>> Thanks everyone again for joining us here today. I hope this is helpful information for you, whether you're joining us live or in a recorded format after the fact. I understand that as well. Today we're going to be talking about making power wheelchairs smarter. This as Becky was saying is sponsored by LUCI, they do make some very innovative new smart wheelchair technology. There's not a lot of this on the market yet, but this is our topic today. Let's dive on in. If I get my slide to move here. We have the following learning objectives for this CEU course here. The participants will be able to define smart technologies in the context of power wheelchairs. The participant will be able to list three features of smart technologies and the participant will be able to describe three clinical applications of smart technologies. This is what we'll be covering here today. We're going to talk about the need, the technology, the human, and the products. We're going to talk about why do we need these smart wheelchair technologies? What are the limitations of our current power wheelchairs? These primarily center around safety and efficiency and the technology, just what is smart wheelchair technology? How does that fit into the realm of assistive technology? How is this classified? This is important when we have a newer technology to make sure that we have a clear definition of just what this is. Then we'll have the human who could benefit from this technology. What are the applications? Then finally, we'll dig into the actual technologies that are currently available. Hopefully, we'll have even more here in the next number of years. If you have questions or comments as we go along, as Becky mentioned, feel free to put those in the chat box wherever you want. I will be stopping periodically to take those questions and we'll have more time at the end as well. The main goal of a power chair is pretty clear. It's to provide mobility, its to provide an alternative means of mobility to get through the environment for people who either are unable to ambulate or walk or to self-propel any type of manual chair. Now, occasionally there may be a client who actually can ambulate, but is an inefficient or unsafe in ambulation who may require a different type of mobility device including a power chair. There may be a client who can push their manual chair, but not very efficiently. Those clients may also be a candidate for a power wheelchair. Now, power chairs do a lot more than just get us around in addition to driving. This is going to vary by the electronic system on that individual power wheelchair, because we have a number of different electronics options. These chairs can also allow the driver to control power seating, such as tilt, recline, seat elevate. To emulate a mouse so that the driving method can be used to control something that can be accessed through mouse access like a communication device, like a computer, like a tablet. We can also use this Bluetooth to emulate a switch output. We can interface external assistive technology devices, also providing a means of the driving method, controlling not just the power wheelchair for driving, but other external assistive technology when we're not using Bluetooth. There's infrared transmission on most of these though this is getting outdated pretty quickly. Some of these chairs include a charging port for all those USB devices that we carry around with us. Then there's some information provision through the power chair as well. I can find out the status of the battery, how fast I'm going. My clients really like to see how fast they're going, how many miles I've traveled in a time period. I can check what time it is. I can get diagnostic information. The system may be able to monitor certain things

about the power wheelchair, the status of the power chair, including, again, those time of driving or driving distance, how many hours the power chair has been on, power seating activity. Is this client doing their weight shifts? How often? How long? These are sometimes capable of providing a notification or reminder like, "Hey, it's time to do that weight shift." But power chairs do have limitations. They're heavy. These power chairs often weigh between 3 and 400 pounds, so quite a bit and that's without sitting and without the client. These require accessible transportation and accessible destinations. This is not something you're going to lift and throw in the back of the car or a pickup truck. You need an accessible vehicle. Getting out and in of buildings is also very challenging. Getting through crowded spaces can be difficult as well just because of the size of this power base. But what's particularly concerning is efficiency of driving and safety of driving. Driving a power chair can be rather inefficient because this is dependent somewhat on the drive wheel configuration. After we complete a turn, the casters are skewed, they're crooked they're in the direction of that term. Here we have a mid-wheel drive chair and we have the front and rear casters. After this person has say turn to the right, the casters still turn to the right. If I give a forward command, it's going to pull the chair off course and I have to compensate for that. That may not seem like a big deal, but for someone who's using a joystick or particularly switches, like a head array, that can be hundreds of compensatory movements throughout the day and that takes more effort and more time. There is something called tracking technologies, which help the chair stay on track. But often this is not recommended by a team. It might be that people forget to recommend this because it is optional. That means it has to be justified and it can be denied. Also impacting driving efficiency is a drive wheel configuration. The alternative driving method that's being used if this person isn't using a joystick. Even more of a concern is safety. The current design of the complex rehab power chairs we have are unable to prevent collisions, going over drop-off, or tipping over. Now, in the world of power wheelchairs, we have consumer level power wheelchairs. Often these are the ones we might see in a television ad, at least we used to see more of those. Might have a simple captain seat on it and usually not a lot of bells and whistles. These don't work well for people who require more customized seating. May not be able to use a standard joystick, need more programming, need more advanced features. Those clients require a different category of mobility and that's complex rehab power wheelchairs. Since these complex power wheelchairs as sophisticated as they are, cannot avoid these situations, then there's a reliance on the driver to first note hazard and then second, be able to avoid these. If you go into a home of someone who's a really good power wheelchair driver, you're probably going to see walls like the one pictured here on the lower left. It's just very difficult not to cause harm with this very large heavy base. Let's look at some specific facts about safety. I was really surprised by these. I've been working in power mobility for over 30 years. I had no idea that the stats were so high when it came to issues with safety. There was a study, this was from 2010. It takes a long time for these retrospective studies to come out. A study of US emergency room visits for kids ages 2-10 using mobility aids found that 67 percent of injuries were related to falls from wheelchairs. Now this includes manual and power wheelchairs. But we have a fall occurring and that is leading to injury enough

