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Auditory Processing Disorder in Adults: Clinical Presentation, Evaluation, and Intervention, in partnership with AVAA

Presenter: Rupa Balachandran, PhD, CCC-A

At this time, it's my pleasure to introduce our presenter, Dr. Rupa Balachandran. She serves as Service Chief for Audiology and speech pathology at VA Northern California Healthcare Services. You can read more about Dr. Balachandran in the course handout and on our course page. And I'd also like to extend a thank you to the Academy of VA Audiologists. We are recording this live webinar today on Veterans Day.

Thank you to our veterans, thank you to our military families, and thank you to the association of VA Audiologists who Serve Our Veterans in Military. Dr. Balachandran, I'll turn the mic over to you. Thank you so much. Carolyn hello everyone. I am really excited and happy to be here with you today.

I'm going to be sharing some insights into working with adults with CAPD. So let's get started. Just before we proceed, here are some disclosures. I'm going to click through some of these slides.

And these are in your handout as well. So let's get started with the presentation. So typically I have students ask me when I teach this class what why don't we regularly test adults for auditory processing disorders? As I talk to clinicians at various times, these are some of the more prominent answers that come up, which is, first of all, first of them being, I don't know how oftentimes clinicians have not had much exposure beyond a single class in their doctoral programs and very rarely have had the opportunity to test an adult for CAPD in their student clinics or based on where they work at their facilities. So definitely don't feel comfortable not having had the right exposure to these clients and having worked with them in turn to do so.

The second biggest reason that I have heard is, well, I don't know if I can test if somebody has a hearing loss. And I'm going to take a minute to talk about this because I think this is important. If you look at the American Academy of Audiology guidelines, you are able to test adults with hearing loss if it is a mild to a moderate hearing loss. Some caveats included in that one is there should be enough audibility across the board so they can actually hear your presentation and two, their word recognition

in quality quiet needs to be fairly robust so you are assured that they're actually hearing all the sounds and the stimuli that you are presenting. And so you are able to test for the adults and be able to come up with a diagnosis of capd, provided you are somewhat certain, to a fair extent defensively, that the results that you're seeing is not due to the peripheral hearing loss, but largely can be attributed to the higher level central auditory functions.

What you can say with 100% confidence is if you get normal results on your CAPD test battery, that the higher level auditory processes are not contributing to their listening difficulties. So it's not a reason to shy away. Especially a mild high frequency hearing loss is not a reason to not do testing. However, as that hearing loss progresses, you need to be careful in terms of how you interpret it and understand the contribution of each side. The third one is I don't have time.

And honestly to my fellow audiologists, I am very empathetic to this. I know that CAPD test batteries typically tend to be very long, very bulky with several tests. So you're looking at two and a half hours of testing, which I understand is really hard when you have a very, very full schedule and being able to carve out that kind of time for testing is hard. The other piece to that is when you're doing a multi component test battery, you'll have some that come out normal, some that don't. Sometimes one ear is okay, the other is not.

It gets very complicated in terms of making a diagnosis. Hopefully today's presentation will give you some tools to really whittle that down to the basics and give you some evidence for how you construct your test battery for testing and be able to incorporate that into your regular assessments where you can do a little bit and get a sense of how the patient is faring and then move on for additional testing or bring them back another day. And the other piece I hear is I don't know what to do after. Again, very, very common and very valid reasoning to say, well now what? I have already tested them.

What is out there? Again, Today we will touch upon some tools for you to figure out what are interventions that are available for adults and how you can lead that management process. Now, we're not talking about the big fat elephant in the room which is reimbursement for testing and I am not especially going to get into that. However, please do not discount being a, you know, charging at the private practice rate or charging outside of insurance to do these tests, because you are, if your facility allows it, you may be able to do that and be able to get some reimbursement for your time outside of the insurance window. Again, there are options and that should not be the only reason you do not do them.

So how is CAPD different in adults versus children? And this is a very important distinction which really does impact how you set up your evaluations. And how you work with. With the two populations, there are some pretty significant differences. Typically with children, you get the concern they arise about the age of, like, between 7 and 10 years of age.

