeful that the parents in the group will glean some additional information from this, as well. So when infants receive a hearing screening at birth they will have been assessed with either otoacoustic emissions or auditory brainstem response technology both of these tests will perform hearing function and for both tests the infant must be very still and quiet that also applies when they come in for diagnostic testing if they need additional testing after the screening. The test environment should also be relatively quiet. Typically the screening test if both situations are met will not take very long and if your infant was screened with otoacoustic emissions the screen would be similar to the picture in the right-hand corner. This is a child receiving an OAE testing this is a small probe like an earplug placed in the ear canal it has a sound generator and very tiny microphone as sounds are presented in the ear canal responses from the cochlea or inner ear are collected and analyzed the cochlea houses the sensory

structures of hearing and these sensory structures are referred to as hair cells.

The otoacoustic emissions test gives information about the auditory pathway from the pinna to the inner ear where hair cells are located. In the upper left hand corner you can see a baby receiving an automated Auditory Brainstem Response screening for this test, electrodes often referred to as sensors especially when we're communicating with families are placed on the head, neck, and shoulder or possibly the cheek. Electrodes are embedded in a sticky gel pad to hold them in place and keep them attached to the skin. The little sensors or electrodes are picking up brain activity that's elicited by sounds presented through earphones while infant is resting quietly this test will provide information about the auditory pathways from the inner ear to the upper levels of the brainstem as sounds are being processed by the brain in screening with either otoacoustic emissions or Auditory Brainstem Response a stimulus is provided at a single loudness level with a screening test you are not looking to find the softest level at which a baby can hear you are also not looking at how a baby can hear for a bunch of different pitches or frequencies. You are just looking to see if the baby should have additional testing.

So a single loudness level is presented. And if a response is obtained the infant is said to have passed the test.

If a response is not obtained, the infant is then referred for further testing to determine if there is a hearing difference and if there is a hearing difference to characterize the infant's hearing ability across multiple pitches and determine the appropriate treatment approaches.

Okay. One second.

(Standing by).

>> ANGELA SHOUP: Okay. Did the next slide come up?

>> ALYSON WARD: Yes, it did.

>> ANGELA SHOUP: Thank you.

>> ALYSON WARD: We're good.

>> ANGELA SHOUP: I couldn't see that come up, thank you. When an infant refers on Newborn Hearing Screening or suspected of having hearing difficulties, it is necessary to determine the softest level at which the ear and the brain can respond to sounds at a variety of pitches. It is possible for the infant to have perfectly normal hearing at one pitch and have significant hearing difficulties for other pitches.

For many conditions it is actually the higher pitches that are more affected by hearing difficulties. So an infant or child may hear normally for the low pitches but not be able to hear in the high pitches.

In that situation they would not be able to develop speech and language appropriately. So this is why it's extremely important for us to determine how well an infant can perceive sounds at multiple pitches across the sound spectrum and in most cases we are much more focused on the high pitches if we are not able to get all of the information necessary.

For this reason, a diagnostic ABR is going to take a lot more time than a screening test is going to take. For a diagnostic ABR the softest level at which sounds are processed by the brain at multiple pitches must be determined.

On the left-hand side of the screen, you will see a graphic of the auditory nervous system pathways from the cochlea which is the spiral shape with the Roman Numeral I near it on up through the brainstem to the midbrain and auditory cortex. The Auditory Brainstem Response starts testing at the distal portion of the hearing nerve as it leaves the cochlea. And then the test assesses the auditory pathways all the way up to the Roman Numeral V in the brainstem area. It's important to remember that the Auditory Brainstem Response is not a test of hearing but it is a test of neural synchrony of the auditory pathways from the cochlea through upper levels of the brainstem and testing has indicated that for most individuals who do not have any type of nervous system disease or disorder affecting the auditory pathways the auditory brainstem response can be used as an effective estimate of hearing sensitivity. On the right side of the slide you will see an auditory brainstem response test from a one day old infant to one pitch of sound or one frequency.

The Roman Numerals on the waveforms reflect the generator sites for the auditory brainstem response when you see the wave 1 response the generator the distal portion of the 8th nerve as depicted on the drawing of the auditory pathways on the left-hand side. The top gray large waveform is to a pretty loud sound about 60 decibels which is pretty much the loudness level of loud conversation at speech. The red waveform below is the baby's response to 40 decibels which is a little softer and the purple is the 30 decibels which is a little bit softer again. The green is the 20 decibels.

