BETTINA M. GYR: Thank you very much for the opportunity to speak to you guys. So this is probably a bit of an interesting topic to hear about from an orthopedic surgeon, but I've had a long standing and very large neuromuscular practice in many places across the country, actually, where I've worked and continue that here. So I just want to talk to you guys about kind of the practical aspects of what we do to evaluate somebody that potentially has cerebral palsy or another neuromuscular disorder.

Next, there you go. So cerebral palsy is actually amazingly common. If you look at other common childhood orthopedic conditions on this slide, other neuromuscular conditions such as spina bifida and muscular dystrophy are much less common than cerebral palsy. And then other sort of common orthopedic conditions we see that have genetic or neurologic abnormalities, such as Down Syndrome; and then common things like sickle cell disease; club feet, which we all think of as a very common pediatric orthopedic condition; and hip dysplasia, also a common pediatric orthopedic condition-- all those things way less common than cerebral palsy.

So what is cerebral palsy? So this is actually a very controversial question, because there's no right or wrong answers to this. So in 2007, a group of neurologists, neurosurgeons, podiatrists, physical therapists, occupational therapists, orthopedic surgeons, all got in a room for like a week and decided they're going to come up with what is the definition of cerebral palsy. So this is what they came up with.

So it's a group of permanent disorders of the development of movement and posture, causing activity limitation, that are attributed to nonprogressive disturbances that occur in the developing fetal or infant brain. The motor disturbances are often accompanied by disturbances in sensation, perception, cognition, communication, and behavior; by epilepsy; and by secondary musculoskeletal problems. That's a long definition of what cerebral palsy is-- because it's not one thing.

It's also important to remember what cerebral palsy is not, and what it's not is progressive neurodevelopmental disabilities not affecting movement and postures. It's not primary brain and spinal cord malformations. It's not genetic or chromosomal disorders. It's not muscle diseases. It's not metabolic disorders.

And a lot of these things get lumped or split. And I always actually tell the pediatric residents that come to my clinic, as well as the orthopedic residents in my clinic, there are people in this world who are splitters. There are people in this world who are lumpers.

For this I'm a splitter. I think cerebral palsy has a very somewhat narrow definition of what it actually is. And I spent a lot of time explaining to parents why their child does not have cerebral palsy, why they have genetic disorders, chromosomal abnormalities, metabolic disorders, and why that's not cerebral palsy and can't be treated as such.

So how do you diagnose cerebral palsy? 90% of this can be done by good history taking. What's the birth history? What's the developmental history?

How is your kid doing in school? I always feel like I'm probably the only orthopedist that asks kids how they're doing in school, and what their favorite subject is, and whether they're making the honor roll. They always look at me a little funny.

Brain imaging is the second important component for diagnosing cerebral palsy. And I'll go into more of that in a little bit. And then the physical exam. The persistence of primitive reflexes, persistent extensor tone in their legs-- as you guys all know, little infants like to lay there with their knees flexed and their feet flexed, and their hip flexed. They curl up in a little ball. If you have a kid that's lying on your exam table with their legs extended, there's something not right with that baby and needs to be looked into a little bit more.

The AAP actually in 2006 came up with a recommendation that a structured neuromotor exam be done once during the first six months of life and a second one during the second six months of life, and annually until age five for very low birth weight infants, i.e., under 1,500 grams. And we see a lot of these very low birth weight infants around here. And don't ask me what exactly a structured neuromotor exam is, because I'm not a neurologist or a pediatrician.

So what's the epidemiology of CP? We already talked about how common it is. So it's seen in the United States in about two to three per 1,000 live births. And the two big risk factors, as I already kind of outlined a minute ago is prematurity and low birth weight. And the risk actually increases significantly with each of these.

So if you are 32 to 36 weeks gestation, your risk is seven per 1,000. And you can see where that jumps all the way up to 146 per 1,000 if you're a 22 to 27 weeker. Being a twin increases your risk fourfold, being a triplet increases your risk 18-fold.

