[Music]

John l. Takayama: I would now like to introduce the next speaker. Dr. Chantel Burkitt is a senior clinical research scientist at Gillette Children's Hospital, a Tertiary Medical Center dedicated to caring for people with childhood-onset developmental disabilities in St. Paul, Minnesota. Dr. Burkitt co-directs the Pain and Comfort Research Program. She completed her PhD in Educational Psychology at the University of Minnesota. She is a founding member and Officer of the International Association for the Study of Pains, Special Interest Group on Pain and Intellectual and Developmental Disabilities. Dr. Burkitt's research focuses on advancing the scientific understanding of pain using novel biomarkers and modified sensory testing strategies, assessing pain management approaches, and characterizing perioperative pain trajectories associated with orthopedic surgery in people with intellectual and developmental disabilities. Together with Dr. Burkitt is Dr. Todd Dalberg, who is a board-certified pediatrician specializing in palliative care and integrative medicine and has been at Gillette's for over 10 years. He has an interest in the gut brain access. Dr. Dalberg embraces a holistic approach to optimize quality of life while alleviating suffering through all available resources. He hopes to advance the scientific literature, along with his co-director of Pain and Comfort Research, Dr. Chantel Burkitt, through novel approaches to managing chronic complex pain. Please welcome Dr. Burkitt and Dalberg, who will discuss pain management, pain assessment and management for children and adults with developmental disabilities.

Dr. Chantel Burkitt: Thank you for having us. We really appreciate the opportunity to be here today. I'm going to talk a little bit about assessment and the burden of pain for people with intellectual and developmental disabilities. Then, like you heard, I'm not a real doctor, so Dr. Dalberg will take over and talk about the pain management portion. I'm grateful that he's joining us today. We don't have any relevant disclosures, and this is the outline, but I'm going to jump right into things to leave enough time for the important things like pain treatment. We're mostly going to talk about chronic pain today, but we also wanted to take a little sidestep and speak to the importance of pain management for procedural pain. As you might be aware, individuals with intellectual and developmental disabilities are at risk of having a lot more medical procedures than their peers. They might have those medical procedures early in life, and they may have less coping skills than their peers, which all sets them up to potentially have more traumatic stress symptoms for them as well as their parents. It's discussed frequently in the qualitative literature that it can be very traumatic. Just encouraging everyone to be aware of that and to be able to provide as many pain-relieving resources as possible during those traumatic events that can be as simple as immunization or IV starts, things like that. Then jumping into the problem of complex chronic pain, that also, unfortunately, is more common in our patients with intellectual developmental disabilities. Rough estimates are about 2-3 times more common for patients with developmental disabilities, and estimates is up to 75% of patients have chronic pain. We know that interferes drastically with their daily life, their mood, sleep, and their function, as well as the whole family's life, and it increases caregiver burden. We wanted to share a little bit of the patient's lived experience story. I'm going to share this video.

[Music]

Speaker 1: My daughter, Angelina, she is an amazing person. I am lucky to be her father.

Speaker 2: The word that probably best describes her is joy. She is a very joyful person.

Speaker 1: Angelina is adopted, and the moment when later in life, we actually met Angelina and heard that she was available for adoption, it was just like, boom, she's our kid. A little bit of that feeling of, when you see your biological child for the first time, and we knew.

Speaker 2: Angelina is dealing with a variety of health conditions. All of them stem from the fact that she has cerebral palsy.

Speaker 1: What we know about Angelina is that she does struggle with pain and discomfort from day to day, and we can see it in her face. Some days it's much worse. Some days it's much better.

Speaker 2: Because she is nonverbal, we don't always know how bad it really is. I think she lives with pain pretty regularly. There's definitely days where it just feels like it's never going to change. This is just going to be life forever. I would want health care providers to know that solutions to pain will greatly improve people's lives and that just because we're not in your office every week, telling you that our child is in pain doesn't mean it went away. It means we're probably just muddling through.

Speaker 1: The best thing that Angelina has given our family is just her joy. It's what she brings to every community. She brings it with her smile.

