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Teleaudiology: Advancing Access and Equity in Hearing Care

Part I: Hearing Care in the 21st Century

Presented in partnership with Salus University

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- Thank for joining today's webinar, Teleaudiology: Advancing Access and Equity in Hearing Care in the 21st Century in partnership with Salus University. It is my pleasure to introduce our presenters today, Dr. Aaron Roman and Dr. Samantha Robler. Aaron is assistant professor at Salus University in Philadelphia, Pennsylvania. He received his BAMA and AUD from the University of Pittsburgh. Dr. Romans has clinical expertise in auditory processing across the lifespan, cognitive screening protocols and aural rehabilitation for individuals with cochlear implants. His research interests include assessing the impact of hearing loss on cognitive impairment, as well as evaluating hearing loss assessment programs, including newborn hearing screening programs. His work has been disseminated through peer reviewed publications and local national and international presentations.

Sam has her AUD and PhD and is an assistant professor and researcher at the University of Arkansas for medical sciences in Little Rock, Arkansas, and a part-time audiologist and population health researcher for Norton Sound Health Corporation in Nome, Alaska. Her clinical and research interests include innovating and improving tools that address accessibility to hearing healthcare, including development and application of telemedicine technology in the clinic, as well as addressing global hearing health and public policy in the hearing healthcare delivery system. Welcome Dr. Roman and Dr. Robler. We're happy to have you both on today.

- Thank you for having us.

- Thanks so much for that great introduction. I'll speak on behalf of Aaron and myself, we're very excited to be here. Super stoked to be giving you this two part series. I'm very passionate about teleaudiology and Aaron is a absolute guru and expert in all things state reimbursement and licensure. So I'm excited for us to be giving you this updated talk on what is the latest and greatest, as well as how do you get down and dirty and get some of this teleaudiology done.

- And as said before, throughout the talk, we hope to keep this as interactive as possible. This is something that impacts audiologists from all practices and all areas of practice. And so throughout the course please utilize that Q and A function. We'll be implementing questions that appear throughout the talk as well as at the end. So if you have a question, please put it in. Either myself or Sam will be looking at it and we will address any questions that come in. So please do that.

- Yeah, we would love to answer questions as much as possible in real time to make this as conversational and relevant for you all. And certainly we'll get it at the end if nothing else. Thanks for that plug, Aaron. Alright, so learning outcomes. We're gonna describe the technology solutions for teleaudiology. We're gonna describe the factors that suggest the need for teleaudiology service delivery, and then we're gonna identify approaches to the implementation of teleaudiology service delivery. Let's just start with an introduction. Let's all start on the same playing field here and with a definition and some models of how we can do telehealth in audiology. So at the core of telehealth is service delivery at a distance. So the use of technology to exchange information and provide healthcare services, whether that's across geographic, time, social, cultural barriers, you name it.

But it's idea of using information technology across a distance and that's really what it is at its core. And then there's a lot of different ways that you can do it. And as technology involves, we're getting more and more creative with that. But let's go over some basic models. Synchronous or real real-time telehealth. This is probably what most people think of when you think telehealth. This is also the most reimbursed form of telehealth, but in essence you have a provider, the audiologist usually in a regional hub or an urban setting with a patient and usually a facilitator in the patient remote site or closer to where that patient lives with equipment in both locations, allowing the

audiologist to connect with the facilitator and patient in real time over a video connection.

You can have, most of the equipment for testing is positioned at the remote patient site. Really just depends on the type of service delivery you're providing. But if it's ABR, the ABR is there. If it's diagnostic testing, the diagnostic testing is at the remote patient site. And then the audiologist is using typically two monitors to both control the equipment remotely and then a video connection to be providing that case history and that counseling and watching the patient throughout the appointment. Benefits of the realtime telehealth or synchronous telehealth are that you get that realtime connection with a patient or the rapport building, the things that usually most audiologists we care about at our cores really getting to know our patient and who they are and real time telehealth allows that to happen.

It's great for getting a lot of the diagnostic testing that really requires the audiologist to collect it. So think about ABR and controlling the machine to do ABR threshold testing. Some drawbacks for synchronous telehealth though are bandwidth. You really need a substantial bandwidth internet connection to make that video exchange work and to be able to control a computer in real time. I'll tell you, even in remote Alaska, we are able to do this now. So the bandwidth has gotten a lot better involved today. And then it's kind of a little bit to manage scheduling, you're managing two different sites, two different schedules, getting people together in the same room at the same time and it can be add some burden to the schedule in terms of making sure that audiologist is available for that time.

- And so Sam, before we advance, can we look at that slide one more time?

- Yeah.

- And to the audience and those watching, one of the things that I'm hoping to do is sort of act as a surrogate and as I'm listening and listening to Sam's explanation, provide some questions as well. So listening to that description, I just wanna make sure I have an understanding of sort of the setup and correct me if I'm wrong in any of this. So I'm an audiologist, I'm sitting in my office right now. So in this synchronous model, a patient would be scheduled in a clinic, it could be in a different state or just within my state in a different location. And that I am providing the services to this patient through a webcam or a setup from my site to theirs.

I'm seeing on the infographic here a facilitator. So let's use the example you said in ABR. What is the role of the facilitator and like are they an audiologist? Is there anything that we need to consider with that?

- Oh yeah, that's a great question actually, and I should elaborate on that. So I appreciate that. So the facilitator can take on any number of roles, so if they can be any number of people as well. So it could be a nurse practitioner, it could be a medical assistant, it could be a nurse, it could be any number of people. It could be an audiology assistant for example, or any number of healthcare roles within that remote site. And we've established some training protocols that are local and then there's some available in literature too about how to train that facilitator, what do they need to know? And so in the case of the ABR, they need to know how to scrub the skin and apply the electrodes.

And so we'll go through that. We've trained our facilitators to capture images of the ear, what's important for capturing in the ear. And so they do both a practical and a theory-based training as part of that. So that's a really good example, but what this model isn't is like the provider traveling to that remote site and meeting the patient

there and doing it. But like you said, being in the remote site and connecting with that facilitator and working with them and many times the facilitator, that interdisciplinary collaboration is fabulous because typically that facilitator is a little bit more embedded into the local context, potentially more relatable to the patients you're serving. And so they often serve as like an advocate for facilitating the patient's needs and understanding maybe some of the lenses that they're coming to that appointment with.

So the facilitator is a very much a core component of many telehealth models and for sure in the synchronous telehealth model. Really good question.

- Awesome. And thank you for that. The one question that did pop up as we're talking about this particular model, using this model, the patient would be required to come to some center to receive services, is that correct? This is not done in home per se.

- Yeah, so that's a good question and this graphic that I'm showing you is a more traditional synchronous model where a patient is coming in, whether that's a community building or a satellite clinic of a regional hospital, they're coming in, it just depends on the testing. You can have synchronous telehealth exchange with the person in the home, but in the home you're a little bit more limited on what you can do. It just depends like right, you won't do an ABR in the home because they're not gonna have the equipment there unless you're shipping them the equipment. So it really just depends. But if you're gonna be doing counseling or a hearing aid check or some remote programming of either an implant or a hearing aid, then certainly you could use a synchronous telehealth model to the patient in the home.

Great question.

- Awesome. Thank you.

- Okay, so asynchronous or store and forward, as it's also called, is this idea of taking packets of information and sending it asynchronously to a provider to review. So let's set up the stage here. So you have a provider, again, generally found in more rural or urban hubs. And then you have the patient in the more remote site, they present to a facilitator with an ear and hearing complaint. And then that facilitator knows a set has been trained to collect a set of information. So that might be endoscopic images, that might be tympanograms, that could be OAEs, really just depends on kind of what the protocol is and the complaint. But they know what tests to do and we do a lot of this in rural Alaska and I can elaborate on throughout the talk, but collect a bunch of information and then use a platform, usually a software based platform to then send that information asynchronously to an audiologist.

And that audiologist then can review that information and make some decisions, some high level triage decisions. "Oh okay, yeah, this is a sudden hearing loss. Let's get this to primary care for treatment or to ENT or this is a surgical case or this needs medical treatment, let's get it to primary care or we definitely need to get more diagnostic testing. I'm gonna set up a real time call with them to do that." So and then send that back. So it is sort of this asynchronous exchange. Now the benefits of this, one less bandwidth. You don't need to have that realtime video exchange to do it. The other thing would be time, particularly for the provider because you don't need to schedule a lot of their time out, consults can be done generally a little bit quicker.