I have triplets in my practice that I take care of, one of them for sort of a non-CP problem. All three of those kids have CP. They're eight years of age. I promise you their mother has no idea they have CP. None whatsoever, she's never been told that.

And the risk also increases with very low birth weight. Once again, you can see here anywhere from 1.16 per 1,000 if you weigh over 2.5 kilos to 60 per 1,000 if you're under 1,500 grams. Neuroimaging is an important component of evaluating somebody for cerebral palsy. And the sort of hallmark finding for cerebral palsy is PVL, periventricular leukomalacia, highly predictive.

And it can come in multiple forms. It can be diffused. It can be cystic. And the way to diagnose this PVL is with an MRI. Now obviously getting an MRI in a young infant is not easy, because they have to go under anesthesia to have this MRI. So you have to kind of weigh the pros and cons of getting an MRI in a very young infant.

But the MRI is also beneficial for excluding other things that may cause neuromotor abnormalities, such as tumors. And about 83% of kids, so a fairly high number with cerebral palsy will have abnormal neuroimaging. And the different kinds of cerebral palsy will have different neuroimaging abnormalities.

One thing I commonly see is children who have had ultrasounds. In the NICU, almost every premature NICU baby has. And the parents get told, oh, the ultrasound in the NICU was normal. Well, an ultrasound in the NICU doesn't pick up periventricular leukomalacia. It will tell your child does not have a massive head bleed, but does not pick up PVL or abnormalities of the white matter.

So how do we classify these impairments that you see in cerebral palsy? So we already just talked about what the definition of cerebral palsy is, and it's primarily a movement disorder. And 80% of children with a cerebral palsy will have some type of movement disorder. Usually spasticity predominates in kids with CP, but almost all of them have more than one type of movement disorder or tone abnormality.

And that's in some ways the hardest thing about CP. And the longer I take care of kids with CP, I'll tell you the less I understand about all this. And they all have some mixed component to their tone and the problem is-- is they're mixed 50/50? Is it 80-20? Is it 90-10? You don't know, and you have no good way of knowing this.

One thing that they all have in common on their exam is loss of selective voluntary motor control. You ask them to move their left foot, and they have to also at the same time move their left arm or move their right foot. They can't isolate movement. They tend to have muscle weakness and poor balance and posture.

So tone like I kind of already mentioned, the more I learn about tone abnormalities, the less I understand them. So we kind of broadly talk about kids being hypertonic or hypotonic. Do they have too much tone or not enough tone? And then hypertonia can be subdivided into all these different kinds of hypertonia-- spasticity, dyskinesia, dystonia, chorea-athetosis. And all of this gets very complicated and very mixed up very quickly. So we're going to spend a little bit of time talking about these different kinds of tone.

Hypertonia-- the most common type of hypertonia you see in cerebral palsy is spasticity. Spasticity is velocity-dependent resistance. If you move the limb slowly, you will be able to bring it through a fairly full, normal feeling range of motion. If you move the limb quickly, you'll get a catch. And we refer to that as R1 or R2-- that different resistances of where you get that catch as you move the limb. So it's velocity dependent is the key sort of distinction between what is spasticity and what is other types of hypertonia.

It's an upper motor neuron dysfunction. It's also associated with hyperreflexia clonus, this reflex overflow. Once again, everything moves all at once-- positive Babinski.

And they have weakness generally in the pyramidal distribution, so more in upper extremity extensors and lower extremity flexors. Hence, they tensor they tend to hold their lower extremities in extension, and they tend to hold their upper extremity flexed. Spasticity is amenable to treatments such as botulinum toxin, baclofen, rhizotomy, and orthopaedic surgery, which mainly is used to alleviate contractures and balance muscles and tendons around joints.