20 decibels is often the cutoff used for normal when testing with an Auditory Brainstem Response test this is the estimated equivalent of the softest level perceived or processed by a normal hearing infant to the sound presented what you might observe by looking at these waveforms as the sound gets softer the waveforms become less distinct and much smaller. During an auditory brainstem diagnostic evaluation this type of process will be completed for each ear at multiple pitches the audiologist will present a loud sound at the pitch or frequency at interest and then gradually reduce the loudness of the sound until a response is no longer observed. In each of these cases they will have to repeat or collect multiple waveforms at the same level to make sure the response obtained is a true response. The audiologist will be obtaining responses at louder levels and consecutively softer levels until the sounds are so soft that no response is obtained or a response is obtained at the cutoff for normal hearing. This allows estimation of hearing sensitivity of the infant to various pitches.

It's extremely important that the audiologist is able to test multiple pitches at multiple loudness levels but also to test each ear individually so the test can be quite lengthy and it may require an hour, an hour and a half or in some cases even two hours to complete.

What is most important is that the baby needs to be cooperative to a certain extent

just like with the screening the baby needs to be very still and very quiet.

Hopefully sleeping soundly.

So to increase the possibility of getting many responses or learning as much as possible about an infant's hearing in one test session, it is extremely helpful if the infant comes to the appointment in the best state possible for them to sleep for an extended period of time if possible it's helpful to schedule the appointment near the infant's normal nap time ask the parent to try to plan to feed the infant when they arrived at the clinic or when the audiologist has prepared the baby for testing and attach the electrodes and put earphones on and things of that sort you also might want to try to keep the baby from napping on the way to the test, it's awful to get to the test site and find the baby is asleep in the car seat as soon as you wake them up they won't go back to sleep for a number of hours the longer the baby can stay in still quiet sleep state the more information will be obtained and more will be learned about their hearing it is also important that all in the test environment turn off any electronic devices. Such as cell phones. During hearing testing. As these can cause interference which may affect the hearing test results and also could lengthen test time.

So otoacoustic emissions as I mentioned before on the screening is a recording of the inner ear's response to sound. They will often be completed in conjunction with an auditory brainstem response diagnostic evaluation. They sometimes may also be used as a complementary test for the behavioral hearing evaluation. OAEs do provide some valuable information about the integrity of the sensory organs in the inner ear however OAEs cannot be used to predict or estimate hearing sensitivity for various pitches such as can be accomplished with the Auditory Brainstem Response or behavioral testing.

Otoacoustic emissions are used as a very powerful complementary test but they are not used as a replacement test for either the behavioral or the auditory brainstem response diagnostic evaluation.

Since once again it is extremely important to find out the very softest level at which the brain is able to process sounds at multiple pitches.

The gold standard for hearing assessment is the behavioral evaluation. Many of you probably had your hearing tested at some point in time. It may have been when you were in school. And you had just a quick hearing screening. Others may have actually had a full diagnostic hearing test. You may recall that when you were tested you were probably asked to raise your hand whenever you heard a sound and raise your hand even for the softest sounds you heard. It's not really possible for us to get a six month old or nine month old or 12 month old to raise their hand on command and especially not to do so based on the softest sound they hear we do have different procedures we can teach a child to participate in to try to assess their hearing behaviorally from a very young age.

Once a child is neurodevelopmental Long Island 6 to 9 months of age we can have them start participating in procedures that utilize a head turn in response to sound if they have volitional head control and enough neck strength to carry their heads

unsupported by a parent, we can teach them whenever they hear a sound they should turn their head in response to a sound and we will provide them with a reinforcement to let them know that that's the behavior we would like for them to continue to provide when they hear a sound.

This is typically called visually reinforcement audiometry or VRA in some cases is referred to as condition orienting response or COR.

