>> Hello and good late morning everyone. Thank you for coming today to this session. Make sure you're in the right room. The first half hour we're going to be, I guess I should say I, there's no we. I'm going to be talking about a comparison between children who've met 1, 2, 3 guidelines versus 1, 3, 6 guidelines. And also a little more generally about successful predictors of outcome. Then at 11:30 we're going to transition to talking about a project I'm involved in called odyssey and talk about that specifically but also more generally about benefits to using a program wide consistent use assessments.

Anyways starting us out, meeting EHDI 1-3-6 versus 1-2-3. My two co-authors are not here with me today. But they were also involved in this particular project. Just to open up why are we even interested in this, so probably most in the room are familiar with the JCIH or joint committee on infant hearing and their guidelines which are called the 1-3-6 guidelines. So that's hearing screening by one month of age. Confirmation or identification of hearing loss by three months of age and intervention by six months of age. This has been a long standard or goal for the last few years or so and commonly referred to as 1-3-6 guidelines.

The 1-3-6 guidelines have been with us now almost 25 years.

Just several years ago the JCIH suggested if a program is meeting 1-3-6, let's set the bar even higher, try to meet 1, 2, 3. So the guideline says should consider, so I guess that's not a mandate. But that's something people should talk about is should we get kids identified earlier. But that's a pretty challenging target as I think all of you probably know. Is it worth it? Is that kind of extra stress on the system, on the families, is that something that's really going to pay off in the end or are we kind of getting into the law of diminishing returns here where a lot of investment would be made for not a lot of return in the end. It's important to look because of the time, money, emotional burden that would be put on people to try to lower these guidelines to 1-2-3. When in fact in many states and really probably all states, not everybody is meeting 1-3-6. At best in most states it's about 50/50 at this point. So we're really not at the 1-3-6 goal yet. First we're going to talk about general predictors of success in children who are hard of hearing and then ask the 1-3-6 question. It's a large public health question, it's always good to look with new language instruments, new groups of kids. Make sure that that's something that is an effective target to have. Then the second piece of it is I'm going to take those kids who did meet 1-3-6, split them into two groups, those that actually did meet 1-2-3 compared to kids who met 1-3-6 but they didn't hit the 1-2-3 guidelines. Maybe they were identified when they were two months or hit the three month mark, got intervention at five months, so they're in that 1-3-6 range but not the 1-2-3 range. I can see some people in the room who helped with collecting data. Thanks so much for your assistance with that.

It was all under a project that we call odyssey which is a project funded by the CDC. We're partnering right now with 17 different programs in 15 different states. Programs do a common set of assessments and this is what we're going to talk more about in detail at 11:30.

And then the information they get from those assessments is sent to us at the odyssey center at the University of Colorado at Boulder. And we create a database for each individual program that works with us that we then can return to the program either as a database or in a report format summarizing the outcomes of the children in that particular program. But then we're also combining those databases to look at larger public health questions like the one I'm going to talk about today. So the participating states are up there you can take a look and see if your state is involved. They're in alphabetical order if you're looking for your state. A big thank you to those of you who are here who are up there on the board. Question one today is what are the factors associated with better language outcomes?

Are there things that we can use to help predict which children are going to be doing better in terms of their language growth over time, and which children might be at more risk for language delay. And we want to look very specifically also at meeting those EHDI 1-3-6 guidelines. Does it really make a difference or does it not make a difference in the ultimate language outcomes of children?

 So we have a large number of children for this first question that we were asking which was general factors and also does EHDI 1-3-6 have a benefit in terms of language results. We have two different instruments I'll talk about in just a moment, but in terms of numbers of children who completed each of these, we had almost 600 children who did the daisy, and that's the breakdown between bilateral and unilateral differences. Then we had 532 children who completed an instrument called the McArthur which I'll tell you about in a moment. Over 500 children, close to 600 for one of the assessments. So the criteria for being included in this particular analysis is that the child had to be between the ages of birth and three when they did the assessment. They could have hearing differences in just one or both of their ears. Could be at any level of hearing, any language of the home, English, Spanish, ASL, other. Any communication mode, might be using sign language, might not be using sign language. But this particular group, one thing we did separate out were children who had additional disabilities.

So this particular group of children does not have disabilities that are thought to impact their speech or development. In any young sample of kid it's hard to know 100% in that birth to three period if a child has disabilities or not.