And so you're really just getting that high level triage out. And so that would be some of the perks of asynchronous health exchange and some of the negatives. Then again, like, there can be some loss in translation, so you really have to have really good communication with your facilitator who's receiving, sending and receiving the information, then interfacing with a patient. Sometimes there can be a disconnect between what the specialist is saying, what the patient is hearing. And so there really

has to be a lot of work done to make sure that that communication piece is well established.

- So on that note, thinking about how we would implement this sort of clinically, one thing that I tend to see in working with hearing aids is a lot of our patients, they'll email me a question. They'll say, "Hey, my hearing aid isn't working. Do I need to come in? Or when does my warranty expire?" Anything along those lines. Would you consider that sort of exchange, a patient describing a problem, me reviewing the problem and sending them recommendations, something like that? Would that be considered an asynchronous form of telehealth?

- Yeah, that's a good question. And there's definitely some gray areas there. Them asking you saying like, "I have an issue, how should I go about approaching it?" And you sending some feedback, maybe not a full encounter, but it is a form of e-consultation, whether that that's likely not reimbursable from a patient to a provider, but it is a form of asynchronous exchange of health information. Whether or not that's enough to be a fully vetted appointment is different. Now if they're sending you their program from their hearing aids or asking you to make a programming exchange and then you're going into the software and then pushing them a change that they then download through their app, now that's a different story.

And that would be a form of asynchronous exchange where you're kind of doing some hearing aid adjustments or mapping adjustments. Great question.

- Okay, that makes sense.

- I would say, and I'll just put a plug in there 'cause I do this every time I talk, is that a lot of the data, that we're data rich profession, we need data, we need pictures of the ear, we need to see tympanograms, we want the audiogram OAEs are great, we're just

a very data heavy diagnosticians and a lot of that is great for asynchronous telehealth exchange in a lot of ways. So, and real time for that matter. But I just always like to put that plugin because we do it a lot in Alaska where we have, we're mostly addressing infection related hearing loss and just getting images of the ear, tympanometry and some quick hearing assessments help us understand how to best treat their care.

Hybrid is what you might imagine, it's a combination in the appointment of both synchronous and asynchronous exchange of information regarding the patient. One example might be a facilitator is grabbing video otoscope images and tympanometry and sending them for you to review. And then you're getting together into a call in advance prepping then doing the case history, controlling the computer for OAEs and pure tone testing or speech testing or ABR, whatever other testing you're going to do, and then provide the counseling and then drop the call. So it's just really a hybrid approach of combining the two we just talked about. And it can also be in a series of appointments. I talk about this a lot with telehealth is, if you're gonna start doing telehealth services if you aren't already, not every appointment is appropriate for telehealth.

So if someone's getting an implant for example, or hearing aid fitting, like you might have a set of appointments are gonna be going and some are real time and some are telehealth. And so you could have a hybrid of just how you're approaching that person's care. And then lastly, this is an evolving model, sort of that self-administered or self-test model where a patient is in their home and they're on a web browser or a platform or a mobile app that's allowing them to test their hearing or even equipment being sent to them to take images of their ear in a set of diagnostic results. And then usually working through an online platform with a provider on the other end to provide a consultation and then walk them through what options might be for intervention and whether or not they need a medical workup.

This is certainly evolving field and I think the technology is gonna kind of keep it rapidly advancing. I think we'll see a lot more of this with over the counter hearing aids too, and I think there's an opportunity for us to get engaged there.

- So looking at all of these models sort of together and given your personal experience, imagine like during the pandemic we made a bunch of changes that happened very rapidly, all right, and so maybe some of those changes to make it telehealth, to do telehealth, maybe those weren't aggressively sustainable. So now let's say as my practice, I might pair back telehealth services. So looking at these models, the four different ones you outlined, in your personal opinion, what do you think is sort of the most viable for someone who would be interested in implementing telehealth at an introductory level or like to start telehealth? What sort of model would be sort of, I don't wanna say the easiest, but the most viable as a newcomer to the telehealth world?

- Yeah, great question. An answer for that. Let's see. I think it really depends on the what elements of service delivery that provider is doing and what the motivations are. So I think for example, someone who is a cochlear implant audiologist and sees a huge loss to follow up on implant wears coming back in for mapping adjustments or same for hearing aids, being able to offer either a real time or asynchronous exchange of support for them, is low hanging fruit, potentially a clinic that does a lot of like, that supports an ENT practice, asynchronous images and some basic audiologic information can really be helpful in better triaging patients through the care, maybe reducing wait lists, being more efficient in the practice.

Even if you aren't getting reimbursed, it could result in more efficiencies in the practice that are value add.

- Awesome.

- You think I answered the question Aaron, is that good?

- I think so, yeah, so-

- Okay.

- So basically the answer to summarize in my understanding of your response is it really depends. It depends on the resources and what exactly you're looking at.

- Yeah and I will talk more at the end here about what could implementation look like for those that either aren't doing it or maybe wanna do it in an area that they aren't yet and not really sure where to start. So we'll talk a little bit more about what that could look like.

- Okay. Awesome.

- But I do think we should buckle up as a profession because the technology is advancing and the consumers are consuming technology differently and we're only gonna see more evolution here and I'm excited. I think there's a lot of opportunity to deliver services to patients with where things are going. We don't wanna spend a lot of time looking back, but let's look a little bit at the history of teleaudiology and I won't go into a ton of detail here, but really the concept of it is not new. This didn't come out at with the pandemic. Like there were some of the greats trying to dabble in teleaudiology in the 1990s and there were some barriers to really larger scale adoption I'll talk about in a minute.

But as you can see, as internet became real more robust as technology evolved, as things became PC-based and more internet-based, you sort of see this upward trend in 2015 and then of course into 2020 we see this rapid jump with the pandemic and then now we're starting to see this trail off. But in general, a lot of these projects, or dabblings into teleaudiology were grant funded or federal funded and we really, that tended to be a barrier on like, how are we gonna really make this sustainable? We did see some technology and infrastructure, there are a lot of workarounds. We were taking pictures of tympanograms and putting it in the system so that technology is really, we've seen growth with the technology grow, but that was a barrier to adoption in the past.

Confidence in the service delivery, like, "Am I gonna get equal results if I do this service over teleaudiology?" And the evidence is robust now and shows that, yeah, you can get reliable data in many of the aspects of what we deliver service on, but that's been a barrier to adoptions. People just don't really believe it's possible, training limitations, certainly like we weren't at scale for teaching people how to use this technology as always with electronic information, privacy and security concerns. And that's something Aaron's gonna talk a lot about is reimbursement and licensure. And I'll be honest, and not to reveal anything people don't know here, but this is an area of growth still where we're working on getting reimbursed for services via teleaudiology.

- And one can argue that's the field of audiology, like the whole-

- Yeah, that, I mean really-

- We're all still fighting.

- Yeah, that's all of audiology. We very much are still fighting and it's a little bit of cart before the horse, we've gotta be able to deliver the services that we think are valuable regardless of whether or not they're reimbursed. So there's that fine line too. But flash forward to the pandemic or I guess should I flash back to the pandemic from the nineties and where were we? So this is a study of Australia, Bennett and his team, they do a ton of work in this area, but what is it, what were we accepting of telehealth in the pandemic? I think we saw a big upswing in people doing telehealth service delivery. I know people were, it wasn't, I went from saying, "Why you should do telehealth?"

" To, "How do we do it?" And so I know a lot of people were trying to implement various things both to meet their patient needs and also keep everyone safe. And then when asked, "Hey, do you think you'll continue?" The large majority said, "Yeah, we're gonna continue doing this because we're confident, we're comfortable and we can do this." But as you saw with the post pandemic trend in where we're at with teleaudiology service delivery, we're seeing this downward slide, we're we are seeing this trend of people moving back into the traditional sort of brick and mortar models, having kind of stepping back from doing some of the services that they were doing remotely. And so we're under utilizing teleaudiology again, despite sort of having like said, "Okay, great," like we've ripped off the bandaid so to speak and we've done some teleaudiology, I'm more comfortable with it.