So to complete this task the infant is placed in a sound attenuating booth sounds are presented either through loudspeakers if the infant resists earphone placement or through earphones which is preferred and whenever the child turns their head to the sound they are given the opportunity to look at a toy that lights up origins to move or they may also be given the opportunity to look at a video clip if they turn their head automatically to the sound this behavior is reinforced by showing them these objects once they become interested in something else and no longer just staring at the toy another sound is presented in the picture on the left you can see that the dad is manipulating some toys in front of the child to keep him from looking at the reinforcer box between sound presentations. Typically you will either have two clinicians one in the booth with the child performing this task and one outside running the equipment or the parent may be asked to help with the task of keeping the child concentrating on another object when they are not being presented with sound.

The responsibility of the person in the room with the child is very important. Because during the test they need to make very sure that they are not cueing the child in any way that the child is being presented so don't be looking for the sound yourself don't be turning or pointing to the sound boxes or anything of that sort, the speakers. In the picture in the middle you can see the picture being reinforced because the child heard the sound and turned their head appropriately to look at the object.

After the child has responded, the audiologist will then wait a while until the child is once again interested in something being held at midline. And then they will present another sound once the child is no longer expecting the sound to occur this will be done for multiple pitches and multiple loudnesses once again at every new pitch the sound will be presented at a nice loud level to make sure the child can hear it and respond easily and then gradually the loudness of the sound will decrease and the child will no longer turn their head in response to the sound.

When the child reaches about two years of age they may quickly become bored with being tested in this manner. They may look at the toy a couple of times and when they have figured out what the toy is they no longer want to turn their head when the sound is presented. So between about 3 to 5 years developmental age we can start teaching them to play a game in response to a sound as is shown in the picture on the far right this little girl was participating in conditioned play audiometry she has been taught when she is ready for testing she should hold the lego up she's holding a blue lego in her left hand when the sound is presented she will put the lego on top of the other legos and build a tower she will then get a new lego and if she hears a sound she

can put that one on the tower, as well one thing to keep in mind for VRA and play audiometry if the child turns their head when a sound is not presented or places a block when the sound is not presented they are given a little bit of a time out and not given reinforcement for their behavior so we can make sure they are not giving us false responses.

We only have about 20 minutes with a child at this age during which they are going to be able to fully participate in the test. Because they are going to lose their attentiveness to the test very rapidly so we have to do all we can to optimize the test experience in a very brief period of time so it's really hard to convince a 2-year-old to continue listening to sound if they are finished with the activity.

Some of the things that we can increase our chances of -- we can do to increase our chances of getting more responses include making sure that the child does not come to the appointment sleepy or hungry unlike with ABR or OAEs where we want them asleep but in this case we want them alert and happy bringing a snack with you to the appointment or feeding the child right before the visit is a good idea. Make sure you try to schedule this around any sort of nap times or rest times that they are used to. So that they will hopefully be in a good physical and mental -- mentally alert state.

Try to make sure they get a good night sleep before the day of testing that's also very helpful so that we can try to get as much information as possible about the child's hearing while they are in the clinic. Another thing you can do is try to get a child used to wearing earphones because once again it's extremely important for us to find out how each ear hears individually not just how both ears hear together if a child has not been introduced to earphones in a non-threatening environment they may be very resistant to putting them on in the clinic. If they won't wear earphones we can test them through speakers however the speaker is just going to tell us about the results from the better hearing ear so if a child has perfectly normal hearing in the right ear but they have significant hearing difficulties in the left ear we're only going to find out information about the right ear and we won't know that that left ear has difficulty and needs to be addressed. So it's sometimes helpful if parents have exposed their child to listening through earphones to music or watching videos with earphones on making sure that the volume is set at an appropriate level.

Okay. So this is a familiar sounds audiogram and it's important to recognize that although the ability to hear specific frequencies of sound is important, much of our focus is on ensuring that the various speech sounds are available to the infant for access to information necessary to develop speech and language. We want to ensure we maximize neural pathways during critical developmental windows in order to maximize neural pathways for development for speech and language we must provide appropriate stimulation to the brain for all of the pitches necessary to process the sounds of speech. Sounds are made up of many different pitches so think of the span of the piano keyboard and the many keys on the piano keyboard there are way more cells in the inner ear processing small differences in pitches of sound that we hear as humans. And

to hear and appreciate the music that you listen to you need to be able to hear the low pitch tones, the mid pitch tones and the high pitch tones. Speech is very similar. As you can see in the diagram. It's also made up of multiple pitches. When you think about the loud low pitches, think about the vowel sounds, ah, ee, oo, aa, all of these sounds are produced by using voicing I use my vocal folds to produce a sound I emit through my mouth the high pitches are at the high end of the piano keyboard and softer because for many of these we don't use our voice to produce them such as . . . sh, ka sound. All we do is simply restrict the airflow at various points in the vocal tract to shape the static noise.

