

## Review Article

# Autism Spectrum Disorder is on the Rise: Speech Pathologists and Audiologists Must Rise up to the Challenges

**Kaf WA<sup>1\*</sup>, Barboa L<sup>2</sup>, Abdelhakiem AK<sup>3</sup> and Almomani MO<sup>4</sup>**<sup>1</sup>Department of Communication Sciences and Disorders, Missouri State University, USA<sup>2</sup>Department of Special Education, Springfield School District, USA<sup>3</sup>Department of Chemistry, Missouri State University, USA<sup>4</sup>Otorhinolaryngology-Head and Neck Surgery Department, King Saud University, Riyadh, KSA**\*Corresponding author:** Kaf WA, Department of Communication Sciences and Disorders, Missouri State University, 901 S National Avenue, Springfield, MO 65897, USA**Received:** September 28, 2014; **Accepted:** March 04, 2015; **Published:** March 05, 2015**Abstract**

Autism spectrum disorder is one of the most prevalent and on the rise disorders in children. Autism causes developmental delays in many areas during childhood. As each of these areas of delay may require a different type of professional intervention, ASD requires a multidisciplinary team. Two crucial delays found in children with autism spectrum disorder are social and communication development including auditory development. This review summarizes some of the communication and auditory deficits in children with autism spectrum disorder and discusses the inter-professional roles of speech language pathologists and audiologists in assessing and enhancing the function of these deficit areas as well as parents' role toward efficient interventions for their children.

**Keywords:** Autism; Speech language pathologist; Audiologist; Communication disorders; Auditory processing disorders**Abbreviations**

ASD: Autism Spectrum Disorders; CDC: Center for Disease Control and Prevention; SLP: Speech Language Pathologist; PECS: Picture Exchange Communication System; ABR: Auditory Brainstem Response; OAEs: Otoacoustic Emissions

**Introduction**

Decades ago, when autism was rarely heard of, it did not really matter whether the general public or professionals understood the challenges and characteristics. Earlier European studies identified the prevalence of autism to be one in 2,500 children in the population [1]. The rate increased to 1%–2% of all children [2–4], with a rate of one in 150 in the year 2000 and one in 110 in the year 2006. According to the Centers for Disease Control and Prevention (CDC), the rate of autism in the United States in 2008 increased to one in 88 eight-year-old children [5]. Within these few years, the rate has dramatically increased more than 80%, and continues to increase (one in 68) based on 2010 data [6]. The latest figures from a 2014 CDC report estimate that one in 68 U.S. children have ASD [7]. Autism is currently a public interest and a commonly known household word. However, early diagnosis and access to early intervention services for children with ASD is not expanding at a similar, parallel fast rate.

A child with autism lacks the normal developmental processes and sequences a typical child goes through. There are delays in many areas. The list includes, but is not limited to: social behaviors and social relations, language, speech, nonverbal communication, cognitive, auditory behaviors, and adaptive behaviors. For this reason, the most comprehensive and effective management for any person with autism requires a team of providers. The diagnostic and treatment path can get very complicated, especially since each child's

need is different [8]. There is not one “cookie cutter” answer to the members who will comprise a professional team. In general, the service team will include members of the educational (school teacher, diagnostician, special education teacher) and medical communities (primary care physicians, pediatrician, neurologist, speech-language pathologist, audiologist, clinical social workers, occupational therapist, music therapist, psychologist). In most cases, the SLP or audiologist may be the first professional to see these children. These providers play a significant role in identifying and describing deficit areas of communication and social interaction skills in children with ASD, which is critical for differential diagnosis and the final diagnosis of ASD. They are instrumental in setting up an intervention protocol and therapy plan to help improve skills in these deficit areas and work with families to keep intervention ongoing. The focus of this review will be on the role of the audiologist and SL Pin assessing the auditory pathway and the speech, language, and cognitive-communication of children with ASD.

**Communication deficits and the speech language pathologist**

Speech, language, and social communication delays are some of the first markers and characteristics for identifying children with ASD [9,10]. A child with autism generally experiences considerable speech and language problems, including delays in babbling and speaking, delays learning to use gestures, echolalia, and lack of spoken language, social-interaction difficulties, and communication challenges. These communication delays interfere with learning and everyday life. For this reason, the child's SLP is one of the most important members of the ASD professional team. The SLP assesses deficits in various areas of speech, language, and cognitive-communication and works with the child to improve these skills.