At least at the current time when the assessment was done people believed that they did not have any issues that would impact their speech or language development. And these children are followed over time, every six months. And so for this particular analysis, we looked at their most recent assessment so when they were the oldest relative to when they had done other assessments. So the age of the children because we restricted it ended up with a mean at two years of age. About half and half, boys and girls.

In terms of their hearing levels, about a third had hearing difference in one ear.

The other two-thirds had hearing difference in both of their ears. Some of which was in the mild to moderate hearing level range, others were in the moderate severe to profound hearing level range. So not completely equally divided across the three groups, but approximating equal division between the three groups. Some other characteristics of this group of children, English was either the spoken or written language of the home for 90%.

I'm throwing written language in there because the face to face communication may have been done through ASL but they rewrite in English, 90% of the sample. We have a pretty large representation of children whose families are of Hispanic ethnicity. We have a lot of assessments that come to us from Colorado, Arizona, and Texas, all of which have a high percentage of Hispanic families.

So 41% were of Hispanic ethnicity. 87% were white. And 90% had hearing parents for both of their parents. And then on average these children were getting 4.2 sessions per month.

I don't know how you get a .2, I guess when you do math, that's what happens. And it's not necessarily from one service provider. They may have gotten two visits from one agency and another three visits from another agency, but it averaged out to 4.2. In terms of the communication approaches that were used, keep in mind again that we're talking about a group of children some of which have hearing difference in one year.

Some of which have mild to moderate hearing difference and also a percentage of children who have more moderate severe to profound. Most of these children their families were using with them primarily spoken language.

And 12% the parents were trying to use sign if they could. But their children are just birth to three, they're just finding out about hearing loss, communication methods and choices that they might make.

And only 1% was using sign only.

So let's look at how they did in terms of meeting the EHDI guidelines. Because I think this particular characteristic is super important in terms of even like why are we looking at this question, how hard should we push for 1-2-3, because I don't know, it's the story of my life, probably most of yours in this room. You feel like you barely met one goal and somebody has another one for you. It's like okay, I'm still working on number one and now we've got to go on to number two. That's kind of how this EHDI 1-3-6, 1-2-3 is. Have we met 1-3-6? That's goal number one. Are we ready to move on to 1-2-3. And the next question is will it make a difference if we do? You can see across these 17 programs, 62% of the children were meeting the 1-3-6. That's not even two-thirds of the kids. If you look at the literature and reports from when somebody does an analysis within their own state or their own program, often they report about 50%. So the 62% is even maybe a little higher than states that aren't participating with us in odyssey. So we're really not there. We're making progress.

Each time I look at these numbers in our dataset, it's going up. But it goes up slowly because there's a lot of factors obviously that impact whether this can happen or not or does happen. So going back to this particular study that we did, we had four different pieces that we collected from our participating programs. We have a demographic form and that's how I have the information I just presented about things like ethnicity and mode of communication, et cetera. We get audiologic information which is information about whether hearing differences were in one or both ears and what levels.

Then we have two language assessments that we do. One is called the daisy. The developmental assessment for young children. It has two language subtests and those are the things I'm going to share with you today. A receptive language, comprehensive language, and expressive language subtest that we'll be talking about. And our second language instrument is the McArthur Bays communicative development inventory. That looks at a number of pieces of language but it's mainly focused on vocabulary, expressive vocabulary that the child uses.

So that's what we'll be looking at today. DAYC is based on the expressionist observation of the child's skills and on parents reports if there is something they haven't had an opportunity to observe. We looked at expressive and receptive language even though there are additional domains assessed.

We've made a few modifications so that it's clear to the interventionist and the family that ASL should also be counted because the test was designed primarily to be used with children using spoken English.

So we had some modifications so that it's clear that sign language, ASL would also count.

The McArthur Bates is mainly of expressive vocabulary. And it also includes both spoken and signed vocabulary. So how did we do this analysis, for anybody who's like a statistical kind of person. We used a multiple regression approach and we started out looking at a wide variety of different variables that might intuitively you might think might impact a child's language skills. And using what's called a forward backward stepwise approach.

Mathematically the program will predict what best predicts the language outcomes without overly complicating the model by putting every possible thing in there that might have the tiniest contribution, what makes a significant contribution to the model. Once that was done, then we did a linear regression.