that someone's brought this child to the ER. 87 percent of wheelchair users reported at least one tip or fall in the last three years. This is something I'm starting to ask the clients I work with during an evaluation. I'm asking them if they have fallen out of their chair, if they've tipped their chair, if they've had any injury related to use of their chair. I'm documenting that. Another study showed that forces of impact from the chair actually tipping over and rolling. That's a scary picture, isn't it? Result in significant risks from mild to severe head injury. Well, yeah, I think so. Depending on the chair position and restraint at the time of the incident, it depends how the chair lands and if that puts the client's head at risk and whether they were restrained, meaning do they have a pelvic belt on to keep them from ejecting out of this chair. Over half of the accidents reported over a 10-year period in our final study here, resulted from drivers that were impacting a stationary object. That could be a wall, it could be a column, it could be a post sticking up out of the sidewalk or encountering environmental hazards like uneven terrain. That could be grass, gravel. It can be the difference between a sidewalk and a gutter, for example.

Driving a power chair is harder than it looks. It sure doesn't look hard if you haven't had a chance to hop in a power chair and try it out, I would encourage you to do so. It's not as intuitive as you think, even if you've played a lot of video games and played around with joysticks. Some of the main reasons that caregivers are reluctant to even consider using a power chair for their loved one is worries that their loved one, the driver won't be safe. That they might hurt someone or damage the environment. I might really want my loved one to be as independent as possible, but I may not be as tolerant of them, ripping up all the walls and door frames in my home. Smart wheelchair technology can provide increased driving efficiency and safety. That can in end protect the driver themselves from injury, protect others around them. It's not fun when you get run into by a power chair, and it can also protect the environment. With that said, we're going to move into definitions, terminology and classification. I know that doesn't sound exciting, but it actually is, at least we will hope it is here. This is really new and I've been talking for a little bit and it really helps to get some contexts. I'm going to play a video here to give you an idea of one of the smart wheelchair technologies. It's now available and that is LUCI.

>> [MUSIC] Introducing LUCI, revolutionary patented technology for power wheelchairs.

>> Hi mum.

>> Hi honey. [BACKGROUND]

>> LUCI believes in real-world technology inclusion. [MUSIC]

>> Alexa, ask my LUCI if my chair is charging. [MUSIC]

>> The battery is approximately 80 percent charged. [MUSIC]

>> [BACKGROUND] An incredible driving experience with cutting edge drop-off

protection in hardware and software providing a first of its kind, collision avoidance for your world to wheelchair better, safer, faster, and smarter.

>> Say cheese [MUSIC].

>> LUCI is modern mobility. [MUSIC]

>> It's called LUCI, it's attached to my chair, and it knows where all the curves are. [BACKGROUND].

>> That means more independence, more fun, and a chair that finally listens to you. With a HIPAA secure platform and app for the information you care about. [MUSIC] Wheelchair smarter with LUCI. [MUSIC]