When reading is not developing, academic progress is slowing. There are concerns from the school in terms of the child thriving in that very structured academic environment. Environment. This happens in like second, third grade when instruction becomes more formal. Teachers often start noticing that the child is not progressing as much as they would like compared to their peers.

So this is when you may start seeing them. At this point, one needs to really assess if they're listening or their learning difficulties are are a result of maybe expressive receptive language disorders, whether there are some learning difficulties present, whether this is a result of some global cognitive or developmental delay, whether there is an attention issue or other neurophysiological issues. So there are many contributing factors in children, and you need to do some assessments to evaluate and identify which of these various reasons are significantly contributing to the child's difficulties. And what does management need to look like where you're prioritizing and targeting interventions so you're

making those gains. With adults, it is a completely different story because most often you are at the stage where they have acquired speech and language.

The they have had some degree of formal education, whether it's high school, whether it's college. So for better or worse, they have managed to overcome some of the constraints. And we're not that concerned about the impact on reading or academic performance, although those might still be present in the background. Oftentimes it's related to very specific incidents, or you can narrow it down to a time. So if it is military service, whether it was some blast injuries or exposure to different agents, or if it was related to a car accident or neurological or brain trauma, whether you are dealing with a progressive neurological disease.

So it is a little better defined in terms of trying to identify what could be causative factors. Of course not to say that there are adults who've had this all their life, and it's a little more diffuse, but for the most part, you are able to try to narrow that down. Adults seeking treatment, they are motivated, they want to find out why they are facing the difficulties they are, and they come to you. So all your strategies are in working directly with the patient, you're not dependent on a parent or a guardian to follow through and be able to provide the care. And the last is treatment options, because these are adults and they can make decisions to pursue various options and hold themselves accountable in terms of getting to their care.

And making the effort to work with you to get to the outcomes. So very different populations and very different ways of managing adults versus children. So move. There are, as you can imagine, several causes of auditory processing disorders in adults. And they can include traumatic brain injury, vascular incidents like stroke or an aneurysm, hazardous noise exposure, depending on occupational hazards or even recreational hazardous noise exposure, certain degenerative causes due to neurological toxic exposure to various agents, space occupying lesions, and of course undetermined where it could be

something where they cannot point a finger on what happened.

Today we're going to focus more on traumatic brain injury and toxic exposure to limit our scope to those two areas where we discuss what is going on. So in terms of risk factors and their impact, we can talk about blast exposure, which often causes diffuse neural injury. There's disruptions to the auditory pathway. You're going to see speech and noise processing problems, temporal processing deficits and auditory attention deficits. Typically with hazardous noise express exposure, you again are going to see speech and noise difficulties.

And they also can have things like hidden hearing loss, cochlear synaptopathy, and all of these can happen in the presence of normal pure tone thresholds. Oftentimes conditions like PTSD and psychological comorbidities resulting from can cause hyperarousal attention deficits, sensitivity to noise reduce auditory processing and may actually cause them to not function very well in auditory environments. Similarly, depression, anxiety, chronic pain and sleep disorders also affect attention, memory and higher auditory processing. And therefore some of these factors can make assessment a little more complicated. So it's important to take those into account as you're developing your your testing mechanisms and your management of the condition.

We are going to focus a little bit now on traumatic brain injury. And common causes of traumatic brain injury could be falls, motor vehicle accidents, sports injury, assaults or workplace accidents. So the brain itself can be injured to like a damage at the site of impact or which is like a coup injury or a contra coup injury where the damage is on the opposite side of the brain when it rebounds. Within this call you can get diffuse actional injury which is caused by stretching and tearing of the nerve fibers by rotational forces just when the brain is rattling around in the skull. And then there is secondary injury resulting from swelling or inflammation and changes in the brain metabolism that occur after the initial injury.

Something to remember is post concussion syndrome, where after the original concussion, which could last anywhere from the symptoms lasting anywhere from seven to 14 days, post concussion syndrome tends to linger long after several months where the person continues to have symptom Symptomatology long after the original incident. In case of traumatic brain injury, you can also have secondary injuries from shrapnel or flying debris. In terms of blast exposure, you can also have organ damage in the lungs and cause hearing loss due to damage to the ears. GI issues from organ damage as well. So those can be have very, very disastrous sequelae.