Speaker 2: She is not giving up. She never gives up. That girl will go over and over into the next situation. Even if the day before was hard, she'll go back the next day with a smile on her face, and she'll try it again. All the way around.

Speaker 3: Samantha is a very happy child who loves her independence. Any way that she can do something by herself, she will try to do it.

Speaker 4: When I describe my daughter Samantha, she is pretty energetic. She's full of energy. She likes to be the center of attention.

Speaker 3: Samantha came very early to us. She was born at 23 weeks due to me having pre-eclampsia and help syndrome. She was born at Abbott down in Minneapolis by Children's Hospital. Through that, she was in the hospital for not that I was counting, but 142 days. She had seven surgeries in that time frame. We were told she may never walk, she may never eat, she may never be able to do all these other things that these kiddos are doing. I guess my husband and I looked at each other and said, we're in this together and God has the choice. We had the opportunity to not continue her life. That is one of the things that was brought up to us and we continued. We knew that we had the support system behind us with our parents, our friends, our family.

Speaker 4: When she does feel pain, we don't always know what's the cause of it. Frequently, one of the more common ways we see her express pain is like she'll wake up in the middle of the night, and she might be like her muscles, because of her cerebral palsy, might be stiff and sore and contracting, and we're trying to reposition her and it may help for a few minutes and then she'll be up again.

Speaker 3: Dealing with pain on a day to day basis for our daughter can be hard. Sometimes not knowing that she is in pain is sometimes also very hard. Samantha has participated in, I believe it was three different research projects that Gillette did. Two of them were a video recording of how she reacted to different pain things that they were doing on the back of her calf. The other main one that we recently did was she just had a double hip surgery done a year and a half ago. A lot of that was pain management after a major hip surgery and what pain she was in, what drugs she was on to help maintain that pain.

Speaker 4: I think the best part about being Samantha's dad is seeing her overcome the challenges that she's had so far. Seeing where she started at like 16 ounces when she was born to where she is now. It's been a really dramatic improvement that, frankly, a lot of people didn't think was going to happen. Seeing her how far she's come, gives me hope for how far she can go in the future.

Dr. Chantel Burkitt: I hope that's helpful to hear from the actual families that experience it every day and gives you some insight into what that's like. I'm sure you already have some, but so I just wanted to share two great resources, specifically that we'll get into some pain education. This one is on the Well Child website and speaks to some resources for non verbal patients that are less able to communicate their pain there's a great video, and there's a fact sheet that is designed to explain

signs of pain to look for, as well as what parents can do, as well as what providers can do to help support patients in the best ways possible to help manage their pain. That's a really great resource. There's also this toolkit where there's 15 vetted tools for patients with physical disabilities. It's freely available. It also provides clinical practice points to help improve clinical practice around pain management. Just as an overview, it is important to help families understand how to assess for those differences in pain. Sometimes that can be looking for times when you're pretty confident that there's pain, as well as comparing that to times when you're pretty confident that there is less pain or no pain and looking for differences. Things like differences in expression or body position. Gathering as much information as you can about triggers, things that make pain worse, things that make pain better, and be able to look for ways that pain affects daily life, and that can help direct treatment as well. For example, if pain interferes with sleep, that might be something that can be helpful to improve upon. There's pain assessment tools we'll run through quickly. These are all in the handouts as well. For example, the RFLC is a great assessment to use inpatient or for acute pain. Allows you to rate different signs of pain observationally, so it doesn't require verbal self report. Same as the pediatric pain profile is a very simple assessment tool. Easy to score. It also has cut points to tell you when the pain is clinically meaningful and it requires treatment. It can also help providers to track the pain over time and to know when that treatment may be effective or maybe when it's less effective. That can be really helpful. Pain interference is really helpful to look at and marking how pain interferes with life on a daily basis. This can also really direct treatment. For example, we had clinicians implementing this in one of our clinics, and they had a family that said, Well, we don't really need to talk about pain today. Everything's going okay? Then they filled this out and found out that pain actually interfered with mobility and that the AFOs or the orthotics really needed to be adjusted, and they left that day with less pain, which made me really happy. This pain assessment tool has been recently adjusted to be easier to use for self report and also is available online. Just in summary, chronic pain can be assessed better if it's assessed consistently, potentially at the same time or at the same time each week. Best if it's using a systematic assessment methodology, but it can really help you with being able to make these complex, challenging problems a little bit more concrete if you're able to track that pain over time and can help with shared decision making if the family is able to see those assessment scores as well. Then also assessing how that pain impacts life can be really important because you might have a pretty mild pain that you think maybe isn't that important if it's maybe rated at a two out of 10. But for example, if it interferes with sleep every day, then it's probably a really big problem that needs to be dealt with. Families say over and over again that they don't want to be in charge of solving the problem, but they want to be listened to, and they want to be trusted. They also want their expertise to be acknowledged in terms of they know their child best. Building that confident, trusting relationship is important. If you don't know the answer, it's okay to ask colleagues and find those answers. They don't expect you to know everything, but just being that trusting partner. Then I also want to invite you, of course, to be a part of our special interest group for pain and developmental disabilities because there's lots of experts, but we always need more clinicians to be involved, and hopefully we can create a network of people that can lean on each other to help with these challenging cases.With that, I will turn it over to Dr. Dalberg.