>> Very cool stuff. Just what is a smart wheelchair? Well, a smart wheelchair is integrated part of the power wheelchair or retrofitted onto that power wheelchair, self monitoring technology for a power chair that provides enhanced and independent mobility to a wheelchair user, is able to collect and report user health and wellness data and provides connectivity to integrate with the connected world. Smart actually stands for something, Self-Monitoring Analysis and Reporting Technology. Now that's a mouthful and why I think most of us can start giving some context is with some of the newer vehicle set are on the market. Vehicles have had backup cameras for some time, but now have far more sophisticated sensors that might let you know, "Hey, you're getting out of your lane or I'm going to help, correct you, keep you in your lane". There's other sensors that might automatically slow you down or even stop the car if there's an obstacle in front of you, and then also sensors that report what's happening behind you. Instead of only relying on the backup camera, I might hear a tone that lets me know, "Hey, there's someone walking behind my car in the parking lot." This is bringing some of this technology to the world of power wheelchairs. We have a comment here from Mike. He says, "I have experienced most of these types of wheelchair accidents". I'm very sorry, Mike, [LAUGHTER] that that has happened to you, but yeah, they're all too common and like I said, I'm starting to ask the clients I work with, how much does this happen if they already are using a power chair and it's amazing how common these things are, it's problem. Someone else's said, Alexandra, "A smart wheelchair would be wonderful for visually impaired or blind users like me". Absolutely, when we get to clinical applications, we're going to talk about this. I think that for people who have any visual impairments, this is a very useful technology. Many of the clients I work with have cortical visual impairment and this technology can be very helpful with that group. Mike has mentioned a sensor that stops the chair. Yeah, let's get into sensors and how this works. Again, we have that mouthful here, Self-Monitoring Analysis Reporting Technology. Self monitoring sensors that can provide environmental surveillance. These sensors may, depending on the technology, be able to detect an obstacle, be able to detect a step or curb, be able to detect the slope of an incline or ramp. By detecting an obstacle, the chair, depending on the rest of this package, can stop the chair before that obstacle is hit. It can detect steps and curves, drop-offs to prevent the chair from going over the edge and detect

slopes because these power chairs, as much as they weigh, can tip over rather readily even on what I would consider not too steep a slope. Analysis where a software on board as part of this package that provides analysis of the data from the sensors. It also, depending on the technology, can take account of the users reaction time, which is cool because each of us react at a different time and some of the people we work with who were using power mobility may have a delayed reaction time. Some of these systems like LUCI, can accommodate and learn that person's reaction time to work efficiently with them. A brain, to send a response to the power wheelchair electronics to avoid that collision or drop-off or otherwise modify where someone's driving and how fast. You have a sensor, it sees what's going on. Software that analyzes that, but then an actual connection to the power chair so that the power chair responds differently depending on what the sensors say. Then a communication reporting system that stores and reports data, situational data, machine data, even data regarding the health and safety of the rider, and this is something that's still greatly emerging. Again, this is technology which is either integrated or retrofitted to a power chair, and you can see here these are examples of some of the sensors that are available.

What does this look like? That's a lot of terminology again, what does this actually look like? Well, it's available along a continuum. Smart wheelchairs could include any of the following. Perhaps a sensor that might warn you of a collision, but not do anything about it. The onus is still on the user to respond to the warning. A backup camera that also warns of a collision. Tracking technologies that can increase driving efficiency. Sensors that actually prevent collisions or drop-offs, but still allow the client to drive, so there's no automatic driving going on. This is not like those driverless cars, these are only assist. Then sensors that monitor the environment and modify speed to allow driving without collision so the driver is still in control, but the speed is modified to make sure that an obstacle like a person walking in front of the chair is not collided with. Then finally, the furthest aspect of this continuum, with sensors that either follow a pre-programmed map or tape on the floor for nearly automated driving the client really just has to hit a switch to start the process. Then smart wheelchairs, as I mentioned before, can also provide communication to external devices. We saw in that video that this young woman was asking Alexa, what the status of her batteries was. This will work with these type of virtual assistance and there's quite a bit of information that the driver or caregivers can receive, and then monitoring of driver health information. Right now it's possible, depending on the type of wearable the person has, like a little more sophisticated Apple Watch that I have. You can monitor someone's heart rate, for example. Let's take a closer look at this continuum and the product options. One of your handouts is entitled Smart Wheelchair Automation Levels. We're talking about real cutting edge technology here, and that means the information changes. From the time that I started working on this document along with Jered Dean, who is the designer of the LUCI system, we've definitely made some updates to it. If this is something you find helpful, you might want to check out. Hopefully this will be posted on the LUCI website here soon, but it's something you can see if there's a newer version of. You can also email me and I'd be happy to send you the latest version. Starting at the