So when you have a direct impact, there is a single blow to the head with an object striking the brain, the head and thereby injuring the brain at the type of impact. You also have acceleration or deceleration types of injury where if you can think of a motor vehicle accident where there's acceleration and then you get hit and then the brain just moves back and forth in the skull and can get hit, can sustain injuries from that back and forth movement. Or in case of a blast exposure, there is a huge pressure wave that passes through the head and it can disrupt neural tissue without directly contacting it. So those can really have a very significant impact on your neurological tissue in the brain. Typical symptoms that you will see in adults with traumatic brain injury, in addition to their listening difficulties would be irritability, loss of sleep, tinnitus, not being able to hear well in noise.

It can be accompanied by a generalized anxiety disorder, ptsd. Social deficits arising from just not feeling good, not wanting to be in social situations, partly because it is so difficult to function and not be able to hear, not really get enjoyment from being able to be in social environments where listening in a large group of people is very, very stressful. There are memory and attention issues accompanying and dizziness as well. One of the things that does concur together with TBI are vestibular insults as well. And therefore being able to assess that part of assess vestibular function as part of management of TBI also is critical.

Oftentimes your patients will tell you that they have had a hearing test they done somewhere and have been told nothing is wrong with their hearing. Because when you look at their audiogram, pure tone thresholds are within normal limits. They may have a word recognition score within normal limits where you start seeing a little bit of deficits are on speech and noise tests. If they're performed where you start seeing mild or moderate deficits, TIMPs and OAEs typically tend to be normal. Sometimes you see an elevated contralateral acoustic reflex, but very little that's glaringly out of place, except maybe your speech and noise scores on a typical audiological evaluation.

The next area that we talk about is jet fuel exposure and this is getting. There's a Lot of research happening. This is getting a lot more play now and as a change should, because it is, it does have some significant impacts. If we think about jet fuels, typically they are a combination of compounds that are used in jet fuels such as JP8. And they typically contain a mixture of solvents like hydrocarbons, some aliphatic compounds like decane, undecane, dodecane, they have cycloalkanes.

Sounds like your chemistry class from high school. But definitely a lot of compounds. And some aromatic hydrocarbons like toluene, xylene, ethyl benzene and naphthalene, all of these do have, especially the aromatic hydrocarbons do have some ototoxic effects.

They make up a small portion of JP8 but are present. The jet fuel compounds are primarily absorbed through inhalation and then are distributed through tissues like your lungs, your blood, your brain, your liver and your fatty tissue. And overexposure can cause headaches, dizziness, fatigue, respiratory and eye irritation, dermatitis and central nervous system effects. And as I said earlier, the hydrocarbons also are known to be ototoxic. So there are guidelines, OSHA guidelines in terms of exposure, in terms of ventilation, in terms of wearing protective gear when you're working with jet fuels, and also what you do if you come into contact with them.

And one of the things we know is there are synergistic effects with noise exposure. So let's get into some more of all of that. If you look at the research and there are some very good papers that are in the reference section of today's presentation, which will give you a good start and then that can lead you, if you really are interested, you can take a nice walk through this literature and there is a lot of good work happening on this right now. So jet fuel exposure can contribute to central auditory nervous system dysfunction. And this is particularly so when it's combined with noise exposure, even when your pure tone thresholds are within normal limits.

And from all the evidence in the literature, what we're seeing which is strongest and very consistent across all types of studies is the difficulty for understanding speech and noise despite normal hearing, and suggesting that jet fuels affect auditory processing pathways rather than causing classic peripheral hearing loss. The pathophysiology of jet fuel exposure is based on solvent induced ototoxicity is 1, oxidative stress is the other. And the combination of combined with noise it can actually impact the hair cells in the cochlea. And the way this happens is identified as a depletion of glutathione, which Is an intracellular antioxidant. So when a body is exposed to JPA8, then it reduces the level of this compound called glutathione GSH within the liver.