Dr. Todd Dalberg: Thank you, Dr. Burkitt. Thank you, everyone, for being here today. I really appreciate the opportunity to talk to you about pain management within chronic complex conditions, specifically cerebral palsy, but it really expands to other conditions as well. First of all, some definition, what is pain? Pain is an unpleasant sensory experience, an emotional experience that is based on actual or anticipated tissue injury. That's what the International Association for the Study of Pain will tell you. Now, I know folks in San Francisco, you have the great luxury of having Dr. Friedrichsdorf as a colleague rather. His definition, which I've once I heard, I've never let go of is pain is whatever the patient tells you it is. I've extrapolated that to our non-verbal patients to say it's whatever the parent or caregiver says it is. The perception is my perception. That really helps framework my approach to their distressing symptoms. So children, it's good to recognize what they're at greater risk for with their underlying condition of cerebral palsy. Certainly reflux, which

could be nutritionally motivated or just chronic inflammatory state. Gastritis is important with that. Constipation is almost universal within this population, and I find always almost under recognized in most cases as a contributor to pain. Pancreatitis or certain medications, Valproic acid being one of them, and hypothermia that can predispose to pancreatitis. Hypothermia, we don't think that's a common occurrence. However, in the spectrum of dysautonomia, where you have temperature instability, autonomic dysfunction, hypothermias can certainly exist. We have patients who can drop from 98-95, 92, even upper 80s can be alert, oriented, and shockingly doing okay. Cholecystitis associated with G-tube feeds, urinary tract infection, of course, for intermittent caffeine, and certainly with an indwelling folly, nephrolithiasis, kidney stones, medication being to pyramate, acutogenic diet, which we'll see with intractable seizure disorders, as well as immobility. Hip dysplasia, subluxation, predisposing to inflammatory processes, dental pain. I think that's also another under recognized area. Fractures, osteopenia, of course, it's so difficult; you can have a fracture even without signs of swelling, redness, but there's usually some sort of clue, like a range of motion, positioning, etc. I like to break these down into three categories, just as when I frame how I approach these patients, one, GI, two, GU, and the last of which is ortho. Now, of course, astute audience members will recognize that teeth are not bones, but from my conceptual approach, that's how I like to do it. How do we assess pain? Doctor Burkitt gave a great overview of that. I won't belabor, but the root source is so important and asking a myriad of questions is imperative. So what descriptor is if the patient is verbal, I want to know the qualifiers. Is it dull, achy, burning, sharp, shooting, radiating, tingly, numb, etc. If they're nonverbal, that's where we rely on those pain assessment skills in particular and just patient parent perception. What do they see and when do they see it? Of course, physical exam head to toe. It's again, so easy to under recognize and just see here's a patient and family that's in severe distress. I want to do something about it. Let's treat you with some pain. Head to toe exam. Labs, it depends. I find in my personal practice, I use labs as confirmatory and imaging as confirmatory versus a shotgun approach where I just order it no matter what. It's actually rare that I order blood work and occasional where I order some imaging. Some higher yield ones, you're going to look for inflammatory, infectious aspects, and then imaging. Usually, abdomen, sometimes a pH probe can be helpful for that gastritis reflux, abdominal ultrasound looking for stones and endoscopy, sometimes for refractory pain that you really think is GI related. Let's move on to pain management. I break down my approach to pain in four different categories, and that really helps frame my treatment approach. So inflammatory, nociceptive, so that's any tissue that can be organ or visceral-related, and that can be deep or superficial tissues. Neuropathic, also in the spectrum is dysautonomia, visceral hyperalgesia. Then what I coin is life pain. I don't know if I've actually coined that, but I started using it eight, nine years ago. What it really means is functional pain. During COVID, life pain became very apparent, and that's when I started to see the prevalence of that and use that terminology. When I think about management of inflammatory pain, so this could be your gastritis, reflux, otitis, subluxation of the hips causing arthritic pain. Obviously, NSAIDs common approach. No problem there whatsoever. Think of Celecoxib or Celebrex as a good option, especially those who have a history of gastritis reflux and you think are benefiting from an NSAID and would benefit from a routine treatment of an NSAID. Don't forget about diclofenac, which is a topical 1%. This is available over the counter, but available by prescription as well that you can use topically for more localized pain, especially when someone has a contraindication like a GI bleed for whatever reason. Proton pump inhibitor. I will consider these in the short term. I tend to avoid long term use of PPIs, in the literature, predisposition to dysbiosis of the gut microbiome as well as osteopenia. I also, as I mentioned earlier, embrace a lot of integrative holistic approaches I use essential oils, peppermint, wintergreen, Arnica in combination for topical use two, three times a day and parents really find it beneficial that they can do something with their hands on to help alleviate pain and suffering in their child. For a severe refractory, there's always opioids or a trade off. I will use them in limited cases for a limited duration and have that open honest conversation with parents that this is not a long term solution, it's a very short term solution, and it's after your fourth, fifth, sixth step of intervention and you're in a pain crisis. Nociceptive again, treating the underlying source rather, whether that's dystonia, at Gillette Children's, we have a robust PM&R