But some barriers have returned and I think that's fed into it a little bit. I mean we like to do what we're most comfortable with, but also, reimbursement and coding and even some of the technology platforms are now back to like, you need to make sure that you're using the right technology. But post pandemic, I think the benefits so far, like it is reliable and effective, we can do it and providers are more comfortable with it and we're starting to put out more tools around the provider, guidelines for how to do it, how to train facilitators and introducing it into academic programs. So I think will help, but at the end of the day, we're here to talk to you about it because people are

interested and wanna do it more and it is possible and I think we will even, it'll be infused through our service line in no time flat, particularly as technology continues to evolve and advance and gives us an opportunity to do that.

Whoops. And that segue that brings me to back to the future here. So if I haven't beat this drum enough I just want to people to think, like, "Oh man, Sam, we are not gonna be, I don't know what you're talking about. Like we need our sound booth, we need our audiometer. Like there's no way we can kind of pivot from that." But if you think about it, the technology around us and how technology has changed over time and how we interact with the world differently now and how our patients do is incredible and how our children interact with technology than when we did when we were little. But holograms, think about Star Wars, projections of holograms in the 1970s, but today we have heads up displays in cars and Microsoft HoloLens technology that is assisting in a pilot fashion.

This isn't large scale but medical students in training and in various other specialties. So the hologram is in our life and it's going to be even more so. But that was something that was projected in the 1970s and so it's here to come and as I talk about these various current technologies available they're gonna continue to evolve to. And I just want us to kind of be excited about where it could go. And then don't get me started, I'm not gonna start triggering everybody's phones and their home systems here, but computer voice interaction, I mean that was Star Trek in the sixties. So, but here we are voice interacting with all of our technology every day dictating our text messages, commanding Siri and Alexa to, shop grocery shop for us and turn music on.

But I'm excited basically I just wanna plant the seed for it is possible and get excited. And with that I will segue into the current state of teleaudiology and kind of walk you through like what's out there, like what can I use to due teleaudiology services. I have a review article I put out recently with some colleagues that goes over these same things

in slightly more detail. So feel free to reference this. And there are several other reviews too out there as you continue your journey in generating evidence for what you wanna do in your practice. But for this section, it's not gonna be totally comprehensive and it's not gonna be every service delivery line, but I'm gonna kind of hit the big buckets that most of us do.

So we'll start with Otoscopy, otoscopy and Aaron, to your question before, like what might be easy, it's like otoscopy is very easy to convert to a teleaudiology application just because it's a static image of the ear or even a movie and there's a lot of options out there and a lot of technology development. And so there's multiple otoscopes on the market that are controlled by a smartphone or a mobile application. And then many that are PC based, like USB. So if you look, can you see my cursor okay? You look here in the middle of the screen, you've got this sort of iPhone or Android otoscope and this is an image of my eardrum, but you can see that the lighting on here is decent and in a pinch, not a bad image of looking at the elements of the ear that we really care about seeing.

This is something I ordered on Amazon for \$50 and then you have some other ones, hearScope out of the hearX Group, a great tool in the arsenal of tools. You've got some great USB based ones down here that you can just plug into a PC based laptop or even a tablet that's Windows based. We do that in Alaska. So those are great options. And then you have even some products that are designed for more lay screeners. So like if you're thinking about a facilitator or working with a parent directly in the home, this is an example of a tool that comes with other tools but has great patented technology with a soft tip and guidance for getting the eardrum in the middle of the picture and things like that.

So there's a lot of options here. And the prices, like I said, can range from \$50 to just over a thousand depending on what you want, but it doesn't break the piggy bank here. So there's a lot of room for otoscopy and teleaudiology.

- So Sam, if you don't mind my asking, this is probably like, I know you just said that this is probably a great way to start and actually otoscopy was one of the ones that I had sort of in mind when I'm thinking about like, "Okay, how do we implement this?" So in your opinion, or based off of your experience, I guess what is the best way to implement it? Like are we going to just recommend that or do we provide it to a facilitator and like you said, train them to do otoscopy and look for certain landmarks or aim it so that we can see certain landmarks or do we trust patients to do it? How would you say from an implementation standpoint, which I know, I know we're gonna get to that, but how would you recommend going about this?

- Yeah, great question. I think it's all of the options, so with my experience in Alaska, it was both audiologists using this technology to capture images to work with ENT remotely for pre-post surgical management. It's also something we put in the hands of a facilitator or a community health worker and train them how to use it to send pictures to us. I think it's also something that depending on your patient base, it can be placed in the home in a direct to patient type of model where they're taking pictures now, sorry, the technology choices you might select will be different based on who's holding the scope. But I think all of those options are available for all those iterations of teleaudiology.

- Awesome, thank you.

- Yeah, great question. So tympanometry, that's the other like main tool we use, like what is the middle ear health? We only really get a 2D static image of the ear when we use the otoscope. And from a telehealth perspective, we do a ton of tympanometry with teleaudiology and mostly asynchronously, 'cause it's a great capture it, store it and send it. But really if you think about it, all of the most common tympanometers that you might be buying and having in your clinic are probably interfaced with either a suite, a software suite that connects with your audiometer and things like that. Or has the option to connect to a laptop. And if that's the case, then you're already well positioned to be able to use that tympanometer for teleaudiology service delivery.

Now whether that is that you are remoting into that computer and controlling it yourself, that would be more of a synchronous model or having a facilitator who's trained to do tympanometry, collect that information and send it as part of an asynchronous or store forward exchange. So any PC-based tympanometer that's true for other testing as well is right for teleaudiology applications. And then I'll just take a second to elaborate because it can be a little bit of a nerd about this, but there's a big gap too in tympanometry and having it be mobile and quite frankly low cost. And so we're doing some work right now to develop a smartphone based tympanometer and that's the images you're seeing here on the top right.

It's very much in prototype and clinical validation stages, but we're excited about what that potential would be when we're talking about screening and or looking at diagnostics for infection related hearing loss in rural areas across the globe so that work is happening. And then there's a group out of Washington University who's doing some awesome work in this space too, where they first looked at spectrometry, so like basically tympanometry, but without the pressure in using the acoustic signal to see if they could tell the difference between a normal eardrum and an eardrum with otitis media with effusion. And that's really neat. So like a phone using the speaker on the

phone and creating a funnel out of paper and putting it in the ear to have a parent be able to, or a lay person be able to capture that sound.

It's really neat. And then they've also just put out a low cost, some early development for a low cost tympanometer that can be controlled by a smartphone. And as you can see, similar to ours, they're also using a syringe. That's one a couple ways that we're trying to reduce the cost and what the tool is. So exciting stuff happening here. Again, I talk a lot about that tech innovation and gotta kind of calm down that tech nerd in me. But I think this is really exciting and I think there's a lot more to come here from a middle ear health management standpoint. So we can get a little bit into diagnostics. I'll start off with saying, there's a lot of people who are like, are like, "No, like I've got my audiologist intuition, I need to be the one getting that audiogram, automated testing, I just can't believe in it.

It really, it's not great" and it's true, like there are situations where it's appropriate and it's where it's not. And it does come with some strings. Like automated testing for pure tone, air conduction or bone conduction does require a good bit of training. Does require a quiet environment, may not be for everybody, we can't do our pediatrics, our youngest pediatrics with it. We can't do our oldest elders with the current state of automated testing. But I do, and I always present this slide, I do wanna remind people that like the evidence suggests it really can be done that overall the average differences between manual and automated are quite small. And in some cases because there's human variability in how we test it gets the margin for the standard deviation or that test retest reliability can be even smaller.

And so as you see with that test retest difference, the manual testing thresholds manually was 1.3 DB and what we'd expect a a six DB standard deviation versus automated just a little under one DB difference with the same standard deviation. So I just put that out there that like, there are elements that are necessary to make this

successful, but automated testing is a viable option for the technology. And I'll talk a little bit more about where the future is going with automated testing in a little bit. Let's see, so hearing diagnostics, we'll talk a little bit about the equipment. There's actually a lot out there and many of this was out before the pandemic, but a lot of it has grown in scale since the pandemic and added many more functionality and features.