And then what starts happening is then it reduces the ability of the cells to react to oxidative stress, and then it makes them susceptible to oxidative injury. And this ends up disrupting the intracellular calcium homeostasis, alters membrane fluidity. There's free radicals generated. And we have seen through studies, this causes dysfunction of cochlear efferent pathways, and it also can induce cell death. So in the cochlea, particularly, you're seeing impaired outer hair cell function, Reduced DPOA ease, auditory dysfunction.

And so there is some higher level dysfunction in the thalamocortical pathways. Disruption of suppression, disruption of adaptation. So definitely there are a lot of factors that are impacted through

this exposure. Again, even this is present even in adults, where the exposure is still considered sometimes to be within safe limits for jet fuel. But combined with noise, it can really create havoc for the auditory pathways.

If you look at the animal evidence, There is very good work done by Murata and by Guthrie, and it shows that it alters brainstem encoding of auditory stimulus intensity, suppresses central auditory system activity. Even in the presence of cochlear function being normal, the upper pathways are impacted.

One of the studies showed that brainstem encoding of sound intensity was impacted with jet fuel exposure with neural abnormalities rather than cochlear damage. These are evidence from animal studies, human evidence. Very good work being done by Dr. Laura at the California State University of San Diego in conjunction with ucsd, has done very, very good research with her partners on looking at military personnel exposed to jet fuel. The references are in your handouts. They looked at.

This is a very nice study. They looked at military personnel who were exposed to both jet fuel and with noise, and they compared them with military personnel who were just exposed to noise. So they had individuals who were on the fuel lines working with jet aircraft Versus those who just had straight up noise exposure. And these were young adults. So a lot of the other factors from aging were kind of limited in this.

So pure tone audiograms were normal in both groups. But the groups who had jet fuel exposure Reported greater listening difficulties on the modified Amsterdam inventory for auditory disability. So they found that they were reporting greater problems. And in their results, it showed that big differences in speech intelligibility in noise, which is considered more of a central auditory issue. There were no differences in the hearing thresholds between the groups.

Jet Fuel exposed participants reported more auditory difficulty and the subgroups with the greatest self reported difficulties showed significantly poorer performance on speech and noise measures. So when they said they were doing poorly on the self reports with the maiad, they also did poorly on their test results. And again, this goes to show that noise exposure combined with jet fuel exposure does accelerate does compound the central auditory nervous system issues. So we have seen this combination with the two even in animal studies. Fector et al in 2007 and a rat study demonstrated that if you exposed the animals to just jet fuel or just to noise, the damage was less or inconsistent.

Whereas when you combine the two, you had greater auditory dysfunction and more auto head cell loss than simply with noise exposure. Again, when some of these adults go to get a standard hearing test where the awareness of these issues are not there, the problem can be missed because they may have normal pure tone thresholds, excellent word recognition and quiet, but they are reporting significant difficulties in real world listening situations. And the mechanism which underlies this is brainstem pathways, thalamocortical auditory pathways and central auditory mechanisms. Again, going back to to what we have been saying as audiologists all along is do some speech and noise testing to clearly identify. I cannot tell you how many times in clinic we have seen adults come and say I told everyone I was having listening difficulties.

They did a hearing test, they said my hearing was fine. So I think as a profession we can start making more forays into taking these concerns seriously and doing some speech and noise testing, doing some additional testing to tease out some of these difficulties. So when you are testing somebody who may have a potential jet fuel exposure, speech and noise testing is recommended. Some dichotic listening testing, some temporal processing testing, maybe an audit, central auditory processing assessment. Very important to take a detailed solvent chemical exposure history and there is a good questionnaire you can use for that if that is something you're seeing quite a bit in your facility, in your practice, there is a lifetime exposure to noise and solvents questionnaire which really helps you look at

not only the, you know, the exposure in terms of time, in terms of frequency and is able to compute a score for you that will will tell you if the overall exposure is significant or not.

So things to keep in mind when you're working with this population. So we're going to move to the next phase which is assessment of auditory processing disorders in adults and let's get more into it. So we are talking about a test battery approach for testing and if you look at the guidelines both by ASHA and by aaa, you can see that there are very many tests that are available. But more commonly, you're looking at doing some testing in three major domains, which is binaural interaction, which includes both binaural separation and binaural integration. Which the tests would be, could be dichotic digits, dichotic words, dichotic syllables, dichotic sentences.