 So we ended up with three different models and they're called predictive models because you put barriers in to try to predict the language outcomes, the language scores that the child got. We had three types of language scores we were trying to predict, so three different models. We were looking at the DAYC expressive language score and specifically at percentile scores. The DAYC receptive language score and also the McArthur vocabulary scores. We had three different pieces that we could look at three different sets of outcomes. So what were the significant predictors overall of those three language outcomes? One of the things that came out on all three of them was the maternal level of education or the primary caregiver's level of education.

This was an important predictor so in other words -- hi. Is it actually working now? Because I don't see any captions. That was an interesting talk. Now it's working, I think we're good.

Just a little delay. Okay so anyway back to our predictors, so the primary caregiver level of education was an important contributor to ultimate outcomes with mothers who had higher levels of education, children having better language outcomes.

Other thing that came out to be a significant predictor was the hearing level in terms of if it was mild to moderate bilateral, those children had better language outcomes than children who had moderately severe to profound. But interestingly if you jump to the not significant, there wasn't any difference between children who had a union loot rail hearing loss and children who had bilateral hearing differences --

unilateral hearing loss and children who had bilateral hearing differences in the mild to moderate range. I'll be talking about hearing loss tomorrow, but I think that's really interesting. We often hear they can hear in one ear so there aren't going to be any problems. But often these children in terms of language are performing like children with hearing differences in two ears at a mild to moderate level. Then in our faded green, meeting EHDI guidelines 1-3-6 did make a difference. All three language measures, those children who made 1-3-6 had better language scores than children who did not meet 1-3-6.

Another significant predictor that came out for the DAYC but not for the McArthur what is the child's sex, whether they were a boy or girl. With girls have been higher language scores. The reason it probably didn't come out on the McArthur is the McArthur has separate norms for boys and girls. So they recognized from the beginning when we did this sample of literally thousands of children, the girls had higher vocabulary scores earlier than the boys did, so they've separated the norms. So they've already accounted for that difference whereas the DAYC is clumped together. Any test makers in the room, I think it's important in that young age to have separate norms for boys and girls. Might not be such an issue once the kids are getting to be school age, things even out a little more. But we're seeing here the girls' languages developing more quickly than the boys is at a young age. One thing on the McArthur is as the children are getting older, unfortunately the gap is getting bigger. So their percentile score is actually going down as they get older.

They're gaining more words for sure, but not at the rate that they need to be to keep up with typical language development. So here's a couple graphics of the predictors I just talked about.

In the dark blue on the right, those are the children who did not meet the EHDI 1-3-6 guidelines. On the left are children who did. We have percentile rank on the left. All of the slides will be oriented like this. The 50th percentile is what we're shooting for because 50th is average, right in the middle of the pack. On the DAYC expressive language, children who met 1-3-6 were doing exactly what they should be compared to kids developing language typically. You really see a big difference in that McArthur. The McArthur is a tough test if anybody has ever given it. It's really exacting, but I think it really identifies those gaps that children are deaf or hard of hearing often have which is diversity of expressive vocabulary. Here's our differences by hearing levels. So the two bars on the left are first unilateral and then children who have hearing differences in both ears at a mild to moderate degree. And then with the third bar being those who have moderately severe to profound hearing difference in both of their ears. You see a pretty big difference there by hearing level. And the little stars are where they're statistically significant. This is the mother's level of education. So grouping them into mothers who had a bachelor's degree or a graduate degree. And then the right bar would be mothers who had something either not finishing high school or all the way up to an associate's degree. You can see there's a significant difference between those two groups. And then here's the boy/girl difference.

And again on the McArthur it almost flipped, but it's not significant so they're basically the same because they're separate norms for boys and girls. And I guess there should be separate norms for the DAYC for boys and girls too. And then the younger versus older kids.

Interestingly again on the DAYC, we didn't see the effect of the percentile going down because it's a general measure. And the McArthur is very specific in terms of vocabulary and diversity. That's where we're seeing a huge difference. Look at that, between kids who did the test when they were less than two and kids who did the test right as they were about to turn two or were approaching age three, how big of a difference in percentile rank which sadly means that gap in vocabulary is unfortunately just getting bigger and bigger in that birth to three period.