Different kind of hypertonia-- dystonia-- so this is involuntary or sustained muscle contractions that cause twistings or repetitive movements or abnormal postures. So these are these kids who will sit there with one arm flexed and one arm extended or vice versa, and just sort of constantly move. If you open a door quickly or slam a door or drop something on the floor, they'll just start doing all this because they can't control how they move. It's completely involuntary.

Their resistance to passive movement does not change with velocity, so that's a distinction to spasticity, that it's present both at moving slowly and moving quickly. And it's the simultaneous agonist and antagonist muscle contractions that then tend to result over the long term in these fixed involuntary postures. And like I said earlier, it's worsened by voluntary movements at distant joints.

So you ask them to move their leg, and their other arm starts going. Or you, on your exam, start moving their legs. And they start doing this with their arms, because they just can't control how they move. This is in some ways some of the most difficult things to take care of.

So dystonia tends to disappear when the child's asleep. So actually an important question to ask a parent, who comes in and their child's laying there all like this on their table is-- what kind of position are they in when they sleep? Can they suddenly move that arm that is just stiff like this and you can't move it and pry it open? And they're like, oh, yeah, when they're asleep, I can move it anywhere.

This often does not appear until five to 10 years of age. And we'll talk a little bit later about why that's important, because this can be a late finding. And if you think about it, some of these kids with cerebral palsy and what people think is spasticity may have already had some sort of operative intervention prior to five to 10 years of age. And then this dystonia comes up, and it can be a big problem.

This is very common. A lot of [INAUDIBLE] goes back to this. It's not a matter of what kind of mixed tone you have, it's what proportion of mixed tone you have. That almost everybody has this sort of secondary, underlying dystonia abnormal muscle control.

Makes orthopedic and neurosurgical interventions unpredictable at times. And kids who have bad dystonia, a lot of times their dystonia gets way worse after any sort of operative intervention. We don't know why that is.

The high risk of recurrent deformities after orthopedic surgical intervention or you can get the reverse deformity, so if you have somebody who has a planovalgus foot, you do an operation, you correct their planovalgus foot and all of a sudden they're in massive cavovarus. You're like, how did this happen? Dystonia, that's how that happened. This responds to botulinum toxin kind of well. It responds really well to intrathecal baclofen.

What is hyperkinesia? Yet another type of hypertonia. So this is, once again, unwanted excess movements that are either voluntary or involuntary. This little girl here is sort of standing, sitting, being propped up by her dad.

Look at her arms. If she doesn't-- these are the kids who sit there and they have to clasp their hands together to stop them from moving. They can't control any other way.

Or they sit there on your exam table with their legs crossed, because otherwise they move constantly. That's that hyperkinesia that they just can't control. These people move a lot so getting contractures is actually very uncommon with these. And it's actually very uncommon for these kids to need any orthopedic intervention. This is best managed through medical management, once again, intrathecal baclofen or botulinum toxin.

So how do we classify cerebral palsy? Because-- as we kind of just reviewed-- classifying it by type of tone is probably not very helpful and is unpredictable and can change over time as kids age. So the gold standard of how to classify cerebral palsy is what we call the gross motor functional classification system. This is how all of us in the cerebral palsy world talk to each other.

I have a patient who's a GMFCS 1 or GMFCS 3. We all know what that means. All my clinic notes sort of identify that as a part of the patient exam, because children have a variability of presentation and severity. And we'll go over what the different GMFCS classifications are. And partly, this is important because classifying the old fashioned way, we referred to cerebral palsy as spastic cerebral palsy or dystonic cerebral palsy or hypotonic cerebral palsy is really not reliable and is not predictable of the prognosis.

So this is the GMFCS classification. I don't know how well you guys can read all those words. The most important thing to know about this is this starts at age six. Prior to age six, this does not apply.

This is available on the internet in a larger font format than I have up here for you guys. But basically it goes from the GMFCS 1s, which are independent ambulators without assistive aids; to the 2s that use assistive aids, such as AFOs; to the 3s who use walkers or crutches for shorter distances and manual wheelchairs for longer distances; to the GMFCS 4s, who use powered mobility and some limited walking and standing; to the GMFCS 5s, who are total care, have no trunk and head control and need full assistance for everything.