So there's a large corpus of test materials, the ssw, which is also a very strong test for binaural interaction. And you can see you can. You can have tests that do both separation and integration. Separation is where you would just selectively answer one side or the other. Like repeat the right ear first or the left ear first, or just say what you heard in your left ear.

Those kinds of tests keep the two streams separately and are looking at your ability to apply that selective attention between the pathways. And then integration is when you're doing both, you're going to hear two numbers in this year, two in these. Give them all back to me. Those are binaural integration tests. So looking at the combination or the differences between separation and integration, it gives you a little more insight into how dichotic processing is working, how selective attention is working, how quickly or efficiently is the auditory system able to switch between the right pathways and the left pathways, contralateral pathways in dichotic listening.

So it tells you a lot about how the auditory system is functioning in those environments. Monorail Low Redundancy is looking at tests that are removing the redundancy present in the speech signal by either low pass filtering the stimuli by adding noise into the signal, or by compressing the time cues within the

signal. And again, you have a lot of tests available in test batteries that will allow you to do this. And finally, Temporal processing looks at how your auditory system is processing temporal cues within a sound. And the most robust tests are the frequency patterns, duration patterns, and then gaps in noise or the random gap are all good tests to be assessing this function.

There are test batteries that you can use. For example, SCAN has a pretty comprehensive test battery. And you can use SCAN for both children and adults. There are two versions and have all of these tests. There is mappa, which is the multiple auditory processing assessment, although that is not normed for adults.

And you can also do the SSW which has the Buffalo model testing, which has the ssw. It has the phonemic synthesis test and a speech and noise test. So there are pre existing batteries that you can pick or you can just pick individual tests for this. We'll get a little bit more into what tests, how many in in Just a couple of minutes. In addition, a questionnaire is very, very helpful while working with auditory processing deficits because the questionnaire highlights the functional deficits that occur or the individual is experiencing throughout their listening experience.

Sometimes, if a test result is not very robust because of the particular test, but you're seeing these functional deficits, that may be time to say, okay, where? Where is the deficit? How am I getting to it? And so you have the modifies Modified Amsterdam Inventory for Auditory Disability. You can have like the Adult Auditory Processing Questionnaire, the Adult Auditory Performance Scale.

Those are just some examples. But having a questionnaire really helps. It also helps in diagnosis because if you look at guidelines for diagnosing where you need to fail two or more tests at greater than two standard deviations, you are able to diagnose failure on tests in a single domain greater than three standard deviations if it is accompanied by documented functional deficits. And having a questionnaire where you're clearly documenting those severe functional deficits allows you to put those two together

in order to diagnose an auditory processing disorder. So questionnaires are a wonderful tool to keep in your test battery.

So back in 2011, this is a fantastic study and a fantastic paper has held up over time.

It was done by Frank Muzak, Gail Schermack and their group, and it really talked about evaluating the accuracy of central auditory processing tests. Now, some of you may feel like there are so many tests, I don't know what to use. There's too many of them. It's too time consuming. I cannot decide what to use, and my facility doesn't.

Is not going to give me three hours to do testing. Fair points. This paper I would suggest as recommended reading for anybody who is doing CAPD or wants to start capd. It's worth the time to sit. It's really worth the time to sit down and read through how they looked at it.

So the goal was to identify which tests in a test battery are most sensitive to lesions of the central auditory nervous system and what gives you the best sensitivity, specificity, and which is a very good, efficient CAPD test battery. In the design, they had 20 individuals with documented central auditory nervous system lesions and auditory symptoms. They had 29 control participants without neurological involvement. And they looked at four behavioral cap tests, which was dichotic digits, competing sentences, frequency patterns, and filtered speech. So this kind of represents some of the domains that we test.

Binaural integrative interaction, monaural low redundancy, and temporal processing. So they looked at it, and what they found was that frequency Patterns demonstrated the strongest overall diagnostic performance with sensitivity at 90%, specificity at 90% and efficiency of 90%. Now, just to remind you, sensitivity is when a test accurately identifies a condition when it's present. Specificity is when it accurately rejects a condition when a condition is not present. And efficiencies, how put together, how

well does it do?