As I mentioned before this is a familiar sounds audiogram for those of you not familiar with an audiogram I'll provide a very quick orientation to what you're looking at across the top you can -- from left to right, the data is organized by frequency or pitch. On the left is the low frequency end and as we move to the right the data is reflecting progressively higher frequencies. Similar to moving along the piano keyboard. From top to bottom the graph depicts loudness. Data at the top reflects soft sounds the further down the marks occur the lighter the sound has to be when hearing is tested the loudness at which each frequency can barely be heard is graphed on the audiogram it's important to remember that although the audiogram will reflect the softness level at which sounds are heard when we can barely hear the sound we often can't resolve the components to recognize the sound so think for a moment about how difficult it is for you to understand when somebody is whispering to you to successfully understand we need the speech information to be about 25 to 35 decibels louder than our ability to just barely be able to hear the sound.

So you can see here this object in the middle that looks like a banana is called the speech banana this is the normal loudness and pitch which conversation at speech sounds occur when speaking at a normal conversational level. As you can see here on the left-hand side at the lower end at a louder level we have the vowel sounds. And then at a very soft level where the little boy is whispering we have the high pitch consonants in the high pitch region in most cases we'll talk about normal hearing being within the purple block for pediatric patients we would like for them to hear about 15 decibels or softer as you can see even within this normal hearing block if your hearing is falling at the borderline of normal you are going to have difficulty hearing probably some of those high frequency consonant sounds. So this is one reason we like pediatric patients to have hearing within the 0 to 15 dB range because they have not developed speech and language yet if they miss some of the sounds it's harder for them to fill in those blanks with adults who are familiar with the language and have quite a bit of experience if they miss a little bit of information, they can often fill in those blanks.

And here you can see this is a mild hearing loss range. Anything that is below the blue bar can be heard by the individual but anything above they are not able to hear very well you can see very rapidly if you have a very limited amount of hearing loss in the high pitches you're not going to have access to the high frequency consonant

sounds which means that you may be able to hear speech just fine because you're hearing the low pitch information but you're not able to really understand because you're missing all of the distinct crispness and high frequency so in these cases for a pediatric patient they definitely could benefit from access to appropriate technology.

As we get to more severe hearing loss you can see more and more of the speech signal is not available to the individual with the difficulty hearing. And we get to the point where they absolutely must have a hearing aid and potentially a cochlear implant to be able to be successful learning speech and language. As we are audiologists very focused on speech and language needs it's very important to recognize that we're assessing hearing to determine do they need intervention, what is the most appropriate intervention to help the child learn speech and language but we also recognize the infant and family may have a lot of other healthcare needs that are being met by other professionals.

And we have found over time that interprofessional practice and collaboration is a means of improving not only patient outcomes. It also helps to enhance population health and to reduce healthcare costs.

So if we cultivate interprofessional relationships we can help ensure that the hearing and speech needs the infants and children we see with congenital cytomegalovirus are recognized and addressed much earlier by the other professionals that are involved in their care, as well, interprofessional collaboration is important in national and international discussions around policies and recommendations. For assessment and interventions that help us to enhance quality of life or maintain and improve outcomes for the individual and their families it also can help us derail environmental emergencies if we are working together and communicating effectively to recognize when intervention is necessary.

Okay. There we go. So there are many groups that may be involved in the care and support of the infant and family with CMV many of these are shown on this slide here but there are also others that may be involved with your individual family or the patient with CMV that you're seeing.

Collaboration amongst these groups can lead to much more effective and efficient case management. The care experience and successful outcomes will be enhanced by collaborating with all involved in supporting the infant and the family and the focus will be on coordinating communication and integration into treatment strategies to provide maximum benefits. An example for this with infants with hearing differences is going to be collaboration between the audiologist and speech pathologist so the audiologist will have fit the infant or child with appropriate technology based on the degree of hearing loss as part of this process the audiologist will have completed a variety of tests to ensure devices are set appropriately and then will provide information about the child's access to various speech sounds to the speech pathologist and the speech pathologist works with the child if there are specific phonemes the child isn't acquiring or continuing to have difficulty with the speech pathologist can communicate this information to the

audiologist who may then determine the child needs additional adjustments or may require a different type of technology. For example if this may trigger transitioning or evaluating for transition from hearing aids to cochlear implants.