department, so I rely on my colleagues heavily when it comes to dystonia, hypertonicity, using baclofen phenol injections as a great resource baclofen, whether that's enteral or intrathecal, tizanidine is another example for an anti spasmodic. As mentioned earlier, when we're doing that head to toe assessment, we're looking at in part the skin. All this equipment, whether it's a wheelchair, AFOs, TLSO has a potential for causing pain and worse skin breakdown in a wound. It's not uncommon where a child or a young adult can slip through a number of cracks only to find that the great distress was from some other equipment. Again, for severe pain, I don't promote opioids. I'm very holistic and integrative minded, but I will use them, as I said earlier, for a short duration, limited quantity. Neuropathic pain certainly gets more challenging. When you think of neuropathic pain, there's other symptoms that can allude to this when a patient is non verbal. Of course, if they can tell you, it's burning it's tingling, it's numb, it's shooting, it's radiating, that's very helpful. However, if there's corroborating symptoms like heart rate of 160s, flushed skin, sweating, dilated pupils, temperature instability, all of which can allude to dysatonomia or autonomic dysfunction. This is when I get into the gabapentinoids. This is just general information dosing. I don't think too many people expect outside of this field to initiate medications. Gabapentin is, I mean, it is pretty common and you can feel confident to start this and then refer so that the patient has a bit of a leg up on a treatment plan as they're waiting to be seen by someone else. I add ketamine and methadone. Those are just in our wheelhouse to use for additional refractory neuropathic components. That being said, that's pretty much in the purview of palliative care pain medicine. Then life pain. I use this metaphor with patients particularly who are more neurotypical, but anyone who has that receptive capacity to understand The Bermuda triangle. Most people have heard of it, whether it's real or not, I don't know. But it is a good metaphor in that there's three elements to pain. If we don't address all of them, we're doing a disservice to that patient. Of course, we think of pain, but we also know that pain influences sleep and pain influences mood and vice versa. Once you get trapped in this triangle of suffering, it's really difficult to get out and if you're not addressing all three, then we're really not servicing the patient as best as possible. What are my approaches, if there is a history starting of anxiety, mood, depression, starting something like sertraline, that's very common. You're probably quite used to that. When I escalate, I think of medications that can treat both musculoskeletal pain and potentially neuropathic pain. There's data that Duloxetine also known as Cymbalta, is effective for that, Venlafaxine. Additionally, amitriptyline, more common with GI associated pain, Trazodone, if there's pain awakening at night, it's a good option to go to. Holistic, that's part of every I use that as standard of care. A psychology referral for these patients, absolutely. I harp on sleep hygiene. No blue light cell phone tablets, two hours before bedtime. Earthing probably a lot easier out in California than it is in Minnesota, but that's getting your feet on the ground, utilizing the Earth's electromagnetic field. I'm