Overall, frequency patterns was found to be really, really sensitive and specific. Dichotic digits also showed high sensitivity. Specificity was a bit lower on that. And competing sentences showed only a moderate sensitivity, but excellent specificity in that if the condition was not there, it was able to rule it out. Filtered speech had the poorest diagnostic performance overall.

Again, for tests. This is not a commentary on all the other test batteries out there. However, if you're beginning and want to zone in on what can work for you, this is a good place to start. The best performing test battery was a combination of dichotic digits and frequency patterns using the strict criterion, which meant you had to fail both tests to be diagnosed with an auditory processing disorder. So sensitivity here with both together was 80%, specificity was 93% and efficiency was 88%.

Which means so if there was a problem, you were going to have a very high chance of identifying it. If there was not a problem, you had a very high degree of rejecting it. And Overall efficiency was 88%. Larger test batteries, so if you added more tests to did not improve your diagnostic efficiency. So I'm going to take a moment here and say, if you're in a very busy clinical practice and you have adults telling you that they're having a lot of difficulty listening in noise, you're not sure if this could be an auditory processing deficit, but you don't have the ability or the resources to go and do a whole big test battery if you simply were able to administer dichotic digits and frequency patterns, which are pretty standard on a lot of audiometers, that takes you about 10 minutes to administer, but it gives you a good starting point to say, oh, hey, this performance here looks abnormal, let's refer them out for further testing.

Or this looks good. And look, the specificity is 93%, which means probably this can be a lower priority on really needing to refer out for a whole big battery of testing. So this can be a good framework, a good screening tool for you to be thinking about just doing these two tests, assuming you're doing some

speech and noise testing as well. So the three put together will start putting you on a decision path of whether this individual is an appropriate referral for further testing of central auditory processing. So something to keep in mind as you are thinking about what you can do to work in this area, we're going to go to our last section which is treatment and starting with some clinical principles, again, working with adults, you can really focus on deficit specific interventions.

They are available, they are effective. Also that will help you avoid like excessive treatment burden, trying to treat everything all at once. If you focus on one deficit at a time, whether it's speech and noise, whether it's temporal processing, whether it's binaural interaction, there are areas that you can work on. You have to monitor the outcomes and adjust your treatment. And very, very effective is if you can combine both bottom up auditory approaches with top down cognitive linguistic interventions put together, working from a more holistic and working at the very basic level like how do we improve signal to noise ratio, how we get you to use some new strategies together will really have the greatest impact.

Very similar to working with adults with hearing loss, we are looking at signal to noise ratio, improving the signal to noise ratio, starting with environmental modifications that can do that, finding ways to reduce background noise, finding ways to improve room acoustics, reduce the speaker learner listener distance, and using preferential seating. Now this is something that adults can very easily do in their own environments once they understand how they can do that. So having that conversation, where are you working? What could you be doing? Can we look at a quieter office space?

Can you be working in an area that has less noise? Could we be looking at some acoustical treatment for your space, Some panels, some doors or some treatments to dampen down the noise in the room? Can we look at things like headsets when you are working? Can we also look at where you sit in a room when you're in a meeting so you are at an advantageous place where you can see the speaker, where you can influence or set yourself up for success? Oftentimes with our adults who have difficulty with

auditory processing, one of the places they struggle the most is in the workplace and are typically very, very hesitant to ask for accommodations, Very, very uncomfortable talking to their managers.

So a lot of the role that as professionals we play is helping them understand, giving them tools, things that they can do themselves, or help them advocate for themselves so they are more successful in the workspace overall. The next area, which today is a lot easier, a lot more support is technological support. Whether you use live captioning, you have devices that record caption telephones, remote mics and low gain hearing aids. More so today than maybe 10 or even 20 years ago, your smartphone can do a lot of this. And sometimes it's a matter of human showing your adult how they can be optimizing some of these technologies in order to access the speech in their environment.

Low gain hearing aids are gaining a lot of traction now as a treatment for auditory processing disorders. As good work coming out in terms of actual prescriptive, how do you set them up? Prescriptive formula, if not a formula per se, but how do you set up the gain at each frequency? What works? There's some evidence based work that is happening which will allow these to be very effective for adults with auditory processing.