Even if these providers are at different facilities the important concept is an interprofessional collaborative team that are leveraging communication to decrease duplication of services and obviate complex referral systems to improve experience and outcomes for the individual and for the family.

Okay now Dr. Park will continue with talking more about current efforts of congenital CMV testing and treatment.

>> ALBERT PARK: Thank you, Angela.

So I wanted to share with you a little bit about the Val Ear Trial because I think some of our experience from this trial is very relevant in terms of some of the hearing surveillance recommendations I'll present later so the Val Ear Trial is really formulated to try to answer a few specific questions. The major one was to determine whether an antiviral drug called valganciclovir is effective in mitigating hearing loss in those children with isolated hearing loss with Congenital CMV so David and his team have nicely demonstrated and have published that a severely affected child with congenital CMV would benefit with antiviral but the real question is for less severely affected child and in this situation more numerous -- the expectation is that more of these children have lesser infection, is there a role for antiviral therapy. And because this medication can cause neutropenia there have been animal studies that indicate potential for carcinogenicity that was part of the study we also wondered if we can provide more individualized -- wondered through more treatment through pharmacokinetic studies. So that's Aim 3.

And this just briefly demonstrates sort of the study design that this is a randomized double wide placebo ran study we have two arms one group undergoing treatment the other one not undergoing the antiviral therapy but they would undergo serial and in many -- pretty aggressive treatment as well as looking at drug resistance and PK et cetera. I want to acknowledge the numerous sites that are involved in this national study. In fact this is going to be an international study. We are going to also have four additional sites in Canada. Joining in this effort.

So one of the sort of exciting aspects of this trial was the need to have early CMV screening.

And really this is a tribute to the sites in that prior to two or three years ago, very few of these sites actually had any early CMV screening process. And essentially what these different institutions did was they had meetings. They had champions that would essentially develop an early CMV screening program. Pretty much from scratch.

So that now there's over 30 sites or institutions and many of these involve multiple birth hospitals have implemented some sort of early detection for CMV.

And this slide really shows you sort of the three common approaches that are being used for early CMV screening. On the left in that column illustrates universal screening.

And so there were a few institutions, these are research -- part of research endeavors. This would include University of Minnesota as well as Texas Children's. Where they really screen a large number of infants. What you can see here is that about .6% of these children were identified with congenital CMV infection which is similar to what one would expect in terms of prevalence and we were looking at those with isolated or less severe CMV infection we were able to identify one.

The middle column shows you a hearing target early CMV screening approach and this is by far the most common approach used by these institutions. And it shows -- which I think this data is very unique in that I don't think anyone has been able to study this in a national or much larger than say a statewide or individual institutional sort of assessment. And so what you can see here is that about a little over 1% of these children who failed their newborn screening were identified with congenital CMV infection and then about almost 20% of these children had isolated sensorineural hearing loss. To the right shows you the approach using dried blood spot this would be in situations where the child is a little older three or four months of age with hearing loss you can obtain at that blood spot run a PCR assay on it through the Department of Health and have the child done that way this is not -- this can be extremely impactful certainly in our state we probably identified at least 20 children ranging from 3 months or so all the way up to 5 or 6 years of age through this approach. And so again this is a powerful approach when you're not able to implement an early CMV screening program. Meaning you're not able to identify or test kids three weeks of age or younger or if you have a child who presents later in life maybe passed their newborn screening but now presents maybe through a kindergarten screening test with hearing loss and you're trying to identify the cause.

So a number of institutions around the country have now implemented this. This is something we have done probably for at least ten years. And I think again is a really nice way to detect these kids.

So in those of you who are in the audience who is either a parent of a child with congenital CMV an audiologist or other professional and your institution does not implement an early CMV screening program I want this data to show to you that this can be done in that all of these institutions -- and this does require a lot of work but they were able to implement something that I think has been extremely beneficial for the families who were treated and who were evaluated at their various regional centers.