a huge fan of cold plunging and guide patients of all complexities through cold of varying degrees for really short periods of time as a means of reducing inflammation and actually improves mood dramatically through dopamine and norepinephrine. If you're really interested and you just want to have a background of expertise in this field, this is a great document out of Boston Children's, a comprehensive list of virtually all the medications we use with dosing guidelines. If you're just trying to have some confidence of, I want to try this medication. I don't know where to go to for the expert doses because what sometimes we use is different than what you'll find in the literature. This is a great resource. Doctor Burkitt pointed out a number of great resources for families. I'm a huge fan of the Courageous Parents Network, also developed by Julie Howard out of Boston Children's, if you're looking to give families a guide of just how to cope and connect with other families across the country and world who are dealing with a child with chronic complex needs, this is a great resource for them as well.

John I. Takayama: Thank you very much for a very comprehensive presentation. I have a number of questions, but first just to confirm, and I'm going to go backwards a little bit, but I think the first part was the screening and assessing and the second part was management. In terms of management did I hear that right where sometimes you think there's pain and you try sometimes some medications to see if that makes a difference, or I guess maybe there's a parallel move to try to figure out what the

original cause of the pain is. But to suspend the treatment while you're figuring out the cause may lead to prolonged pain. Sorry. I just wanted to double check.

Dr. Todd Dalberg: Yeah, great point. I think I mean, treatments can be both therapeutic and diagnostic. If I'm suspecting a particular source of pain, whether it's inflammatory, nociceptive, neuropathic, I might just do an impairic treatment, and that might inform me that, oh, they responded well to this, so that helps me understand the source of the pain. I don't typically suspend treatment, especially when we're in a distressing situation. I'll escalate with other medications before the peeling off the medications I think are least helpful and are most harmful. That help address that point?

John l. Takayama: Yes.

John l. Takayama: Both have to address both. There is a question very specific about ketamine. Is ketamine delivered IV, oral, nasal, low-dose continuous infusion, or bolus?

Dr. Todd Dalberg: Great question. We use it in both IV and enteral or oral dosing. You can do intranasal. Ketamine it's very noxious. I've never actually prescribed it for that reason. It's been deemed intolerable. IV ketamine has 100% bioavailability, so delivery is fantastic. Depends on your institution. I know UCSF has a policy out of the ICU. At Gillette, we have to be in the ICU to administer IV ketamine. We'll do boluses as needed occasionally, but predominantly we do infusions, and the data support that as most effective. The enteral oral version it's only 19% bioavailable so you get a lot of first pass associated with that. I have three or four patients currently on oral ketamine. They're actually doing really well with it, so as a long-term solution, relatively safe, and it's always low dose so the side effects are quite minimal, if any.