So in general, the motor function of all kids, actually, whether they have cerebral palsy or not, is that they all tend to improve when they're young. Kids make progress. They learn new motor activities. And even in CP, most children with CP will have improvements in their gross motor function up to about six to seven years of age, after which it plateaus, which is why we don't assign GMFCS level to anybody under 6.

This actually makes it interesting, because we all like to pat ourselves on the back and say, wow, look how great my xyz intervention, or these AFOs, or this brand new type of physical therapy that this three-year-old with CP gets. And look how well it worked, because by the time they're four, they're walking more, and walking better. Well, that most likely actually would have happened without any of us being involved, because that's what the natural history of cerebral palsy is. So you have to place improvement after intervention into this context.

Illustrating the plateau here, once again. And they plateau at different times. So the GMFCS 1s that are the more highly functioning, more typically developing kids, will plateau at a later age, usually closer to six to seven as opposed to the younger GMFCS will-- sorry. The worse GMFCS's will plateau at a younger age.

So the secondary musculoskeletal pathology that you see in cerebral palsy tends to worsen over time. And this is also an important distinction, because as we talked about in the definition, the brain injury that happens is a static problem. This is referred to as a static encephalopathy.

So all these people are like, well, they said it wasn't going to get any worse. But why's it getting worse? Well, their musculoskeletal pathology does tend to worsen over time. And their gait function deteriorates over time. And so once again, you have to look at the-- just like you have to look at the effectiveness of intervention in the very young kids against what the natural history is-- you have to look at the effectiveness of intervention in older kids in this context as well.

So now I'm going to talk about something a little controversial. And that's a recommendation for therapies, because I, just like all of you guys, have lots of parents who come in who have read on the internet what the latest, greatest treatment for cerebral palsy is. And they want you to sign for this piece of equipment or this kind of therapy or this, that and the other now. And if you won't do it, I'll go to my other doctor, they will. So in 2013 a woman named Anita Novak who's a physical therapist in Australia did a meta-analysis of 166-- what they categorize as high quality-- articles about children with cerebral palsy, to see-- to try to describe, systematically, what the best available intervention evidence is for kids with cerebral palsy.

And this has really sort of turned the cerebral palsy world on its ear, because she made these recommendations she referred to as green light, yellow light, red light. Orange light, sorry, in between yellow and red. And only 16% were recommended as green light interventions for these kids.

58 are probably OK, they're not going to hurt them. They may help some of the kids, because once again, CP is a spectrum of diseases. And then percent fell into this, probably do not do, or should not do it. This orange or red category, I will go into this a little bit more into details.

So the therapy to improve motor activities. Once again, this slide is very busy. Her article is available online for anybody, for free use, free download. Improvement for motor activities are various types of therapies. Biofeedback, hypnotherapy, hydrotherapy, single event multilevel orthopedic surgery, early intervention therapy. All that is very important. Things like conductive education, which is very popular in Canada.

And then I get asked all the time. Hyperbaric oxygen-- we read on the internet, some child got hyperbaric oxygen, and they got cured of their cerebral palsy. Well I'd be a little leery. We all hope to be cured of your cerebral palsy.

Recommendation therapy for spasticity management-- so botulinum toxin, valium, selective dorsal rhizotomy-- very good, green light evidence that that works to reduce spasticity. What you have to remember is most of these kids don't have isolated spasticity. They all have some sort of mixed motor abnormality underlying their spasticity.

What else works well for spasticity-- other medical management things, diazedine, baclofen, phenol injections, alcohol injections. Casting is very controversial, because it doesn't really do anything for spasticity. And we'll talk a little bit more about casting in one of the next slides.

Improving muscle strength-- this is actually a very important thing for children with cerebral palsy. I think it's highly underutilized. It can be done.