So we've actually gone a little bit beyond here in targeted CMV so actually the four -- there's actually four approaches I just showed you three but there's actually a fourth and this is somewhat an exciting approach and these are sort of the things we did and this is really based on a conversation with one of the pediatric neurologists. Several years ago. Really wanting to make a bigger difference. Because at that time all the data and unfortunately still we don't have enough clinical trials to answer the question of a severely affected child but we knew then we still know that children with severe infection can get better with antivirals and the studies show we don't do a good job of

identifying these children unless you have a formalized protocolized process to look for children who are microcephalic or have elevated amino transferases or cytopenia the data shows these children are often missed these are children you would think would benefit from antiviral treatment we essentially came up with a list we didn't know if this was the right list or the best approach but we decided we would in a few hospitals use this protocol and see what happens so this is kind of what we call an expanded target. It's not just a hearing target. We're expanding it to beyond just hearing to all of these other signs and symptoms that really you would expect we would be able to identify and be able to diagnose for congenital CMV but were not.

This is the results that we found from our study here.

We looked at about 750 children who were screened of about 895,000 births. Those children who were screened we identified about 21 or about almost 3% of children were positive for congenital CMV infection. And if you look at this in terms of sort of a metric and the way we looked at this was how many symptomatic cases out of 100,000 would you identify through this approach. We came out with about 14. And if you look at the literature in those studies that have not used a protocol to evaluate these children, the number came out to 4.

So already you can see that this expanded screening process will identify many more children than in programs that don't have a protocol.

And how does this compare to universal, which would be really the gold standard. Based on our known prevalence of congenital CMV infection in Utah as well as the 10% rate of severe infection we came out with about 26 we certainly do not identify all the children with symptomatic or severe disease but certainly do identify many more than we would without any sort of protocol. And this is a relatively low cost essentially this is probably what any practitioner neonatologist should be doing anyway. So this was we thought a sort of going after the low lying fruit approach where we are going to a -- through a low cost relatively low utilization to identify children and make a difference. This work has actually been published in the journal of pediatric infectious disease. As a result of this success we have implemented this statewide. I can tell you it's just amazing in the last six months where before I would maybe identify one or two kids a month we are getting at least two or three a week. So maybe it's just because there's a greater awareness. Now people are knowing they have to look for this more. But we have seen certainly a bigger impact on this than even the target hearing screening program that was implemented back in 2013 so this is great now we're identifying more children but the obvious question is what do you do especially from an audiological standpoint I think Dr. Shoup nicely described the diagnostic and screening modalities that are available so I wanted to present to you a classic case of a child that we see quite frequently this is a 2 month old child after CMV testing was found to have right moderate and left sensorineural hearing loss mild hearing loss we did a head ultrasound and a number of lab testing and look for obvious signs and symptoms of more systematic disease we have a multidisciplinary clinic where pediatric neurology

infectious disease audiology and ENT see these families.

And right now after that analysis we found again this child has isolated sensorineural hearing loss so the question is how often should you recheck this child in terms of hearing and we all know kids are not always the most cooperative. So maybe we need to know what are the priorities in terms of frequencies. And what are the priorities in terms of years. Because oftentimes we'll do a soundfield test to assess a better hearing ear is that a sufficient sort of approach for the congenitally infected child.

So to answer this question, we partnered with Gayle Demule at Texas Children's as well as the CDC Gayle has a wonderful database where she longitudinally followed children all the way through 18 years of age we asked her whether or not we could use that database to try to use some of these fundamental questions she very graciously and the CDC group were great to work with so this is just some of the methodology we use we tried to be very stringent in terms of their diagnosis of hearing loss how we define progressive loss how we define better and worse ear and what frequency we also define sort of two groups. One group that were identified early in life with hearing loss. And another group that were identified later so they presented with normal hearing at birth or early in life and then unfortunately presented with progressive loss. What we found is a lot of these children had asymmetric hearing loss so one obvious major finding we found if you compare the poor and better hearing ear it's really the poor hearing ear that will change first. It will tend to progress earlier than the better hearing ear as well as will worsen more precipitously in the better hearing ear we found this when looking at two different time points we looked at this early in the child's development at one year of age and also looked at it through the adolescent period. Regardless of whether it was a congenitally -- a child with congenital hearing loss or a child who had a delayed onset we found the same findings. The other thing we wanted to look at was the issue of frequency and actually this is work by Tatiana from CDC and Gayle's group using the same database but looking at a larger cohort of children both who had severe infection from CMV as those with less severe and it's kind of a busy graph.