John l. Takayama: Thank you. Dr. Burkitt, looking back at some of the video that you had showed earlier, where I guess parents seem to know that their children have some pain, probably because of symptoms such as crying or becoming tense or changing behavior during the course of the day. I'm wondering if the prevalence of pain in certain developmental conditions is high enough that maybe we should start screening earlier than waiting for a parent to ask is there pain? I don't even know. Maybe parents might feel ashamed, or it might be hard for them to broach the subject of pain?

Dr. Chantel Burkitt: Yes, I think that that would be amazing and a great progress in the field. I think there's been a longstanding bias or belief that there wasn't a lot of pain or that pain wasn't a problem for people with developmental disabilities. I think that stems from it wasn't that long ago that we didn't believe neonates didn't feel pain and so we're a long ways behind in the research and the evidence to support those things. But I think the more that we can get providers to understand the severity of it and be the ones to bring it up and start those conversations, the better that that relationship will go, especially if you start that early before maybe it becomes a problem. We've seen that so much at Gillette's, even like orthopedic providers that before didn't talk a lot about pain, the more that they talk about it and bring it up to families and ask detailed questions, the more that the families will have a more constructive conversation about it, versus not feeling like there's a window into that conversation.

John l. Takayama: Using some of the screeners that you hadn't.

Dr. Chantel Burkitt: I think you get a lot more information when you use those specific questions, and it gets people thinking. They might say, no, pain is not a problem. Then once they see that, well, pain does interfere with sleep, and actually, I do see that pain interferes with their mobility, and it starts, it helps them remember those things that might be otherwise hard to remember.

John l. Takayama: Also screening for things like sleep and constipation, etc..

Dr. Chantel Burkitt: Yes, exactly.

John l. Takayama: Great. There's another question in Q&A. How to help a child who is low verbal and cannot isolate the pain to treat the pain accurately, especially when the pain is often.

Dr. Todd Dalberg: That's every day what we see at Gillette and that's the mystery of pain. That's where those environments, whether it's during transfers, sitting in their wheelchair, bracing temperature, when they go outside. Are they due for Botox and phenol, and their tone is ramping up, so their distress and pain is ramping up? Using medications like anti-spasmotics in those periods where the Botox is worn off, important. Have they had a recent orthopedic surgery? Are they still recovering from it? Do they have a skin breakdown wound, an inflammatory component? General rule of thumb it's the gut until proven otherwise. It's always a great starting point. Even when a family says, yeah, they have regular bowel wounds, tell me what regular means. About once a day, maybe every two days. What's the volume? It's moderate normal. Well, I don't image often, but every once in a while I will, and I'm always impressed at how much stool burden a child can bear so constipation, GI, optimizing bowel management, and I'm a huge proponent for blenderized nutrition, I put a huge plug in for blenderized options I don't know what insurance reimburses in California, Minnesota. We have five different FDA-approved blenderize formulas that are available and are wonderful for constipation, gas bloating, gastritis, and influences the brain as well.

John l. Takayama: Well, thank you very much. As I'm thinking about pain, I'm wondering if sometimes we prescribe the very triggers that might cause more pain. What comes to mind is physical therapy, where, especially in a child with cerebral palsy, physical therapy may be really helpful to reduce the spasticity from becoming worse. But perhaps that might also cause pain. Do you ever pre-treat or do you ever, I'm thinking that for some children, pain may be cyclical, maybe worse in the afternoons if you do therapy in the morning, it's not so much of a problem, etc.. I'm wondering other factors that might help with reducing pain.

Dr. Todd Dalberg: I think physical therapies, all therapies, all approaches really depend upon the comfortability of that treating provider. Again, we're blessed at Gillette to have therapists, occupational speech, physical that are well in tune and understand restrictions. If you find that the experience or the comfort confidence isn't there, there's potential risk of referring to just to do PT for the sake of it, maybe not in the child's best interest. To your point, I think other aspects, anxiety, also really underrecognized, and anxiety is based on trauma. These patients who have been surgerized over and over, medicalized over and over, they have an immense amount of trauma and one of the key histories that you can take is if you pick up on the distressing symptoms start when they enter the parking lot, or they take the exit. Those are the detailed history points. It's clear that anticipatory anxiety is driving their dystonia, their pain, you name it.