In my personal experience with adults with auditory processing wearing low gain instrumentation, I am hearing things like feeling less fatigue at the end of the day, being able to stretch the day out much longer before that fatigue kicks in and the irritation kicks in. Being able to listen better in a noisy environment because the algorithm and the directional microphones really help put that speech within range. And a little bit of the noise reduction that happens even though you're going to fit these oftentimes with open moles. And if you want, sometimes you can look at some if the person can tolerate it, you can look at more closed fits if noise reduction is an issue. But even that little low frequency gain combined with noise reduction combined with the directional microphones really provides a big boost and has a great impact.

Combined with remote microphone systems, it is a game changer. And given how much easier it is with newer technology to have these all talk to each other, it has become a lot easier to manage the signal to noise ratio component of auditory processing, providing those gains in our adult population.

As you move into more complex management of an individual with auditory processing, we absolutely recommend a team based approach. If this is somebody with traumatic brain injury, you're going to have a team, an interdisciplinary team who will consist of a social worker, a medical doctor who's managing some of this, maybe some behavioral health is involved. Your speech pathologists, occupational therapy, the audiologist. We can come together as a team to really help manage the various aspects. As we said earlier, traumatic brain injury doesn't only have sequelae for hearing loss.

There are a whole multitude of areas that need to be addressed. So working in a team really helps you prioritize, get to the low hanging fruits, start providing some relief and start moving forward and work with the individual to get them to a better place. I can never overemphasize the importance of working with our speech pathology colleagues in the management of individuals with auditory processing because they are Able to really work on the everyday functional deficits and working together well as an audiologist, you can really contribute to improving the signal to noise ratio. While we have strategies and therapies for the deficit specific interventions, what the speech pathology side of the house is able to do is assess the functional communication and those participatory restrictions. Like I don't like going out in a social environment, I find it very hard, I don't know how to manage.

So really being able to evaluate the cognitive and the communication processes, the language processing factors that are affecting listening, we are able to develop a plan that can be worked upon. Having another partner to talk about that, do the patient education piece to be able to talk about self advocacy training is all very robust and required. So if you are able to make friends with the speech pathologist or you have one in your facility, this would be a very strong partner in management of these

deficits. Communication strategies, again, not very different than when working with adults with hearing loss. Again, just emphasizing and some of these are very, very appropriate to put into a management handout for the workplace.

Like things they can hand to their supervisors, things they can bring to their performance evaluation to really talk about what might help them become better, more efficient in their workplace with regards to communication and performance related to that. So speak clearly with good vocal modulation, use of visual supports and gestures. Provide written instructions and summaries, preview, highlight, review, repeat and rephrase key information. This is fantastic to bring to your supervisor at work and say, hey, I have been diagnosed with an auditory processing deficit and some of these will really help me be a better team player, a better worker. If we can follow up a conversation, especially if it's important tasks, if it is a performance evaluation, if it is feedback, where some of this is followed up in writing.

Big definite emphasis on closed loop communication. So if you tell me, I would like you to do X, Y and Z, if I can repeat it back to you and say, from my understanding we're doing X, Y and Z and this is Y. Closing that loop is super helpful. It's helpful for all of us. But definitely when you have an auditory process processing disorder that makes it so much better in the workplace.

Instead of everybody thinking what they heard or said was what was communicated, providing written instructions, providing summaries, if there is a big presentation, a meeting with the client, instead of the our patient being surprised at the meeting or not having previous access to the information and then needing to act upon it in the minute, it's better if the supervisor gives them a heads up Lets them know this is coming. We're going to be discussing this. I'm going to be expecting you to weigh in on these conversations in this format and having these strategies discussed beforehand, which may or may not be necessary when you're dealing with team members who don't have auditory processing difficulties. But definitely becomes very important for that individual to be able to contribute fully in those

environments. We also need to help our adults advocate for themselves.

Really get into the role of I am going to make sure I can do this. So requesting clarification, using visual cues and speech reading, making sure they're sitting near the primary speaker and advocating for communication accommodations. Auditory training works because it really builds new neural connections and allows the brain to focus on what is important. Typically a bottom up auditory training program starts with sound awareness, sound discrimination, identification and comprehension. And there are programs, web based programs that help you do some of this.