Really heard a lot of what audiologists needed in the real time in that moment and have adapted their tools to incorporate that. So I'm actually quite excited to see sort of this acceleration in what's available in the market today. But I think about it in a couple of different ways. There's several professional diagnostic models out there that are really intended and designed for telehealth. And then there's the opportunity to convert existing technology like a PC-based audiometer for telehealth purposes. So you can have tablet controlled headset which can do air, bone and speech. You could have a kiosk esque model where it's just in a waiting room or in your primary care in your regional hospital screening diabetic patients as they come through and then punting them up to you.

You can have, there's several phone-based applications out there and then here at the bottom right, there's even a wireless headset out there and many of these can screen at ANSI standards outside of a sound booth.

- So Sam, thinking about sort of the last slide in conjunction with this one, it sounds great, like automated or not. Yeah, automated testing I guess, so thinking about like the nature of this, like when we test, we test in a controlled environment, a soundproof booth, what kind of considerations, like are the headphones a specialty headphone that we have to send to patients? Like what kind of considerations do we have to think about because assumably these patients aren't necessarily finding a soundproof booth to be tested in.

- Oh, yeah, totally. I mean that's sort of part of the hardship. I mean, not only is there a shortage of audiologists, but then, we have a big footprint, we require this booth space and like all this heavy equipment that can't be moved around. So people have to sort of come to us traditionally. So it's a great question, both for automated and for diagnostics. So we've sort of the slides have moved around here a little bit, but in terms of diagnostic testing and an audiologist controlling this or controlling it remotely, there is actually a lot in the technology happening that is allowing outside the booth testing that you can consider valid. And that includes passive noise attenuation.

So you can kind of see like some of these systems have larger cups around the ear, they're providing a lot more just passive sound attenuation. But then many of these also have active noise canceling in the headsets that help also control the noise environment. And then almost all of these solutions that I've presented to you right here on this slide, and there's more, this is not a comprehensive list, but all of them have some element of noise monitoring and whether that's like monitoring in the background or active monitoring where it like stops the testing until it's acceptable again or just advises, it gives you a little notification that says you should wait, but nearly all of these will be monitoring the levels of noise and they do that per frequency, 'cause you can have more noise in some frequencies than others that are acceptable for the level you're testing at.

So there's a lot of sophistication here. It is getting better and better and there's even a lot of these manufacturers of this technology meet in groups and present a lot about like, how are we coming along with testing outside the booth? I would love to see booth list audiology in 20 years, because I think there's a lot that we can do and if we're more mobile then we're more accessible. And so I think that that's part of it. It will always need elements of traditional technology, but I really think that we can be taking this to the next level.

- Thanks, that makes a ton of sense. To sort of follow up on that you indicate like PC based audiometers, so a PC based audio, like I use one in my clinic, we have several. So in those cases, how would that be implemented using telehealth?

- Yeah, so we've done this in a couple of different ways and I have some other providers that do this across the state in Alaska too. But for the PC-based audiometer you can connect to that audiometer much like using a remote desktop control and control it much like you would in the sound booth itself. And so really in this case, we're working with a facilitator either behind the audiometer if it's an adult or with the child in the booth. The video setup is always a little interesting. So that's like a clutch part of it. But in terms of technologically, these PC-based audiometers for the most part allow you to dial in and then control the keyboard from the screen or use the soft keys within the software.

- Okay, cool. So just so I understand, like the setup would basically be, there's a patient in a sound booth that is instructed or has headphones put on by a facilitator of some capacity and then I'm remoting into the computer side of the audiometer and controlling it using my keyboard or something like that to obtain a hearing test?

- Correct.

- Oh, that's very cool. I like that.

- Yeah, it's neat. It's pretty sweet. It does take a little jiggling depending on what your configuration is or the patient you're trying to serve or the testing you're trying to do. But you can get really creative with a good facilitator and a good tech setup. All right, so back a little bit to automated bone conduction. So again, the same concept of we

can do it with air conduction. We're also have some early work that has looked at bone conduction and also seeing no difference from doing it automated versus doing it manual including test-retest reliability. But what I'm most excited about is where we're going beyond automated because the technology is continuing to evolve and we're all hearing about these AI and machine learning and I'm no expert, but this is gonna be applicable to us in many ways.

There's machine learning and AI being trained for interpreting otoscopy. We have a machine learning algorithm that interprets tympanograms, 'cause lay screeners can collect a tympanogram and have it interpreted for them. And there's also some early work in machine learning audiometry where an AI or machine learning algorithm is running through an audiogram with a patient and collecting basically thresholds and that evidence shows that there really is not a big difference between the machine learning algorithm and conventional threshold audiometry, which is very exciting to me. And that is also true for both a difference between them absolute and then also on repeated measures. So if you did it twice, are you getting similar results? And you can kind of see the findings here for what that looks like.

But very exciting to me to see where this is gonna take us.

- So this is always very cool. And I will say like, sort of as a personal caveat, like whenever I see machine learning or AI, I like sort of think in the back of my head like, "Okay great," because everyone says it now and it's all part of everything. So my question then to you is like, how is this different than sort of automated testing? Like from a technical side, automated testing from my understanding would basically be an if then statement, like if the patient responds go down 10, they don't, go up five. So how is this different?

- Yeah, that's a great question. So let me take a second, how to describe it. Okay, we're audiologists, we're behind the booth within a couple of responses. You know you've got your patient pegged down, like if they push the button soft when it's close to the threshold, they're really hard, because they're confident they heard it, how quickly they respond. We're using a lot of behavioral observations, psychometrics, things like that to feed into like getting at our patient's audiogram. And that's why often an audiologist acquired audiogram is much faster than traditional automated testing, even though they're both getting at the same thing. Automated testing has to get a lot more samples. And you're right, it's like the Houston West, like up and down, two or three times, depending on the protocol, through all the frequencies, it could take 20 minutes.

You're like, "I can do an audiogram of five." And they could be almost the same. I think for me what's exciting about machine learning is it's almost like a blend of both of those. So machine learning is getting these results but with far fewer samples. And so I'm not an expert but it's using sophisticated computation to basically create a probability classifier for what a person's threshold might be across the frequencies based on how they respond. And as it gets trained to do that better and better, it's just gonna do it faster and faster. So that to me is the best lay way I can describe where I think machine learning is an advantage, at the end of the day it's doing it with less samples, getting the same result, incorporating those kind of psychometrics.

And I think that we'll be able to actually get even more granular should we ever want to, more than just the five DB steps. So that's where I think that's gonna be going, and it's exciting.

- Okay. Awesome.

- And then just to kind of continue to plugging where I think things are going with incorporating metrics into like how we're getting audiograms and we do a lot of this just subconsciously as we get audiograms, but there's technology coming out where that's getting automated results, that's taking other factors, like a false alarm rate and response time and gender and age and all these characteristics about a person and then helping give a result of like good, poor or fair. And then you can be using those to say, "Okay, great, it seems like we have a really great audiogram, we can work off of this for the next step." Or okay, this is an example of like automated testing did not work here and we're gonna have to jump in and it's a little bit more of a complex case and do the diagnostic testing manually.

And I'll pause here and say that this is gonna be an evolution here. I think we'll see a lot of support come out and more technology come out to support us in how we're doing the testing. And the thing that gets me excited about it is that there's a shortage of us. And there's wait lists often to be seen and to have a patient wait to come in to sit in a booth with the audiologist behind the audiometer I think is, I think we can actually be more efficient. I think we could see more patients at the same time if we're using a hybrid approach of automated testing along with jumping in and providing the counseling and the intervention and taking over for complex cases.

But I do think that this is a great first line on extending access to audiology and getting people plugged in because there's one point, 6 billion people in the world right now with hearing loss at some point across their lifespan. And we're not nearly supporting a fraction of those and we need to be doing a better job and using our technology to advantage.

- So Sam, we actually have a question that I think it's a really good one that a lot of people might be asking it. We talked a lot about, or you specifically talked a lot about like, all these different test mechanisms for diagnostics, both in booth and out booth.

So how would calibration, what does calibration look like for someone who's testing outside of the booth? What is that for the patient and what do we as providers need to be aware about it?