But really what it's really demonstrating is that regardless of the frequency that you evaluate, whether it's 500 hertz, 2,000, 4,000, all of the frequencies seem to progressively worsen and over a sort of similar period of time.

So to me that indicates that it really doesn't matter what frequency in a way that you're testing, you're going to see that change both in the low frequencies and the high frequencies. So our recommendation as a result of these studies is that it's really important to test both ears. There are some occasions where the better hearing may worsen than the poor it's not always black and white so I think testing both ears is really important if you have a child with normal hearing and you want to do surveillance testing. The child is a little bit difficult to test. I think it's okay to maybe rely a lot on distortion product otoacoustic emissions cases in those -- in Utah we follow these kids every three months for the first three years then we go through every six months

through six years of age and I recommend following them annually afterwards I don't think there's any consensus in terms of the frequency of follow-up I think the reason that we do recommend the three month is I think it really emphasizes to the families the importance of very close follow-up. And we do try to develop strategies to make it easier for them. Unfortunately with COVID it's been quite difficult at times. I mean before COVID we could actually use early intervention services where they could do otoacoustic emission testing at the family's mobile home to help us with this but that's not really a great option we right now try to find a locate audiologist with Utah with such a large geographic referral we try to limit them to drive all the way up to see us so we tried to work with them in terms of that aspect and we're also using some teleABR testing especially the Department of Health that has been very helpful especially in this age group trying to minimize exposure.

So I hope that this talk that Angela and I provided you emphasizes the importance that hearing has in terms of how it effects children with congenital CMV infection we also demonstrated child can undergo testing regardless of age long-term follow-up is really important and you really need to test both ears. Thank you and certainly we welcome any questions.

>> ALYSON WARD: Great, thank you, Dr. Park so I've opened up the question box over there on the left-hand side. So please go ahead and enter your questions in there. And then I will voice them to Dr. Park. I know I have one to kick us off here.

I am wondering if you were to have a crystal ball and you could see into the future, where would you like to see CMV screening going? Both in terms of the actual testing itself and how CMV is tested.

>> ALBERT PARK: Angela, do you want to go first?

>> ANGELA SHOUP: I would personally like to see universal CMV screening. I recognize that there are a lot of issues and concerns about that and we're still discussing that as a group. But I would certainly like to have the opportunity for all infants to receive congenital CMV screening.

>> ALBERT PARK: Yeah I would agree with Angela I think that would certainly be the ultimate goal. It's interesting, though, with these 20 plus sites that have been in the Val Ear Trial you would think a hearing targeted screening approach would be common sense and really easy to implement that wouldn't really get a lot of resistance. But it's been surprisingly hard to even convince the medical community that this somewhat modest approach is worthwhile it's cost effective and can have an impact. So to go to universal screening today I think is going to be really, really difficult. There was a recent pediatric paper that actually condemned hearing targeted screening. We have a publication that Angela and I and Travis Hallard had published this recently in our international journal of pediatric otolaryngology going step by step using the Wilson and Jungner criteria which is sort of the standard criteria for looking at whether a screening program is worthwhile or not. And so we went point by point using that criteria to justify

that a hearing targeted CMV screening approach is worthwhile and worth doing. You know, in this day and age it's 2020 I'm sort of an impatient person I don't want to wait or keep -- you know I think we need more studies, we need more evidence base to show that universal is the way to go and convince insurance payers for this.

I think we have enough information now that we can at least start doing hearing targeted if you want to go to expanded we can start that I do think we also should be doing dried blood testing. We should be doing that now any institution in the United States should be able to test kids with that approach and that provides us some experience and additional data that will help us when we get to the time when we're ready for universal screening.

>> ALYSON WARD: Great. Thank you. And hopefully we do move in that direction. Because that's what I would like to see, as well so a few other questions that have come in. One comment someone had put in that they had started the targeted CMV program at their hospital. In Maryland it sounds like this individual is an audiologist and manages the Newborn Hearing Screening Program they said it was easy once they had support of the medical Director or neonatologist for mother to baby unit so just a little bit more information there.