Most of you are familiar with LACE with their new LACE AI, there's a lot of enhancements. There is a Listen app and then capdots is a very, very good program from Canada which does a lot of good work with binaural integration and separation and can be used extensively. This is by no means a comprehensive list. There are great programs out there. More recently we have been using BrainHQ.

It has a bunch of auditory training software in there as well. Modules we have not yet. We don't have the conclusive evidence only because some of these are hard for people to stay on track. But we are working on it. But there's a lot of different programs.

Pioneer Acoustics has a bunch of programs. So lots and lots of commercially available listening web based software. We will talk about cognitive communication intervention. This would be something your speech pathologist colleague might be able to help with working on attention memory, executive functioning, metacognitive strategy use and compensatory communication techniques to help you really make the most of your situations. Being able to navigate those have the right tools to be able to do that.

Lastly, we did touch upon this in terms of workplace accommodations. Definitely spend a lot of time writing out this list so the adults can bring it to their workplace. Be open to conversations, really discuss in partnership with the client, with the workplace to come upon ways on how to make it better. We know

that not everything can happen all at once. But focusing on high impact low hanging fruit will really help us move forward.

Modification of schedule to allow for listening breaks. I think this is very underrated. It is really, really important to be understanding how that will help in the management. So in summary, CAPD can occur in the absence in the presence of normal pure tone thresholds. Typically, you're listening to complaints of speech and noise, difficulty listening fatigue, localization deficits.

I don't think somebody is going to tell you, oh, I can't hear somebody from the left side or the right side. This will show up. As I'm in this room, I can't understand who's saying what. I have no idea. It sounds like a mess.

That's because typically in a normal auditory system, you're able to build this nice 3D map and be able to tell where sounds are coming from. That does not happen with auditory processing deficits. So they're going to say everything sounds jumbled up, mushed together a lot of times. Given the conditions that give rise to the CAPD in adults, you're going to have ptsd, cognitive deficits, tinnitus, sleep disorders, chronic pain. So having that multidisciplinary team to help you would be essential to being successful.

And remote microphones and low gain hearing aids do work and there's a lot of evidence that shows that they work. So thank you all for your time today and we may have a couple of minutes for some questions. Thank you so much. Dr. Balachandran, you got so much in the hour there. You covered so much and there's so many great practical takeaways for the clinic.

We have one question queued up and again for participants. Please take a moment and ask any questions, comments, suggestions you would like to share in the Q and A. But before we get to that, I have one quick question myself. Are there any materials that you use for a lot of this information you

shared, like advocacy tips, tips for partners, tips for employers. So we're not all kind of reinventing the wheel on putting those together, like communication strategies and things like that A lot.

Some of the papers that I have listed will have them and I don't have a single resource. But your best documents come from the ASHA or the aaa. The guidelines are fantastic. They are still. I just reviewed them again yesterday.

The AAA guidelines for Management of Auditory Processing Deficits. Fantastic. And Ashes as well. Talks about most of the main points over here. Great.

Oh, thank you. And so we have a question here that says it goes back to the jet fuel exposure. Does exposure refer to direct contact with or inhalation of the liquid jet fuel and its vapors, or does it primarily refer to inhaling the exhaust and combustion byproducts produced when jet fuel is burned in aircraft engines? So great question. And I will start off by saying I'M not the jet fuel expert however all the papers that I have reviewed for this presentation talk about inhalation of the jet fuels so in the animal studies the animals were actually inhaling it.

In terms of the human studies these were people who were fueling the airplanes and hands were inhaling even though it was limited. You know they could wear filters or have a mask or stuff like that but it was inhalation of those as they were processing with the fuels not so much the afterburn. Thank you. That was all new information to me. Fascinating.

That is the only question I see here that's open but I want to thank everybody who participated today. We had quite a big turnout here. Thanks again Dr. Balachandran and just a reminder to everyone if you are earning CEUs please log into your account in Audiology Online and take that exam as it will expire and thanks everybody again for attending and thanks to our presenter today. That's a wrap. Thank you all.