 Question two, what you all came for, do children who meet 1-2-3 demonstrate better language outcomes than children who meet 1-3-6 but did not meet the 1-2-3 benchmark. For that analysis, we had close to 400 children who did the DAYC and a little over 300 who did the McArthur. Now we're peeling off those who didn't meet 1-3-6, so we're losing that part of the sample. So when we controlled for a variety of factors that we knew were significant predictors like the child's sex, their age, whether they had hearing difference in one or both ears, what level it was, and primary caregiver's level of education, when those variables were controlled for, there were no significant differences between children who met 1-2-3 versus 1-3-6. So based on the results of this study and let me say that this is a very important public health question and a major decision like this should never be based on one study, so future work is definitely warranted in this regard, maybe looking at subgroups of children where there might be differences. There is one study, Beth Walker from the University of Iowa with a group spearheaded a study where she did see some differences with a very specific subset of kids who met 1-2-3 did a bit better with their language growth over time. But this was a broader sample of children in terms of unilateral, bilateral, any degree of hearing difference, any language spoken in the home, et cetera. Hers was much more restrictive. So it might be in restricted groups 1-2-3 would make a difference.

But in this larger sample, it did not. So in some ways, I guess it's good news in that it would definitely be a burden. It would be an emotional burden on families to try to meet these timelines. It would be a burden on a system that's already often backlogged with trying to get people in for appointments to make these guidelines. And it does seem to follow the law of diminishing returns in that it would be a big investment for maybe in the end at least in terms of language outcomes, not a lot of pay off. Just a few other conclusions from some of the kind of first question that I asked was that meeting EHDI 1-3-6 is worth it. So meeting those guidelines is important.

Those children are doing better.

And that's a push too and we still have a little bit of a ways to go to try to get up to or close to 100% in that because at this point at least in this sample, not even quite two-thirds of the children were meeting those benchmarks. And just looking at the language results in general, we see that on a general language measure, the children are looking like they're doing really fairly well. The meets EHDI expressive language on the DAYC was right on target. Receptive language was a little lower. But when you look at something really specific in a rigorous assessment like the McArthur and you're looking at diversity of vocabulary, 40 % of those children were at or below the 50th percentile. There's still a lot of work to be done as you know. Vocabulary is one of those areas that's so critical to later literacy, later language development, and where there's a gap. And that gap is widening with age. And so focusing on that in intervention and focusing parents on that and giving them strategies to expand diversity of vocabulary, doesn't matter whether they're using spoken language, sign language, combination thereof, this is something that we see across the board is an area of language that really needs attention and is so important. And one of the ways to do this is to help families understand the kind of growth that is typical in vocabulary. And so these benchmarks here, this is typical language acquisition. 12 months, maybe you're not talking at all, that's still considered within the average range, but most kids maybe have 1 to 5 words at 12 months. Six months later they have another 80. So that's a decent chunk, but it's not incredible or mind blowing. But then wow six months later, we're up to 300 words. So we've gone up 215. So this growth is exponential in normal language acquisition and so one can't be complacent with oh, we learned ten words this month. If you want to stay on track with what is typical in vocabulary development. Sharing that information with families, I think helps reinforce how critical it is to be exposing the children to new vocabulary in highly contextual situations where the child can understand and learn those words and learn what they mean across different context. And another piece of information I feel like we gleaned from this from a clinical standpoint is even if a child is off to a great start, it's critical to continue to assess over time and not say oh we looked at it when you were 18 months, you were doing great.

Well at 18 months, vocabulary as an example, bar is not that high yet. 85 words would be right on target. But six months later you really have to have made a lot of growth to be staying on track. So A looking at language every six months, especially once the child is getting close to or above age two is really important. And using a rigorous test, not just something that's looking at general language skills, where children can get kind of a point by doing a whole variety of different things that might not really be full, rich language. Whereas something like a McArthur is so specific where the parent is checking off literally the words their child can say or sign is going to give you really a better measure of their language and if they're on track or not. So anyway, I'll just end by saying thank you so much to many groups of people.

One large group being the families who participated in this and were willing to have their information sent to odyssey. And to the interventionists, many of you are in the room. Thank you so much to you for being willing to do this as well. And also to our staff at the University of Colorado, we have a great group of assessment coordinators that some of you work with, and also a great group of students who serve as project assistants for us. Thank you very much, and if you want to hear more about odyssey and assessments to use with children who are deaf or hard of hearing, we're going to launch into that in about two minutes.