lowest level of intervention, we have a situation where the driver still has to monitor the environment. They're only receiving a warning, and so there's really no automation here. We have this on the chart because I think it's important to know what comes right before the smart wheelchair technologies come in, but this isn't really technically considered a smart technology because it's not integrated into the wheelchair electronics. It's not going to modify the driving. That onus is on the driver. There may be sensors that warn the driver of a hazard, but again, are not integrated, the driver has to respond. These will warn the driver of potential collision or other hazard. These are available from Braze Mobility, ASL or Adaptive Switch Labs, and LUCI. Braze Mobility has warning systems based on their sensors, and their warnings are auditory, visual or haptic, you might actually feel vibration. ASL has sensors that are mounted in areas of the chair that will make a noise to alert someone that they're getting close to potential obstacles. These are photoelectric switch, and then LUCI has a sensor that will warn the client that they might be approaching an angle of incline that could lead to tipping, but this will not stop the chair. The reason is that there's inclines in our environment where we know they are higher than they should be. The client just needs to be very careful on that incline, but still needs to be able to drive the chair up that. We also have backup cameras. Quantum Rehab recently began offering an optional backup camera on it's complex rehab power chairs. There's also a couple of other companies you see listed here. They have been making a backup camera that can be retrofitted as well. But these warn someone. They warn someone if I'm looking at that backup camera, of what could be behind me, but I have to interpret the information I've seen on that screen and make a driving decision based on that, and that can be a challenge for some drivers. Here's the switch for Adaptive Switch Labs. Again, it's a photoelectric switch. You can get two or four of these, put them in the front or front and back, and you'll hear a alert. You can adjust these between four and 24 inches. Now, if you make this a really long activation distance, it's going to be beeping at you all the time if you're driving through your home. If it's really short, well, if you get close to things, it might still be blurred and then people tend to start ignoring it a bit. Or depending on someone's response time, they may not have time to respond without hitting something. They might hear that beep, let go and still run into something. These do not detect drop-offs. This is the braze mobility system. It uses ultrasonic sensors that can be placed rear sides in front of the wheelchair. As I mentioned before, the feedback can be visual. You can see that on the upper right picture here, it can be auditory. It can also be vibration. We see vibration coming into a lot of motor vehicles as well. My steering wheel might vibrate to let me know I'm getting close to the lines on the road. You can see this particular sensor on the bottom provides 180 degrees of horizontal detection and about 50 degrees vertically. Let's go ahead and watch a video that discusses this braze mobility system.

>> I've been in a wheelchair just over two years.

>> I've been in a wheelchair for 25 years now. I injured myself in an ATV accident.

>> Two years ago on Christmas Eve, literally, they drop this wheelchair off to me, within hours of me getting in this place, I had pretty much destroyed my apartment.

>> I've done a lot of damage in my house and on my furniture and knocking a lot of things over unintentional. After a while you just start ignoring it because you're either constantly frustrated with the damage you do, and so now it's like two or three dents in a wall a day is just normal.

>> To have a device factor that is literally watching my back, is an amazing feeling.

>> When we added this sensory to the chair, it was just amazing to, it gives you an alert before you hit something, because you don't do it intentionally. Like I said, it lets you know where you are, when you're back.

>> Here we go. Then backup cameras. Here's some examples of the available backup cameras that are on the market. We then move to our next level, but we have a few questions here.

Mike has said, "A sensor that stops the chair when obstacles are available is awesome," absolutely. Danielle has said, "It's one type of sensory it has multiple functions or is it typically a different sensor per function?" We're going to be talking about that in just a little bit, so hang on. [NOISE] Tom, thank you for taking a crack at that question. Tom has said, "Could be a single sensor like a backup camera or multiple sensors like LUCI. They use radar cameras and ultrasonics." Again, we'll talk about all those cool sensors here in just a little bit. This next level of smart wheelchair technology is where both the driver and the system monitor the environment. This could be conceivably a sensor that warns the driver stops the power chair, and is integrated into the electronics of the chair, but there is not a product like that right now. Tracking technologies are available on all of our main manufacturers complex rehab chairs now. These increase efficiency by reducing the amount of compensatory movements that are required. There are systems available where the driver can steer, but the system will avoid collisions, drop-offs, or tipping. This is called driver assistance. It doesn't just stop the chair. The client can still drive, just not hit something. An example of that would be LUCI's navigation assistance and drop-off protection. Then another example where the driver and the system are both monitoring the environment is driver assistance of speed, acceleration, and deceleration. This is where the driver can control their speed, but the system will automatically slow as needed, and LUCI does that as well. Then finally, the ability to do both where there's assistance with both speed and navigation. Tracking technology, we mentioned before helps increase efficiency of driving by reducing compensatory movements. This is available on all of these various chairs and has been shown to increase efficiency quite a bit. We then have where we really get into the hardest smart wheelchair technologies, the ability to assist with navigation, also called steering and speed assistance acceleration and deceleration. If the sensors detect an obstacle or drop-off like a car, the power chair will no longer move in that direction, but can move in another direction. For example, if you're trying to get through a doorway, the chair will not collide with the sides of the doorway, but will allow you to go through. If the client can generally move through that doorway, that's where they'll go, but without worrying about hitting the sides of the frame. With speed assistance, an example would be moving

through a crowd without worrying about running into any one because the speed would automatically be modified. Now, this will make more sense if we actually take a look. We're going to go ahead and see saul here, who actually lives in my neck of the woods as he reports all the difference LUCI has made with steering assistant.