My mentor, friend, colleague, Diane Damiano, who's a PhD Researcher at the NIH has been talking about muscle strengthening for cerebral palsy for 20 years. And it actually can be done. It does work. It has to be started very, very early though, and in a very structured program.

Contracture management-- this is where casting is important. So once again, are you casting because they're spastic or are you casting because they have contractures? You can stretch out a contracture, sometimes, with some casting. You can't necessarily help their spasticity with casting. Manual stretching-- you'll see here in the orange light recommendation for contractures, because there's no evidence that shows that stretching does anything for these kids, or very limited evidence that it does anything.

So now we've talked about all the stuff. What's effective? What's not effective? What's red light? What's green light? What should we be doing?

Well, what really defines success in these kids? What do these kids really need? What are their expectations? I always ask these kids, when they're getting around to having big surgical procedures, in sort of late childhood, early adolescence, what do you want to do here? What are your goals?

And I'm always very conscious of listening to them, because they'll tell you some very important stuff. And they oftentimes have very different goals than what their parents do. So you listen to what the parent's goals are, you listen to what their kids' goals are. You actually try to talk to the kids with the parents not in the room, if they're teenagers, because they sometimes want very different things.

And then lifelong goals, I think are very important. And I think we have to remember that not only is this child going to be in our clinic and in our practice from now until they're 18, but then they're going to be in somebody else's practice. And then they're going to be out in the real world.

And they're going to be getting a job. And they might be someday making friends and meeting their eventual spouse. And all these things are very important to talk about.

So in ambulatory kids, the primary goal in cerebral palsy is optimizing how they walk. This helps to preserve or improve their overall physical function. It helps them increase their activities or increase their participation in physical activities and recreation in sports.

And how do you do this? You improve their speed. You improve their endurance. You have to optimize their balance and their stability, preventing tripping and falling. All this has to do with strength.

And then trying to reduce the reliance on walking aids-- parents are really fixated on the appearance of the gait. And I spend a lot of time talking to people about the difference between walking well and walking pretty. It's not about pretty.

It's about well. It's about energy expenditure. It's about being able to keep up with your peers. It's about being able to get from point A to point B. Parents are very concerned about how it looks.

The World Health Organization has a classification for Function, Disability, and Health. That actually talks about body function and structure. It talks about activities. It talks about participation in sports and social events, and school and careers. And interventions we do-- be they therapy, surgery, what not-- most likely will have effects on multiple of these domains.

And one example I always use is, power mobility as a child enters school-- whether they have cerebral palsy or some other neuromuscular disorder-- is not a failure. Everybody says, oh my god, we've spent the first five years of our lives slogging to physical therapy so our child could walk. And you, bad doctor, are now telling me they need to sit in a wheelchair?

They don't need to sit in a wheelchair. What they need to do is have enough energy left to pay attention in school. They need to be able to keep up with their peers while the whole rest of the class is running to the playground at recess. How do you think your child with cerebral palsy, who walks very, very slowly and takes a ton of energy with a walker, how are they going to get there?

They're not going to get there. If they're in a power wheelchair, they are going to get there. And they'll be able to participate. And they will be able to play ring around the rosie and tag and whatever else these kids play, because that's how they run. That's how they keep up with other kids.

So how do we measure outcomes? We talked about how we measure effectiveness. So how do we measure outcomes? Everybody always talks about outcomes.

So there's lots of tools available to measure outcomes and collect all these different things and data points and measure this and measure that. So each one of these tools has their own shortcomings. You have to think about the physical impairments versus the functional consequences, the capacity and capability to do certain activities versus the actual performance of these activities, the function of walking like I just talked about versus the appearance of walking.

None of these measurement tools really incorporate what the goals and expectations of children and families are. So we have lots of different intervention strategies. We're not going to talk a lot about physical therapy, but I will talk a little bit about bracing, tone reduction, botulinum toxin injections or selective dorsal rhizotomy, or then various orthopedic surgical interventions.