- That's a great question and certainly I'm not a calibration expert. All the technology I'm using for the most part is calibrated. So it does take some effort to consolidate equipment or travel a calibration person around, but we're calibrating equipment as we traditionally do. And a lot of the equipment we're using that's more telehealth based has some evolving models where we're actually just setting headsets in and coming back and we're getting calibration files for example. So we do some peripheral headphone swapping where they don't really even need all the equipment because the calibration files live in the headphones or things like that. So we've gotten a little bit savvier, but for the most part for now I follow traditional calibration mechanisms but probably more for me to even learn there on what the opportunities might be.

- Okay. So just to sort of summarize and so I understand, when you calibrate headphones that get calibrated like in booth with anything else. Now you said there were some that are like noise cancellation, like we can have some them use noise cancellation. To your knowledge there's no standard calibration file that is sent like, or is developed under those applications, is that correct?

- Yeah, I'm not savvy here.

- Okay.

- So I would probably need to do a little homework to answer that question and whoever asked that should email us and I will help get an answer to that.

- Absolutely.

- In due time. But like the best wanna pull out of South Africa, that's the hearX Group that android smartphone app solution, they've got a lot of papers out on calibrating headphones with smartphone technology, not necessarily going into like active canceling and things like that, but they sort of introduce the concept of like headphone calibration and what does that look like. So there's some information in the literature too on how it can be done. But yeah, I apologize, I should kind of like kind of be honest about where my level of knowledge is there and I can do some digging and follow up on that.

- Okay. I think that's awesome. And I think another thing that I've seen in my personal practice is, it really depends on the manufacturer because I know some manufacturers do have some sort of free calibration for the patient whenever they set up the what, like let's say they're doing it at home for their home. So it might also depend on the individual technologies that you're implementing as well as just general like calibrating a pair of headphones or whatever you're using to do this remote test.

- Oh, yeah, that's a great point Aaron. And that's true. So a lot of times when you are doing testing in the home, like you're right, like the volume levels are set to calibration so that it's almost like kind of setting your VU meter to zero when you're gonna do monitor live voice, like the same thing will happen in the home. And then one of the technology solutions I presented actually has a headphone calibration that's done each day. So it sits on a stand and it runs through its own calibration in the headset each day, as long as it meets standard, then the testing can go on. So yeah, you're right. I mean I don't know the specifics behind the calibration math and all of that, but you're right, like for a lot of these at-home testing you are doing a specific calibration check and that's driven by the manufacturer each and every time you start.

So really good point. Thanks for bringing that up.

- Yeah, absolutely.

- Alright, cool. So let's make sure we're getting through everything today. So advanced testing again, like think acoustic emissions, ABR, we've talked a little about this, most of these are PC-based or can be, which means they're great for teleaudiology services. We do a ton of OAEs with our middle ear and ear infection related hearing loss cases in Alaska. ABR testing is great. You can have the equipment at the patient site and with a trained facilitator very easily remote in and do that testing or support an audiology assistant or an audiologist who's scaling up on doing testing. So these are both great opportunities for doing teleaudiology and in fact there's quite a bit of research driven generated about both of these.

- Now in your experience, these would be, I imagine probably in my opinion, if we were using a facilitator, the most difficult to train, specifically in ABR because we have to deal with electrode placement, we have to deal with all sorts of nuance that we're trained in. So how is this done? How do you work with a facilitator? Oh, I assume there's a facilitator. How do you get these tests done? Is it through just like intense training or what's your experience with that?

- Yeah, that's a great question and it's really true. I mean, your relationship with the facilitator in this case is really important and having a good facilitator is almost essential. And if you don't have a good facilitator then you're almost dead in the water. But for us with the diagnostic ABRs I've done, and actually we're gonna have a video demonstration in your talk Aaron, next week of me doing an ABR with a facilitator. I've

infused it, it's usually infused in the newborn hearing screening protocol. And so we have screeners there who are really comfortable doing OAEs and working with babies and applying electrodes. So they've been trained and you can certainly train on how to do that.

But I think more than just that initial training, they do a lot of it. And so they're very comfortable. But at the end of the day it really just comes down to that communication piece. And when I'm starting an ABR with my facilitator, they're applying electrodes. I have to use the video to make sure that they're placed correctly. Remember it's a mirror so it's a little bit backwards, you have to remember that. But I'm checking impedances, we sometimes have to reapply. It just really comes down to, where you're infusing it in and if you can do it with someone who's gonna do a lot of ABRs, that's really key because, or really to get really comfortable with it and to generate that skillset.

Much like a lot of our testing, it just kind of takes practice over time. And then we do this through simple connection, remote desktop connection that's available on your Windows machine right now for free as part of the base platform. Takes a little networking configuration. Sometimes permissions need to be granted, but it's a really easy solution and we do that a lot in Alaska. And then also I do a ton with TeamViewer, but even like this, like Zoom and teams and all these platforms really have a remote control functionality in almost all of the video connections we use today.

- Awesome. Thank you.

- So let's head into rehabilitation. We'll sort of talk about all of it. There's a ton of work done in this area. We'll just scratch the surface. But at the end of the day, amplification is prime for teleaudiology service delivery and even just certain aspects of it, fittings can be done over teleaudiology now. It takes a little work to get it set up, but evidence

has been generated that trained facilitators can get accurate real ear measures. There's a lot of guidance now for probe mic placement that really helps ensure that we're getting good accurate real ear measures, programming for sure. Most we're always on a computer when we're doing some programming. So all that can be done through remote control.

And then there's a lot happening in the area of self fitting too. So patients doing self fittings like generating an audiogram through the device and then self-fitting them. And we're just gonna see that technology continue to evolve and then the manufacturers are supporting that, they're we're building more robust app opportunities and the ability for an audiologist to push adjustments to an app to be installed and uploaded to their devices. So this is an exciting area. I think we're doing a lot more and I think we'll see higher satisfaction rates with utilizing and maximizing this technology, new patients' needs. And then Aaron, I'm gonna pun AR over to you 'cause I think that this is an area that you dabbled in quite a bit for.

- Absolutely. Yeah, absolutely. But before that, I kind of wanna echo what you're saying about the self fitting because not only is this like an area that manufacturers are building into their apps and making those smarter, but the term self fitting is used in the FDA regulations for over-the-counter hearing aids. So for a hearing aid to be over the counter, there is a level of self fit that the over-the-counter hearing aid has to have. And so just like by theory of growth of technology, that particular area of technology is probably going to grow and develop very rapidly, very quickly, especially for people that are trying to emerge into the OTC market. But yes, Sam, so as you said, like aural rehab is sort of the area that I got into specifically during the pandemic, but throughout and I'm not gonna say after, but as it's sort of abated and we started returning to office, aural rehab is something I've always done within telehealth component.

Now one thing that you might not know if you work in the aural rehab sphere at all is as audiologists, we don't really get reimbursed for aural rehab services. And that's gonna be something you're gonna hear me talk about in next week's talk when we talk about reimbursement, when we talk about billing and things like that. And to that, the first thing I would recommend, I would say is just because we don't get reimbursed doesn't mean you shouldn't do it if you can, I know there are practices with limitations of course, but if it is something that will improve your patient's outcomes and it's a service that you do have the capacity to provide in some way, be it in person or remote, I feel that as long as it's within our scope of practice, it's something that we should do.

So aural rehabilitation has always had, or for a very long time now, has had some aspect of teleaudiology, telehealth to it. So an example here, and a lot of people are familiar with it, is the LACE training program that is an aural rehabilitation based training program that is implemented oftentimes in private practices, is often implemented through VAs and other hospital networks. And what that allows you to do is it allows the patient to establish an account and complete listening specific activities such as listening noise through computer monitor speakers. And you link your account to a provider. And so you can monitor your patient's progress over time so that when you meet with your patient you can then say, "Oh, I see that we're still struggling in these domains and maybe that will affect your programming of the hearing aids or it will affect your counseling or it might generate referrals to get further testing done.