>> You want to keep LUCI or you want to turn her back in?

>> No, I don't want her turn her in. [LAUGHTER]. No, it's useful.

>> It's useful. He has not run into anything since he's had LUCI and that's a good thing.

>> You see the dog is on the way.

>> People like me love that, people like you love it too.

>> Was not going to run into the wall. I feel safer.

>> It's an awesome video and all too common a scenario. In this next video, we have a colleague of mine also in the Denver area, Kelly Walsh, who is describing her experience when she was trying out LUCI with a crowd of people around her.

>> When we simulated walking in a crowd for some reason that stood out to me because it made me realize that this is like an unbelievably normal, typical activity for somebody who is not a wheelchair user, that somebody who is in a wheelchair gets nervous and feels like that they can't be a part of that because they're afraid they're going to bump into somebody. That is what inclusion is supposed to be about.

>> She expresses that so, so well, exactly. There we go. Now, we're going to talk about sensors, and I see we have some more questions about sensors here and hopefully this will clear it up a little bit. Now, again, I'm an occupational therapist, I'm not an electrical engineer, but I've been learning a lot about sensors. The available smart wheelchair technology systems may use either one sensor or a combination of sensors to detect obstacles, drop-offs, and slopes. Each sensor has pros and cons, and so some systems use multiple sensors to help cover those deficits so that we have as comprehensive a sensing situation as possible. Here are the common sensors on the market, stereovision, ultrasonic and radar [NOISE]. Stereovision: we have two of them. Like with our eyes, it helps us to measure depth. We have depth perception because of our stereovision. This can be used to actually map the ground and is used for collision avoidance. But a drawback of this is if there's some really clean glass in front of them, they may not be able to see that and someone could run into that. Hence the need for other sensors alongside. Now, in the LUCI system, there's also infrared waves that are used lightwaves to assist the stereo vision and all lighting conditions. If it's darker, the stereo vision sensors can still see what they need to. Ultrasonic sensors, which are used on LUCI and on the brace mobility system, detect obstacles at night. That's important. They don't rely on lighting. They can detect glass no matter how clean it is, and how far away something is. Well, that sounds great. Why don't we just use ultrasonic? Well, they

do have some trouble with soft surfaces. If there's some curtains that are hanging on the wall, and we don't want the client to still be able to run into that wall behind the curtains. The ultrasonic sensors have a little more difficulty determining just how far away an obstacle is. Then finally we have radar. The pros of radar is they work well for uneven surfaces. They see farther away than ultrasonic. We can better map out what's coming ahead. More specific in terms of distance and placement measures, you can use these to detect in all lighting conditions and these will detect glass. But they can't see everything. They're more expensive and than they use more power. In the LUCI system, all three of these are combined to give the best possible feedback to the system. As I mentioned, Braze Mobility uses ultrasonic, and I believe they're working on adding in another sensor actually type right now. LUCI uses all three of these sensors. All that information is fused together to inform the system to make the best reaction to what's going on around the chair. To avoid collisions, to avoid tips, to avoid drop-offs. The sensor transmissions, and this is really important in the world of medical healthcare are not harmful to the driver. That's important to know and will not cause interference with other devices. Let's say someone's driving around with a vent on the back of their chair. We sure don't want interference with that or other medical equipment. These sensors have all passed some rigorous testing and are certified to not cause interference. We have another question here and then we'll get into our next slide. There we go. Alexandria said, "Can all the different sensors have different vibrations so the driver knows which sensor is what?" The driver doesn't even have to know what sensors detected what at all. The response of the chair is a response to either a single sensor like on the Braze system, or to a combination of sensors where all that information is integrated within the chair. The driver isn't even aware of that. The driver just knows that I'm not hitting the door frame when I'm trying to get through it. Then on, Danielle has said "So the difference let me see here, lost you there, between 2A and 2B is a smart system adjusts the speed. Is it only LUCI that offers that?" Yeah, if we go back here, hold on. Hope not going too fast for you. This is further back than I thought. Here we go. If we go here between 2A and 2B on the LUCI system, there is assistance with steering. That's 2A assistance with speed, that's 2B and driver's assistance with both and LUCI will do each of those. So we can do each of those. Hope that makes sense. When we jump back [LAUGHTER] forward, it rise. I had done so many slides. Here we go. Then. Here we go. Danielle, thank you for helping with that question as well. Then we have this next level in our smart wheelchair spectrum. The system monitors the environment. This is also, as you can see under the name, the second column of this, considered conditional automation, high automation or full automation. First we would have a system that follows a pre-programmed map and modifies driving in response to sensory feedback. There is not a commercially available product that does this right now. However, there is a system that's used at some airports where someone literally gets into this chair from their Uber driver, let's say, and it takes them all the way to the gate of the airport. It's following a pre-programmed map and it uses sensors to keep from running into anything on its way to the gate. Sounds like something that would help me at the airport, but it's not commercially available. Then we have the smile smart system, and it follows a tape on the floor. It also has sensors to keep it from running

into anything as it follows the tape along. The driver only initiates and stops movement with a switch. Otherwise, the driver is not interacting with the driver experience. Then high and full automation would be a system that controlled all features of driving in specific environments or a system that controls all features regardless of the environment, we do not have those systems commercially available either.