Bracing-- you guys probably get asked about this as much as I do. You get, probably, prescription requests from physical therapists, from schools, from whatnot, about signing off on various types of braces that these kids need. And you have to kind of think about, what is this brace designed to do?

Just because you have cerebral palsy doesn't mean you have to wear a brace. But if you are going to wear a brace, it has to do what you need for it to do. And so you can think of braces, basically, as tools, to help with gait abnormalities.

And there's a whole other lecture about gait abnormalities that I could give that I won't bore you with this afternoon. But think basic, in basic broad picture talks, that we divide gait into stance phase and swing phase. Either your limb is on the floor or it's off the floor. And does the patient's walking abnormality have to do with the stance phase abnormality or a swing phase abnormality, or a combination of those two? And then what kind of brace is designed to fix those gait abnormalities?

So most foot orthotics, i.e., inserts that go just into the shoe, are for stance phase problems. They do nothing for your foot once it's in the air. It controls the foot while it's flat on the ground. Most ankle foot orthotics are for swing phase problems. And then there's more sophisticated orthotics such as ground reaction orthotics that are both for stance phase and swing phase problems. So does the brace prescription that is laying on your desk match the needs of what the child has?

What is the evidence for botulinum toxin injection? As you guys know, we're sort of the mecca of botulinum toxin injections. Dr. Koman, our department chairman, was actually the first person in the United States to inject botulinum toxin into a child with cerebral palsy.

As with a lot of pediatric interventions, there's not a lot of evidence in the literature out there. It's very hard to do a prospective randomized controlled trial for anything that involves children. There is evidence that botulinum toxin injections reduce calf muscles spasticity and improve ankle dorsiflexion and for that it is superior to placebo.

There's limited evidence to support the widely held belief that the reduction in spasticity potentiates the effect of physical therapy. But there's really not a lot of evidence that this translates into functional benefits over the long term. And there's not a whole lot of information about what happens to those muscles over the long term after they have been repeatedly paralyzed with botulinum toxin.

Rhizotomy is being done here by our pediatric neurosurgery colleagues. It is specifically designed to reduce spasticity. There are three small randomized trials that have been published that compare selective dorsal rhizotomy plus physical therapy to physical therapy. Only all those showed that SDR plus physical therapy was more effective in reducing spasticity than physical therapy alone, which obviously makes sense.

And the largest trial, which was only 38 patients, showed that there was no demonstrable differences in functional outcome at 12 and 24 months with either group. Both STR plus PT and the PT only group had the same equivalent functional gains at one and two years post-operative-- or post-intervention. And there's limited evidence out there that SDR may reduce the need for orthopedic surgical intervention.

So what are the options for orthopedic interventions, since I am an orthopedist? There are muscle tendon lengthenings or muscle tendon transfers, corrective osteotomies, joint stabilizing procedures. In the last several years, really, the trend across the country and big CP centers is to go to what we call single event multilevel surgery.

It's one operation where we address all their deformities at once, all their bony deformities and all their soft tissue deformities. This is one big operation, one very lengthy rehab. But it avoids the staged multiple operations during childhood.

Once again, what's the evidence for this? So there is evidence that limited early surgical intervention can enhance function. So this is things in young kids, like adductor tenotomies, Achilles tendon lengthenings, to get their hips more abducted, to get their feet more plantigrade and braceable, and that does allow improvement in their motor skills. But is this really an improvement, or is this simply like we talked earlier, in the natural history of what normally happens to young children under age six with cerebral palsy? There are two small comparative studies of single event multilevel orthopedic surgery versus just the natural history of cerebral palsy that showed that the gait deteriorated in the natural history group, whereas the surgery group had improvement in their walking distances and less reliance on assistive devices over time.

The rehab, like I talked about, for big orthopedic intervention, is lengthy. The functional gains take about 24 months to fully realize, but have been shown to be superior to those associated with botulinum toxin or SDR. There are two recently published five year follow-up studies on a single event multilevel surgery that show that the improvement you get is maintained at the five year mark. There is no data out there longer than that at this point.