So a couple other questions here, any recommendations about audiological monitoring for premature infants with postnatal CMV infections acquired commonly from breast milk and should these babies be monitored?

>> ALBERT PARK: Angela do you want to take that or do you want me to take that?

>> ANGELA SHOUP: I haven't seen any evidence that would suggest that just for that purpose they would have to be monitored more closely. However, the NICU babies often are monitored for delayed onset of hearing loss due to other risk factors.

>> ALBERT PARK: Yeah I think there's one study that may have shown -- at least reported sensorineural hearing loss as you were talking about postnatal CMV infection.

>> ANGELA SHOUP: Right.

>> ALYSON WARD: Yeah.

>> ALBERT PARK: So I think the likelihood of a child with postnatal CMV infection having hearing loss is quite low. I think the most common issue, though, is in many cases we don't know if a child is postnatal or has congenital CMV infection and that's where the dilemma really comes in in that case oftentimes we will do dried blood spot testing to try to see if that will help but even the most recent data from Mark Sclich's group in Minnesota says sensitivity at dried blood spot is 80% that's much better than what Sharesh showed in earlier studies but that may be you have 100 children with congenital CMV that have dried blood spot testing and 20 aren't picked up on that in those equivocal situations I tend to think they may have -- assume they may have congenital those kids need to be followed closely and Angela's point about prenatal infants being at risk to have sensorineural hearing loss being so high they still need to have testing but not so much from the CMV route.

>> ANGELA SHOUP: I think it's also just so important to stress that these parents should be getting strong counseling about developmental milestones for speech and hearing. Regardless so hopefully if they identify their child is not developing as anticipated, they will then seek additional testing at that point in time.

>> ALYSON WARD: Great thank you so a couple other questions here. So why -- why use an OAE screener instead of an ABR? Angela you might be the best to quickly answer that or at least kick it off.

>> ANGELA SHOUP: Well I'm probably not the best one simply because I tend to have a preference for automated ABR. As I mentioned in my discussion, they can both be used for screening. We actually in the facility I work with Parkland Hospital in Dallas, Texas have been using automated ABR for all babies since starting the hearing screening program back in the '90s we have identified a number of babies in the well baby nursery with auditory neuropathy as well because we do the screening ABRs I would say that once the child has passed the screening ABR and we have done a diagnostic evaluation, we know what this child's hearing is, if they are at risk for delayed onset of hearing loss, screening OAE is a perfect ability to screen them on a regular basis to make sure that they are not having a significant change of hearing status. Unfortunately if the child does start developing hearing loss you cannot then monitor their hearing anymore with screening OAE because the OAEs disappear pretty rapidly once the child has more than a mild hearing loss. So it's a useful complementary aid to give us more information about the hearing system. It also can be used for monitoring the status of the auditory system in a child that has normal hearing and we're just trying to see if there's a transition from normal hearing to some degree of hearing loss. But once they start developing hearing loss it's no longer an effective tool.

>> ALYSON WARD: Excellent. That's great clarification. So we are at the end of the hour but I do -- there are several questions that have rolled in, Angela, Albert, are you okay answering those or do you need to run and we can see if we can do something via email?

>> ALBERT PARK: I'm going to probably have to run because unfortunately I'm in the OR and so I don't want to have too many of my patients under anesthesia waiting.

>> ALYSON WARD: Yes that makes sense.

>> ALBERT PARK: But you know if Angela, if you have time and certainly if there's anything I can try to answer a little bit later through emails.

>> ALYSON WARD: Okay. Why don't we -- Angela, what are your thoughts?

>> ANGELA SHOUP: Yeah, unfortunately, I've got to run, as well. In a few minutes so if -- I would be happy to respond to anything by email though.

>> ALYSON WARD: Okay. No worries. Okay let's move to that so I will make sure that we pull these questions and send them to the both of you. And thank you so much for taking the time to present with us today and share your expertise.

For all of the attendees, thank you for joining us today. Please take a minute and click on the link that you see on your screen right now. We would really like to hear your

feedback about this particular webinar. And at the end of the evaluation, you can get your certificate of attendance. And just a quick reminder to save the date for August 22nd to 24th. 2021. To come visit us in-person in Ottawa. Thank you so much, everyone, and have a marvelous Thursday.