This is the Smile Smart System and this young man has activated a switch, you could see the tape on the floor. You can also see the hoop around the power wheelchair. That hoop has sensors in it. I hope that the pillow is not blocking any of those sensors. The sensors are making sure that if anything gets in his way, like someone walking in front of him, the chair will stop. Sensors prevent collision. The power wheelchair follows that tape along the floor. [LAUGHTER] Then we have connectivity to integrate with a connected world, that's a mouthful as well. We live in a very sophisticated environment these days. I've never had a chance to go to the Consumer Electronic Show, but I hear awesome things about it. I try to keep track of some of these things in my job, but it can be a challenge. We have lots of very sophisticated consumer technologies that we are surrounded with. Some of these smart wheelchair technologies have the ability to interface, to communicate with those. Some power chairs, actually, all of our complex rear power chairs have the option to emulate a mouse using a Bluetooth connection between the power wheelchair electronics and an external assistive technology device, like a communication device for example. There's also a Bluetooth connection to apps for very specific monitoring. Permobil for example, has the MyPermobil app. Quickie has the Switch-it Remote Seating app. Then finally, Bluetooth connection to external technologies and this would include virtual assistants like Alexa, like Google Assistant. LUCI has an app called MyLuci portal. It will provide information such as notifications of how many obstacles were avoided, let's say during a period of time, tip alerts. It could even provide a location of where the driver is. It can provide power siting reminders, it's time to do your weight shift. Supports over a 100 phrases with these virtual assistants and is compatible with a number of different platforms. Then finally, Health and Wellness Data Collection. I think this is something that really is just starting. We have a lot of people including myself, who are wearing things like Apple watches, like Google Fit. These systems, these wearables are collecting a lot of information, the latest watch commercials you've probably seen. You can check your pulse ox, you can check your heart rate. It will even let you know if there's an issue, maybe your heart is an arrhythmia. It's really amazing stuff. These wearables can track and that information can interface, can communicate with LUCI. Again, all of our complex power chairs offer Bluetooth and that can be used to provide switch access or mouse emulation to an external device. This is that MyPermobile App that I mentioned, it tracks battery status, distance traveled, power seating activity. It also has an integrated map to help the driver. Quickie has the Switch-it Remote Seating App. It's on certain systems and it will measure and track the duration of seating angles. If you're a therapist like me, you can see just how often did my client do their weight shifts, how far back did they tilt to recline, how long did they stay there? Then this is the LUCI app and again it will provide

notifications if the driver allows it. This is certainly up to the driver of obstacle avoidance occurrences tip alerts. These notifications can be received in multiple ways. For example, one of the clients I work with who uses the LUCI system, if I want I can open the app on my phone. I can see what her driving activity has been today or over the last week or over the last month and see how many times has this system prevented a collision. It will provide that driver's location so that perhaps this driver can have a little more independence that caregivers can go truck them down if they need to. Again, Power Seating reminders. This is an example of the screen on the app when it's tracking someone's heart rate. This can send a notification to caregivers or other healthcare professionals that there's an elevation in heart rate. A lot of people when they are experiencing pain have an increased heart rate and so this can be helpful information. You can track this so that if you're going to an appointment, you can say here's my heart rate activity over the last period of time. Other health features will certainly be available in the future. In summary of this continuum, and then giving us some time to look at some applications, these technologies fall on a continuum, a spectrum of interventions. Some of these categories are not currently represented by a specific product, but could be. Knowing where each of these products fall within a hierarchy is very important. There is a resource on us, it's available at no cost. You can request a print copy or just download a digital copy. You can find this on LUCI.com and it's called Judging Smart and the ideas to start a discussion about these technologies. All right I'm going to take a second for some questions here, and then we'll get into clinical applications. Alexander wants to know if we have access to this webinar later after this is over. Yeah. This will be available on the Closing the Gap website for about a month. We have some wells on here, I agree. Isn't new technology and innovation so exciting? I am so onboard with anything that could be helpful to the clients I'm working with. If you have more questions or comments feel free to type them in there and I will stay on top of those. But I want to make sure we have time to get into clinical applications. Let me go ahead and start this video right there, [NOISE] and then I'll make it quiet. This is my little buddy Miles. Accessibility is a big deal when we're driving power wheelchairs, maneuvering around tight spaces is very difficult. This young man is in the lobby of our local equipment supplier but imagine if he's at home right now. This is during an evaluation. Other examples is, for example driving up a ramp into accessible van, lining up with tie downs, moving around a crowded classroom. These are all very challenging situations, and these Smart Technologies can help with those accessibility concerns. Obstacles. Well, to avoid obstacles, the driver has to first see them. It's really hard for many power wheelchair drivers, probably most power wheelchair drivers, to see what's going on behind them and see what's happening down low. I may not realize there's something on the floor before I run it over. It also can be very challenging from a visual standpoint to gauge distance, that depth perception, and to respond in a timely manner. If I'm just walking throughout my home, I need to have a sense of how far away is something ahead of me and at what point do I need to slow down my walking and stop, so that I don't walk into that obstacle. Well, same with a power wheelchair. If they're visual issues for this client, then driving becomes much more difficult. We then have distractions. I get distracted, we all get distracted. But if