So this always comes. Sort of the ortho versus neuro debate. Do you get a selective dorsal rhizotomy? Do you wait and have single event multilevel orthopedic surgery? Either one of these will show improvements in passive range of motion and muscle tone and gait kinematics and oxygen consumption.

But the indications for choosing one of these over the other are really two completely different indications. And so the comparison between these groups is probably not very helpful. And these two interventions really are complementary to each other. I work closely with our neurosurgical colleagues who do SDRs, and they should not be seen as competing alternatives. Rather, these two things address different aspects of what the child with cerebral palsy needs.

A quick case example, and then I'll finish up. This is a 14-year-old who's a twin. I wish I hadn't cropped this picture quite so much, because his twin Eddie is sitting next to him. He's a fully wheelchair dependent GMFCS 5.

This child who came to see me was a GMFCS 3, had had multiple surgical procedures at many hospitals around the Carolinas, and his complaint is his progressive decline in walking ability and worsening knee and foot pain. So this kid I think is walking by sheer willpower. And we know, long term, this is not going to be-- and it'll keep coming back the other way-- this is not going to be a very effective way for him to continue to ambulate as an adolescent and as a young adult. Gravity is not your friend when you have cerebral palsy.

So what did this child have? He had this big giant laundry list of surgical interventions. And parents usually look at me like I'm a little crazy when I told them all this. And it has to be individualized.

You can see he actually had slightly different things done to the left leg and to the right leg. Luckily, his hips were fine. So I didn't have to do anything for that.

But he had distal femur extension osteotomies and the patellar tendon advancements. That's the only way to get somebody out of fixed crouch gait, which is what he has. And then his feet had bilateral calcaneous osteotomies and talo-navicular fusion. He had had previous Achilles lengthening, so I only had to have this redone on the right side, and then had had previous tibial osteotomies, but also had to have it redone on the left side.

And here he is, on the video, a year post-op. And he's actually now four years post-op, is a senior in high school, is looking at going to community college, is an independent ambulator without any sort of assistive aids. They don't all turn out like this, I promise you.

I like showing this. But I can also show you lots of CP kids who didn't turn out that good. But we all like to show our good results.

So what are the take home messages? Make a diagnosis. Don't be afraid to tell the parents that you think there's something wrong. Send them to somebody who can make the diagnosis.

They already know there's something wrong. As a parent, everybody knows, deep in the pit of your stomach, that there's something not right with your child. And back to what I said earlier, if they have history of prematurity, very low birth weight infants, that the AP recommends a comprehensive neuro-exam at six months of age, again at second six months, and then annually until age five.

Usually the diagnosis can be made on history, but you usually need imaging and a good neuro-eval to confirm. Remember that walking is a brain activity. I say this all day long. My residents quote me on this all day long. Walking has nothing to do with your feet and legs and everything to do with your brain.

Why is making the diagnosis important? So they have CP. They're mild. It'll be OK. You don't want parents to be scared or nervous.

They can develop seizures, later in life. So they need to know that there seizure risks. Oftentimes doesn't happen until they're school age.

And this opens up, actually, available resources. As we talked about when-- what the definition is of CP-- a lot of these children have cognitive issues, behavioral issues. And if you can actually attach a diagnosis to this, they suddenly have resources available for school.

They get IEPs. They can qualify for special education programs, for adaptive PE, all those kind of things. And then things like PT, OT and speech oftentimes won't be covered, especially for the long term, unless you have a diagnosis.

So making the diagnosis either Peds Ortho-- sorry, Peds Neuro or developmental Peds. And this will depend on the institution in which you practice. Peds Ortho-- we're always happy to see them to discuss therapeutic interventions. EPT, OT, speech, early childhood interventions, CDSA, all that kind of stuff, you guys already are aware of. Thank you very much.