" So that is something that's been implemented honestly as long as I've been in practice as an audiologist. So about seven years now. Now with the advent of covid and when we had to start moving services online, at that time I was the clinic director of both the speech and hearing service clinic. And so what we did for our patients that had cochlear implants for example, is we worked with speech pathology to design

aural rehabilitation remotely. And I'll be giving a case of that in next week's discussion. But what that allowed us to do is it allowed us to develop a plan where we provide quality therapy intervention to patients. And that was generally provided through a speech language pathologist.

But with my oversight as an audiologist in developing the plan to determine what is uniquely beneficial to this patient, what do we need to target with this patient to make them functionally improve in their listening and understanding. And we were able to do that both in person but also remotely. And that allowed us to expand our reach dramatically. It allowed us to expand the number of patients we brought in exponentially and it allowed us to provide services in a unique and interesting way. So aural rehabilitation I really see as a forefront, especially if we look at the expansion of our services either through federal state regulation, this is an area that I imagine we can grow pretty dramatically in the upcoming years, both in person and using teleaudiology.

- Yes. Love it. Yep. Cool. Well I know we're scratching the surface here on those that are really in this space a lot. There's a lot of evidence that has been generated in the last three to five years looking at validation of self fitting outcomes. We're gonna see that evidence jump significantly. So please reach out to us if you're looking for a little bit more in the weeds details on this and we can get you connected to what you need to know.

- And a-

- Go ahead.

- Oh, I'm sorry. We do have a question in the chat that I think this is a good time to address it as well. We're talking a lot about these sort of services. We're talking about not only aural rehab but just like remote telehealth, teleaudiology services. So the question is asking, are these types of services being implemented in hospitals that have traditional audiology clinics? An example given is being able to test bedside patients who can't be brought down or up to the audiology wing, this would be a great way to reach those patients.

- Oh my gosh, I love that.

- So do you know that-

- I love that. At the top of my head we've used our mobile technology, so some of that stuff I showed in the hearing diagnostic slide to go and test the patient at the bedside. We have not, the only instance where we've done this remotely is we had a few patients in quarantine but still needed some acute assessments. And so we work with the nurse to be the facilitator in the room while we were remote. So I guess that's in essence the same thing. But yeah, that's an amazing opportunity for sure to be doing that. The coding on that is a little interesting, because you're in the same like sometimes you're in the same facility and you have an inpatient and outpatient and what all that looks like, but I think you could work with your hospital HIM department or kind of get some, go with state regulation to kind of figure out what the sustainability of what that looks like on the reimbursement side.

But an amazing opportunity to provide a local service in the hospital using teleaudiology and mobile technology. I think that's a great idea.

- And I would imagine it's not too dissimilar from having a newborn hearing screener, like it's not dramatically to that where the newborn hearing screener functionally under

that model is essentially the facilitator. In which you are then looking at the pass fail result and determining need for follow up or whatever. So I imagine that that is something that can be implemented relatively easily from that structural standpoint because it's already done in newborn hearing screening.

- Yeah, that's really interesting. And I think I'm gonna have a newborn hearing screening example in your talk, Aaron, next week. But this does put a bug in my ear on maybe talking a little bit about, what might we do with this suggestion for reducing loss to follow up from like a referred or missed inpatient hearing screening. So I think that's a great comment. Alright, great. This is a slide I generally have presented before and I think it's just a great review article. If you're thinking about, "Well where can I do teleaudiology across the intervention or hearing aid or implant journey?" This article has done the adult hearing aid process pre fitting and post fitting through the whole thing.

And this is a good starting place and there are several articles out there that have kind of reviewed what others are doing and writing about. So I think we this is a great one to reference and again, please reach out to us if you need any specific questions answered. We can put you in the right direction. We'll start to wrap up here on what's currently available. Like again, it's surprising but this isn't even that comprehensive. There's a lot out there, but for implants people are like, "No, definitely can't do implants teleaudiology." But actually yes you can. And there's quite a bit of evidence, not as much as hearing aids, but there's quite a bit. And if you think about it, there's a lot we can do.

Again, you're connecting to a PC machine to connect to the device. You're looking at ECAP thresholds, from the time of implant and moving forward, speech perception mapping, aural rehab, all of the evidence is available showing validity and feasibility for all of these aspects of the cochlear implant journey. A couple that I wanna highlight for

you that get me excited and I'll just be full transparency, I would not consider myself an implant audiologist. So for those in the room, feel free to reach out if you need help finding resources. But I'm no expert but some exciting things that I have come across, I haven't emulated practically myself, but I think are really neat in coming down the pike would be the direct audio input for speech perception on the remote fitting.

So they've done a lot of remote fittings, you're not in a sound treated room. A lot of what we do is in sound field, so for implants, so what does that look like? And we do see some challenges there with remote implant mapping and follow up, but taking advantage of that direct audio input for that testing is clutch. And I think there's a lot to be said about that. And then I'll also say some new things coming down are impedance measurements from home and it's like not actually not that unheard of. So the articles are all referenced here that you can dig into, but connecting that pod to the device and to the USB, downloading the impedances, having the audiologist take a look and doing that as part of troubleshooting or that mapping session is a great opportunity to keep the patient at home and not having them traveling back and forth so much.

And then lastly, I'll say there's some new work coming out that's looking at self fitting implants. Yes, self fitting implant mapping. And so again, this is not my area of expertise, but I just wanna point it out there that the people are dabbling in these areas and I think it's kind of exciting. This is a small study, I think the N was six and I think four of the six were able to like map themselves without needing any further adjustments and like love the opportunity and were comfortable doing it and like that sort of independence. And so I think that this is something, I don't think that's every, I don't think we're gonna implant someone, they're gonna self fit and we're done.

But that implant journey for people it's almost part of their candidacy, can they come to the clinic 10 times in that first year to get all that follow follow-up that they need?

And really we can be converting a lot of that journey into a hybrid using spurts of teleaudiology throughout it. This is certainly prime for centers that see loss to follow-up from implants or are having to bring people travel multiple hours at a time to come in and be seen. Okay. So like, okay great. I mean that's a lot of interesting technology across our various diagnostic areas and service lines. But like what does this really look like in my clinic? And it can take a lot of different forms, in the tribal health organization where most of my experiences with, we sort of have those cart structure in all of our clinics and we use that to really collect the information and send it around both asynchronously and in real time.

The VA has a really robust telehealth cart solution and they're doing a ton of telehealth in their kind of closed network makes it a little easier. So we're anomalies in that sense. We don't necessarily represent the real world, but that's one opportunity. But you don't need a big cart, we just went through all of this. It could be a kiosk in your waiting room, it could be a laptop in your clinic and you've got the tympanometer and the otoscope USB plugged in, the headset. There's a lot of different ways as this can look in your practice as just from like one USB otoscope to a full suite of tools depending on what you're trying to accomplish from a service delivery standpoint.

- Alright, so I'm gonna actually jump in and talk about this to kind of summarize sort of all the stuff that you've said thus far. So Sam sort of highlighted all of the technology that's available for you and really all of the cool things that you can do. So the question is like, why do this? There was that question in the chat, where we said can you help someone within the hospital that has an audiology program? Is that only for those people? And it really isn't. It's for everyone. Like teleaudiology is not just to go across state lines, it's to really look at different populations, hard to test populations, hard to reach populations. And so what we're tending to see here are these vast benefits to

teleaudiology if not implemented in a primary state as in your primary mode of service delivery, maybe as a secondary or tertiary mode of service delivery.

And so some of the things that you can see, and this was all discussed but just to really highlight them, is that it, first of all, it allows you to expand your services. Now when I talk about legislation and licensure next semester, next semester, I'm in my teaching mode as you can tell, when I talk about that in our next talk next week, I'm gonna talk like there are limitations to that. But it allows us to reach populations that have historically been difficult to reach. And that could be patients that, as Sam said, have to drive three or four hours to get audiology services. Or maybe it's just a patient that like relies on bus transportation and the buses in your town are famously unreliable.

I worked in a hospital where we had such a high no-show rate because the patient would try to catch the bus and the buses would just simply not show up. So this is also for them just as much it is for those who live in rural areas or difficult to connect to areas. The other thing that we're seeing is that addresses provider shortages. One of the things as we were making this talk, one of the things I looked up was in 2021, the last time that there was a measurement of this, there were 14,000 audiologists actually just shy of 14,000 audiologists in the United States. Now if we think about all the people with hearing loss in the United States, that means that we are severely underrepresented to help or we are severely, we are positioned in a very bad position to reach all of the people that need our help.