I get distracted and I'm not paying attention, I might bump into something, I might trip and stumble, but I'm probably not going to hurt myself real bad. But the consequences of being distracted, we know are quite severe in a motor vehicle. We have a lot of distracted drivers that are getting into accidents and the consequences can be quite severe in a power chair. Now I could tip my chair over and injure myself. There's also quite a bit of motor, visual, and cognitive requirements when it comes to using a power wheelchair. Motor limitations may limit driving precision, as well as reaction time. I should mention that my buddy Taylor here is in an evaluation chair. We don't usually use that type of legs support. [LAUGHTER] But this is helping in this chair that he doesn't quite fit in. Visual limitations can also make driving a lot more difficult. Acuity, how clear things are around me, but also those special concerns like depth perception. Where I'm I in space in relation to other obstacles around me, other people around me? Cognitive limitations can lead to a reduced understanding of what could happen under certain circumstances, like if I go over that curve, or if I go with the wrong angle of that steep slope, or even if I run into somebody, what can happen? Many clients have more than one area of involvement, so we might be working with someone like this young man who has motor, visual, and cognitive limitations. That suddenly makes driving much more difficult, and the Smart Technologies can help compensate for that. Now, many people using a power chair may be using an alternative driving methods, something besides a standard joystick. These clients are going to have limited motor skills. They may also have visual and cognitive limitations. What does this impact? Well, driving precision, my ability to determine how far away things are, determined changes in height. It can be hard to realize especially down low, that there's a difference in height between that gray sidewalk and that gray curve and that gray gutter and that gray street. This can really lead to dangerous situations. Visual field can also be impacted, again, especially behind the driver and down low, those are areas that are harder to see. All of these factors can impact the functional mobility for this client, how well they drive his power chair, their level of independence, their confidence, and their safety.

Now, smart wheelchairs can make driving a power chair more efficient and safer. The cool thing about that, the really important message about that is that more people might be able to use a power chair than did before, and people who are currently using a power chair might be able to be more confident and safe. I've seen some clients whose world has really opened up instead of just staying within the four walls of their home, they're starting to get out and about and actually participate because they feel more confident, they feel safer. It's important to make sure that whatever system you're looking at with smart wheelchair technology that's compatible with the alternative driving method that your client is using. In summary, for clinical applications, who can benefit from smart wheelchair technologies? Well, really anyone who's not driving efficiently and safely into their full potential. I would add to that someone who has previously injured themselves, someone whose home looks a little like a war zone, someone who's regularly colliding into obstacles could benefit from this technology. It's important to match with that individual client needs with specific smart wheelchair technologies. Here's our take-home message and then we'll have time for more discussion about all of this. Complex power