John l. Takayama: Then there are a couple more very specific questions. Can you expand on cold plunging and the benefits of this motor therapy?

Dr. Todd Dalberg: I could talk forever. Dr. Burkitt knows. Dr. Burkitt also cold-plunges. The physiological benefits, one, there's about a 500% increase in dopamine that is sustained for at least 4 hours. There's a 250% increase in norepinephrine, also sustained so these are going to immediately modulate your mood and pain perception. It decreases inflammation, so joint pain, back pain goes away. You just get a sense of clarity and focus that is incredible. There's also a huge cardiometabolic benefit. There's something called brown adipose tissue, or BAT, that we lost as soon as the thermostatin air conditioner became commonplace. Brown adipose tissue is a heat-generating thermodynamic tissue that burns white adipose tissue, which is one of the more lethal tissues in our body. When you get cold, you start to build up brown adipose tissue, and instead of shivering after cold plunging for a period of time, you'll find that you actually don't shiver anymore because you're generating heat not by shivering, but by activating brown adipose tissue, getting rid of your white adipose and visceral fat.

John l. Takayama: I guess all of us should be cold-plunging.

Dr. Todd Dalberg: Yes.

John l. Takayama: Then we can let people know what it's like.

Dr. Todd Dalberg: I'll just piggyback by saying it doesn't have to be like you watch on YouTube or TV. You can just start in your shower, 30 seconds at a time, build up to 60 seconds. If you want to read more about this, Wim Hof, W-I-M-H-O-F. He's the Iceman out of the Netherlands who wrote the book on breath work in cold plunging.

John l. Takayama: One of the audience ask is are there any conditions where cold-plunge could be dangerous?

Dr. Todd Dalberg: Most definitely, if you're pregnant, you don't want to cold plunge. If you have heart conditions, you don't want to cold plunge. But for diseases of age like dementia, multiple sclerosis, autoimmune diseases, it can have profound effects. If there's any concern, of course, talk to your physician. I don't recommend it for everybody. In my practice, I've had patients with GMFCS 3 and 4 who have cold-plunge, and it's amazing. I get the parents of these patients to cold-plunge too because they're in the throes of it. They're suffering, watching their child suffer. Within a week, if you do it consistently, you're going to find some benefit.

John l. Takayama: Final question, Dr. Burkitt. As AI progresses and we're able to process more data. I know that things like blood pressure and heart rate can be associated with other signs of possible pain. Do you foresee in the future additional ways to assess pain or screen for pain?

Dr. Chantel Burkitt: I hope so. That's my dream for a long time now is that we would be able to build on things like the aura rings and the whoop bracelets and be able to have a better sense of when our patients, especially those who are less able to tell us about what they're feeling when they're having, especially a severe pain episode that they'd be able to to have a voice through that, it's definitely something we're interested in and would like to continue exploring. Maybe not there yet, but definitely see that as a possibility. I know there's been lots of work on that in the NICU and some progress made, and I think there's definitely hope for that. We've also been exploring biomarkers. Through saliva and other sampling techniques. I think we're always getting a little bit closer. That's our hope that there are other ways to better understand and pinpoint, not just the experience of pain. I think our scales and our measurement approaches that we have do a pretty good job of assessing that there's pain, that it's burdensome, that's interfering with life. But if we can get better at understanding the mechanism of the pain so that people like Dr. Dalberg can know for sure that it is neuropathic pain or it's nosiplastic pain, and that that could direct the treatment if we could find ways to be a little bit better at directing that type of treatment path, that would be ideal.

John l. Takayama: Well, doctor Burkitt and Dalberg, thank you so very much for the presentation.

Dr. Chantel Burkitt: Yes.

Dr. Todd Dalberg: Thank you.

Dr. Chantel Burkitt: Thank you so much for having us.