And that's why we are seeing such a demand for services. So this allows us to expand our services and reach even more patients and more people while staying in our chairs in our states, in our clinics. One thing that I am hugely a fan of, I mentioned this already when I was talking about aural rehabilitation, is the ability to practice interprofessionally. And I know Sam has an example in a case study coming up where

we talk about an interprofessional collaboration between ENT and audiology, which is one that you probably are keenly aware of. But as I mentioned we can integrate with SLP, we can integrate with pediatricians, we can integrate with other members of a child's medical home to provide better services and to better share our findings than simply sending a note to here, sending a note to here.

They could feasibly have access to all of these findings and look at them on their own term. And to that point, some of the things that telehealth does is it really improves our sort of clinical efficiency. How much are we getting done and are we doing it in an optimal way? And telehealth is an avenue that we can do that. And there are studies that show that utilizing telehealth, I actually published one of these and utilizing teleservices improves patient satisfaction. And so patients are happier that they can more easily and more readily reach their provider, more readily obtain services and they could do so from the comfort of their own house. So it may not even be that they're super far away, maybe they have to travel on a busy highway and they just don't wanna do that during rush hour.

Well now they're satisfied because they're getting services and they don't have to worry about that. Sam, are there any that you can think of that I haven't touched on?

- Oh, I mean, no, but I loved everything you were saying and I do think that telehealth can really move us from this visit centric model where you're just seeing this patient probably not in their best state 'cause something's going on from that one time that it took them to like drive to you and pay to park and find the office to under seeing them in their own environment in their home. And that's something I really enjoyed about what teleaudiology has allowed us. So I would just kind of also highlight that, but you know-

- Absolutely.

- There's challenges to those benefits, right Aaron?

- And I unfortunately feel like that's what the focus of the next talk is more or less like there are absolute, we're talking benefits, but the challenges are sort of the nuance and the details, there are different standards and guidelines and those terms standards and guidelines. That all plays a role in licensure. And I would say one of the biggest barriers we're seeing to telehealth services is licensure. So just to kind of give you a preview of next week's talk, unless your state is a part of an interstate compact, which we currently are implementing but is currently not fully implemented yet, you need to be licensed in every state that you provide services. So for me, for example, I live in southeastern Pennsylvania that, so I'm very close to Delaware, I'm very close to New Jersey.

I cannot provide services to patients if they are residing or receiving those services in New Jersey or Delaware without having a license in those states. And that is probably one of the biggest barriers that we are seeing. And that the other thing that the first three could be one bullet point, but they all say different things like state regulation. Yeah that has to do with licensure, but it also depends on like what does the state define as telepractice, what does it define as telehealth? And those definitions vary from state to state. Some states don't say anything at all. And so it's up to your imagination and your interpretation of the laws that are in place. And then of course the big thing that we've talked about is this payment.

How are we getting reimbursed for our services? How are we charging for our services? And how do these services fit into our model of clinical service delivery? And then I guess finally the last one that we kind of said sort of repeatedly through the talk thus far is this requires training not only on a facilitator standpoint. It takes training on the audiologist standpoint, there are several different levels of technology, if not more,

that you're gonna have to learn to navigate and sort of critique, like how do I decide which audiometer to go with, if any? How do I decide if I'm going to implement a tympanometer, a mobile tympanometer if that's possible. And so then I have to train myself on the implementation of it, then I have to decide if I need a facilitator and I have to train them on that.

So that takes time and that takes training. So these are challenges that we do have to be keenly aware of before jumping in and saying like, "Yep, now we're gonna do telehealth." But it is something that I think once you overcome those challenges, the payoff is absolutely worth it.

- Yeah. Great. Thanks. I'm looking forward to next week, Aaron. I'm gonna learn a thing or two too. Alright, so we'll pivot a little bit. Let's go into some case examples. We always love, okay applications like, okay, what does this really look like? And I'm gonna give you an example from our work in rural Alaska and don't worry about reading the slide. This is more a visual more than anything else but, for teleaudiology in Alaska, like I've alluded to, we mostly are addressing infection related hearing loss. I mean the full gamut. But that's something that is really high. It's the top five diagnosis in all of our communities we serve. And as for anyone who hasn't been to Alaska, it's a very large state, it's very remote.

Almost 80% of the communities live off of the rural system, which means if they need healthcare, they're either flying for it or they're getting it via teleaudiology. So we've had to really lean on being innovative in how we provide care. And I'm just gonna give you one example where I saw a patient using that cart I showed you the picture of and working closely with ENT for what I saw was an eminent surgical case. Let's get into the case itself. So this is a 14 year old male when he presented to me and he had been in the primary care quite a bit with chronic otorrhea that wasn't resolved. And he presented in I think July of 19, this is a 2019 case.

So as you can see, based on the data you're looking at here, right ear beautiful, tympanogram is normal, hearing normal. The left ear definitely got something going on here and if you're thinking cholesteatoma, you are right. I saw this and I was like, "Oh dear, we need to address this quickly." And I was a little bit concerned by how long it took for him to get to me. So I wanted to elevate getting this managed. And so you can see tympanogram there is flat and he's got this mild to moderate conductive hearing loss. So I used that telemedicine case right here. So I collected all that data in the cart, the images, the tympanometry, the integrated hearing testing and bone and speech and all of that, collected all that information on the cart.

And I created a case and I sent it to ENT and I said, "A little bit concerned about cholesteatoma, what are your thoughts and how do you wanna manage because it's been some time and I don't know how involved the cholesteatoma." And so they were like, "Yes, let's treat the otorrhea right now with the following set of drops," and I think it was ciprodex, "And then let's schedule them for imaging and then right into surgery." And so by October, so within three months or less he was seen for surgery, he had a left t-mastoidectomy done. And what you're looking at here is the left ear image post-surgery, the results a little bit of a stiffened TM there.

But what ended up happening was, this is a pretty far along cholesteatoma, they had to remove the incus and the malleus, the inner ear is not affected. Everything else. The tympanum and the rest of the middle ear space was affected by this cholesteatoma, needed to be removed, but the inner ear was saved, which I was so thankful for, that we were able to catch it that quickly and act on it. So then the rest of his care we did via telemedicine. So all his post-surgical care, monitoring his hearing, he needed multiple surgeries, so they first cleared the cholesteatoma and then he needed to go back to have an another exploratory surgery done and then have a prosthetic placed, pandemic happened in the middle.

So we're seeing a little delay in that second surgery. But again, these are images and technology all that came from using telehealth back and forth with the ENT to be monitoring them in real time. And we use that to say, "Hey, don't forget, we stopped doing preventive care surgeries with the pandemic, but this kiddo needs to be on your radar because he's got this left ear hearing loss that needs to be addressed." And so you can see his hearing improved with the prosthetic. So almost near normal, although he is got this slight to mild high frequency conductive loss. So just a good example of how we used telehealth to facilitate very quick expedited triage and get this person what he needed quickly.

- So the only question I have, and I do wanna be cognizant of time because we're starting to run a little long, but well we're not running long but we're getting close to our timeline. But I'm listening to this and I'm thinking how did you get the ENT to buy into it, like how do you get an ENT to be like, "Yeah I wanna do telehealth" in this case?

- It's a great question. I mean in the state of Alaska we depend on each other so intimately. Like we almost are the extension of ENT in a lot of these rural communities doing the medical management for these years. But so Alaska's a bit unique, but I also emulated some of this in a pilot program at Mayo when I was there for a postdoc. And it's interesting ENTs buy into it because they love this idea of doing low level triage via static images because there's so much you can see just from an image attempt and some basic hearing results. So their outpatient clinics they want filled with high yield surgical cases 'cause that's what you know they're interested in.

That's what's great for them. And so if we can use telehealth and asynchronous exchange of information for them to say like, "Oh yeah, primary care person, you're just

looking at a canal wall down mastoidectomy" or this is just tympanosclerosis because you know, that's a lot what sometimes comes on their door from these referrals. And so if we can use this technology for sort of high-end triage referral, ENTs love it because it's just more efficient care and we're getting people to where they need faster without waiting.

- Awesome. That makes total sense.