wheelchairs provide a means of mobility. We know they do a lot more power seating, interfacing with other technologies, Bluetooth, mouse emulation, etc. Even with all that amazing design, there are still limitations in efficiency and in safety. Smart wheelchair technology has come along, is emerging to address those issues along a continuum and to offer even more features such as connectivity with other devices in our environment, other consumer technologies, and even track health and wellness. This new technology helps drivers do what they do, but better and safer. Let's look at some more questions. I'm going to move our chat box where I can see it a little better here. Mike has said, "How much customization does a user have through these phone apps? Can you adjust sensors, speed settings, etc? Is there a Child Lock to these settings when needed?" Those are all great questions. The main decision you can make on the app is who you want to share information with and Tom, feel free to chime in on this as well. Tom Butcher Dang is also on this call and works with LUCI, and make sure that I'm not forgetting something important here. Actually it would not be a great idea to adjust the sensors. The sensors are already adjusted for that specific wheelchair base. These are not universal for any power chair. They are designed for the dimensions of an individual power chair. The specifications of that chair. That chair is tolerance to certain angles, for example, all of this is very customized already, so we don't want to get in there and mess that up. That's not something you would adjust. The system is customized further to the user during the fitting so that it helps to compensate for that person's particular reactions. So if there's a reaction delay, that's compensated for that time. Then in terms of a Child Lock, there's primarily notification, so there's really nothing on that app that someone can do that would compromise the efficiency or the safety of the system. That's specifically on the LUCI system. I hope that answers your question, Mike. Really important stuff. Great. Other questions or comments that people have about these systems, and while you're typing, I want to make sure too, that I think everybody very much I know our time is all really, really valuable and makes you have our contact information. Julisa, I like your name there. Do the sensors work well in outdoor recreation activities such as hikes and different types of weather? Again, this combination of sensors on the LUCI system in particular is designed to handle that very terrain because some sensors do map that out better than others, and different lighting scenarios that can occur with changes in weather. What's probably the most difficult thing about outdoor recreational activities is that a lot of his power chairs just don't do very well when they're not on smooth level surfaces. So if I'm going to one of our wonderful state parks in Colorado and there's some paved or boardwalk surfaces, a power chair is going to do just fine. But if it's dirt, it may or may not do as well or other varied surfaces. There are some more outdoor terrain-based power chairs that are available that can handle those situations a little better, but don't always do as well indoors. So little challenging to be super active in very terrain as power wheelchair user. We do have some great suspension on some of these power chairs, and that does help quite a bit. While people are typing in more questions, one question that people almost always ask about is funding, can you get this stuff paid for? That's a really important question because as great as this technology is, if no one can get it, that's not so helpful. Right now, the VA, Veterans Administration, is covering LUCI when indicated. I think many workman comp

situations or I'm sorry, I'm saying that wrong. Vocational rehabilitation would cover LUCI when indicated. There have been insurance companies and some state Medicaid programs that have covered this as well. It is important to make sure we really explain what is this technology? Why are we recommending it for someone, and to do so in a way that is clear to the funding source who's reading our documentation. There is some information to help with funding. We have a funding toolkit on the LUCI website they might find helpful. Tiffany has said, "Is there a cleaning regimen for the LUCI system, I imagine the sensors could get covered in dirt?" Absolutely. Actually, on the display, on the LUCI display if a sensor is not working at top-notch and that can include covered in dirt, then there's a notification on the display. There'll be a light that's yellow that indicates there's an issue and notify someone that hey, those needs to get cleaned off because that can happen. One of the nice things about having multiple types of sensors is if one sensor happens to have an issue, it's occluded for some reason, the other sensors are still working so the person should be able to continue driving safely until that's cleaned up. Let's see here, Dan has said, "For the smart systems that go on existing systems, have you ever tried it on early mobility devices like Go Baby Go or wheelchair trainers?" Not at this time Danielle. There are limited amount of power chairs that LUCI particularly will work on right now. Systems like braise will work on a wider variety because they're not actually integrated into the electronics of the chair. You can go to LUCI site to see a full list of compatible power wheelchairs. Alexander has asked, "Can the display be audio?" Depending on the notification or the issue that LUCI is alerting the client to, it can be audio or visual or perhaps both, and it's somewhat depends on the urgency of the alert. I should say too, that LUCI includes something called an override where these webinars go faster, so much information we can go into that I did not include everything in this particular PowerPoint. But the override feature allows the client to push a button or a switch if they can't activate that button to override LUCI for a period of time. It's not for very long and LUCI will reengage, but that can allow someone to do something that LUCI is not allowing them to do. Let's say I use my footplate to open up a doorway. Well, LUCI won't let me run into things. I can activate override, push through that door, and then LUCI will reengage. We want to make sure the client has as much independence and control as possible. Great. Well, we still have just another minute. If anyone else has any other questions or comments, please pop them in there, and after this webinar, or for those of you watching online, if you have other questions or comments, feel free to reach out to LUCI or directly to myself. I'm in private practice myself. I do work with clients. I also consult with LUCI I should have mentioned that at the very beginning as a disclaimer. But I use a variety of technologies with my clients scan. I'm very excited about any new innovation that can be helpful to the clients that I work with that we all live with. Great. Well, Becky, I don't see any more questions right now, so I will let you wrap us up and if there's any more questions or comments that pop up, I'm happy to stay on after the course as needed.