- Okay, so we have a couple of examples of other applications where we created some videos that I'll play.

- I'm not sure if we'll actually have the time for this round if I think about, 'cause we have about 10 minutes.

- Okay. All right. So sounds good. So maybe should I play one and then I'll kind of fast forward through?

- Yeah, let's do that.

- Alright, let's play one of the two here so you can get a taste and then you'll be able to see these later hopefully.

- Good morning Mr. Romine. So how are you doing today?

- Good, thank you.

- Yeah. Yeah. So I did notice that you said you've been having some trouble with your hearing aids.

- Yes. I'm having trouble with this one. It doesn't seem to be working.
- Sure. The left hearing aid. What have you tried so far?
- I haven't really tried much.
- Okay. Okay. You know what, let's do something real quick actually, if you can take out that left hearing aid for me. And.
- [Announcer] This is an example of a direct to consumer telehealth model using video conferencing technology. Video conferencing can be used for counseling, orientation and troubleshooting. In many cases an audiology assistant or tech may be able to carry out these appointments. This is convenient and accessible but assumes that patients have access to high speed internet and smart devices and ability to navigate them.
- Take off.
- All right, so for the sake of time, I'll just pause there, but we just wanna give you, the goal of these is just to give some demonstrations for how teleaudiology can be done. And this was just an example of a patient calling in from their home and getting some hearing aid consult and some troubleshooting for their device. And our next video here was more about a patient in real time struggling to hear in a noisy environment and she uses her app to connect to her audiologist right away and get some programming adjustments so that she can function well in real time in that noisy environment. And I just love these examples because really it's all about, the end of the day we don't fit technology for it to sit in the drawer and not be used.

So the more that we can be supporting the patient in real time, the better. And I think there are efficient ways to do that. Now Aaron's gonna ask me, "But how do you bill for this?" And I'm gonna let him talk a little bit about that next week. But at the end of the day, this really comes down to state, to state what your state allows and what you're doing on those services. Regardless of reimbursement though the value add is that people aren't returning their devices, they're more satisfied. So just think about that too. All right, so let me go through implementation quickly and make sure if you have some questions to be throwing them in the Q and A.

So we're getting to them because I think we're gonna narrow in on our Q and A window. But when I think about, I get asked a lot, "But Sam like I don't know where to start." People feel sometimes overwhelmed and I'm gonna reference a book chapter I have coming out that is really just like how to set up your clinic for teleaudiology depending on what you wanna do. And so there's just things you need to think about and I've presented this before, are you looking at screening? Is it diagnostics, is it interventional? Are you trying to reach people you don't currently serve? Or are they existing patients who maybe aren't coming in for follow-up that they need?

What technology do you currently have? What don't you have? What might be the models that you need to use based on the services you wanna deliver? And then who might be partners in this with you? Who might your facilitators be? You sort of have to look internally at your infrastructure and then go from there. And that really depends a lot on what your needs are. So when I think about teleaudiology implementation, these are some steps. First you assess and define the clinical need, you need to have a why. You're not just gonna like do it 'cause you want to necessarily, but like patients are saying, "Listen, I can't get to you. Can I call you from my house?"

" And you'll be like, "Well we haven't set up for that yet, but let's try." So that's the first and foremost of what's important. And then the market analysis is important too. Like

are there people that are gonna utilize that service? You need to think about the sustainability of the program you're building. And then there's the development plan, the who, what, when, where, and how. We've talked a little bit about that. You gotta build a team and you gotta train them and you have to provide ongoing training and then you gotta implement, evaluate and monitor. And so you can do this on a big scale, you can do it on a small scale. And I'll give you an example of how we did this on a small scale.

But this is the best way to think about implementation, assess, define, develop and plan, build your team and then implement and evaluate. So a quick example of something that I did where I moved, I was in rural Alaska for a long time. I left to get more training and then I came back as director of the clinic and I was like, "Oh my gosh, our bandwidth up here after four years of being gone was amazing." There was no way we could have done anything real time when I was there before, but when I came back it was incredible. So I noticed, I was like right away I was like, "What can we take advantage of?" Like we were fitting technology and then not seeing patients for six months to a year because they were so remote.

And so I was like, "I wanna change that," 'cause at the time our model was a fitting and then a follow up in two weeks, but we weren't anywhere close to that for our most rural of patients that live on an island between Russia and Alaska. So what I ended up doing was saying, "Okay, well what technology do we currently have?" Well all of our clinics where patients live, there's a clinic there with a community health aid worker called a community health aid in our region and laptops or PC based desktops and equipment. And I said "Okay, we can remote into that. We can get a wireless programmer for the type of technology we're fitting in each of these clinics and we can train a health aide for how to put that programmer on connect devices and program from there.

" So we started at the time we're fitting in person and doing that follow up via telehealth. And that's just one example. And so I thought through like, "What technology do we have? What can we utilize? What might we need? And who might we work with?" So you can start really small, maybe you're just implementing an iPad for an initial, we used to do some triage at Mayo for BPPV in our vestibular clinic. Maybe you're doing that on an iPad, before they come in for a full vestibular workup, things like that. So there's all different things to think of and you can start small, but again, this is not out yet, it's coming soon. I have a very detailed chapter that goes through just those highlights for you all to be able to learn more about how you might start up either a service line, just something small or maybe convert more things to teleaudiology if you aren't already.

So stay tuned for that one. Be on the lookout, it's gonna be on like Amazon, self-publishing, direct publishing. And then let's just give you a summary. And Aaron, feel free to chime in if I miss something. But at the end of the day, the benefits, I should make that bubble really big. Outweigh what might be some challenges we need to work through. But equity, like equity, everyone's talking about it, but it really is important. And if you look at the demographic of the patients you serve, does it match the census? And if it doesn't, why is that? Patient satisfaction. Like we know patients are happier, people are consuming healthcare differently, they're banking differently, they're ordering their food differently.

We need to be matching that in healthcare and teleaudiology can help us do that. We will inevitably always have a provider shortage with the burden of hearing loss that is happening globally. We need to use technology to our advantage to address that. We need to be efficient, we need to embrace that continuity of care. I think in some cases we can do things better over teleaudiology. And then challenges, we've met some, we still have some, Aaron's gonna elaborate on some. The technology and infrastructure is getting better, it's going to continue getting better. And then we are continuing to

provide training and guidelines and competencies. You're gonna see more and more come out about that. So stay tuned, be looking in the literature, there is evidence out there to help you get started and to frame your program and then more to come.

This is a two part series, this was your first part, Aaron's gonna lead the second part. He's gonna be talking to us about licensure and reimbursement, which is everyone's question when it comes to teleaudiology and actually all things audiology. So I think that's gonna be a great talk and I'm excited to take some of the applications that he's done and that I do and embed it in that framework of like, "Well what does this mean from a licensure reimbursement standpoint?" So make sure you're joining us for that second part series. We look forward to seeing you there. And we have time for questions if there are any. Otherwise we've got, here are our references. I would like to acknowledge my colleague Laura Coco, who helped me on those videos that you got a sample of.

And then I'll just leave up on the screen while we chat, our email that we'll have here. And then also next week, please, we are very open to hearing from you and offering any guidance we can, if we've left you with more questions than answers, we'd like to address that. But hopefully you found this talk interesting and at least start getting you the wheels turning about what's possible.

- Yeah, absolutely. And at this point, please if you have any questions, I know we have about a minute or two, so feel free to use that Q and A if there's anything that we can feasibly answer. But if not, then we answered all of your questions and we just got all of that information all out. Cut on our back please. As Sam said, please join us next week. We're talking licensure, we're talking reimbursement, we're talking all things regarding sort of the practicalities of implementation. So if you think about those last couple of slides we might even make, maybe I'll throw those back in just so we can look at them one more time when we start next week.

But we're gonna be talking about the, like the practicalities of implementing it from a regulatory standpoint as well as everything you need to know to get it going in your practice, to get teleaudiology going in your practice. And so for those of you who joined us, thank you so much for joining us and for those watching remotely, thank you again.

- Thank you so much Dr. Roman and Dr. Robler for your time and expertise today. And thank you to everyone who participated in today's course. This concludes our course for today. And everybody have a great rest of your day.