Since communication is vital to every child's success, teaching a child to speak is a goal of most parents of children with autism. However, this should not always be the first goal because many children are non-verbal and communication does not necessarily mean oral language. Communication is how a child makes known his wants, desires and feelings, and does not have to include the use of spoken words. It is not necessary for children to use oral language to express themselves. A child on the autism spectrum may not even possess the ability to communicate well enough to satisfy his basic wants and needs. For instance, a child dragging the parent by hand to the refrigerator is not using a form of good functional communication. The child is only using the other person as a tool to fill a need; hand leading is a crutch which must be replaced with specific language. One of the first things the SLP must do is supply the child with a strong, usable form of communication. A child who lacks this ability is a very frustrated child that often displays meltdowns. It is not until the team can decrease this frustration that teaching and learning begin.

Together the SLP and parents may choose to teach the child language using either oral or nonverbal means. It is very important to involve the care giving team in the decision making process as to what type of communication to teach each child first. In deciding which type, or modality, of communication to teach a particular child, the professional must keep in mind the child's age and skill level. They must consider how motivated he or she is to communicate with others. For example, if the child leads a caregiver by the hand, the SLP should encourage the child to sign "come". The caregiver may be taught to use the hand over hand method to help the child form the sign, and then follow him to his destination, if possible without holding hands. When children use broad gestures to fill needs, the decision is made to begin with non-verbal bridges to the skill of oral communication. In this case, the team will work to refine these to be of a higher communicative value. The SLP is trained in teaching those basic signs.

The cognitive level of the child and the interest in electronic devices should also be taken into consideration by the SLP. Are the choices limited by any motor involvement? The SLP will be highly involved in this decision and will be instrumental in finding any information needed to make the best choice for each child. If the decision is made to begin with non-verbal bridges to the skill of oral communication, the SLP will need to consider the choice between low tech and high tech options.

Low tech options include use of cue cards, the Picture Exchange Communication System (PECS), simple interactive communication boards, facilitated communication, and sign language. The PECS was developed by Bondy and Frost to teach young children to communicate in a social context [11]. A picture board or communication board is a method which uses pictures of basic wants and needs that are significant to a given child. The idea is that the child is to touch them meaningfully. By touching them he is communicating his desire to the caregiver. This type of communication is particularly good for very young children and those who cannot physically use sign language. Picture communication is good to use in the classroom to show activities or help in transitioning. PECS is a structured, commercially available program which uses pictures, but involves much more than just the child pointing. It is a very exact form of

communication which encourages understanding of communication and language. Both of these forms of communication are much more involved than just pointing and receiving. Proper training should be completed before beginning.

If the team chooses to use boards, it is recommended to implement oral language and signs concurrently because using a board exclusively limit a child just as he is starting to communicate. Sign language is a good way to encourage language. A child with ASD who is capable will most likely benefit from some signs. Although not all children will be able to use signs or respond to any other form of communication, most children will be introduced to sign language as part of their early intervention program because it is a quick way to start diminishing a non-verbal child's frustration. This means of communication has the advantage of being basically free and no expensive equipment is required. Sign language has been shown to improve a child's eye contact and attention and promote social skills more than working with an electronic machine. It has the added benefit of decreasing echolalia which is often a characteristic of autism. Signing promotes a relationship between the caregiver and the child. By using sign along with oral speech, the caregiver is able to help the child even if the child is not using signs himself. It will help the child to learn to understand what words mean. Many caregivers choose to begin with general signs like "more" and "please." These are good signs to start with as long as the caregivers are careful not to generalize and allow these signs to fill every need. However, many professionals advise not to use *more* and *please* because they are too abstract for a child with autism [12]. This may cause problems for concrete and literal thinkers, which most children with autism are. When teaching a child to sign the SLP should incorporate verbal words simultaneously and make a connection between the sign and the oral word. When the child learns that the sign has the same meaning as the spoken word, he will be able to make a more natural transition to spoken language. However, if the child is not capable of oral speech, the team will have provided him with the ability to communicate. *Signing time*, by R. Coleman is a great resource for early learning [13].

If the team prefers high tech options to teach a child, the choices include a wide variety of electronic devices available commercially, all which have certain advantages. A child with autism often has a strong interest in using gadgets. The devices have voice outputs that can actually speak for the child and can be used to communicate with others in the child's environment. Many children can learn quickly using an assistive or augmentative device. However, this method also has its drawbacks. Whether the team chooses to use a voice program for an iPad or other device, the equipment must travel from place to place with the child—on the bus, to school, and on play dates. Also, electronics are expensive, must be programmed, are useless without fresh batteries, and are easily damaged. Although children who use high tech devices learn to use the system faster than they learn sign language, they are slower to acquire verbal language than those who begin by learning sign language. If the team chooses to teach a particular child through the use of the high tech devices such as iPads, most professionals suggest that the particular device should be kept for teaching only. Many choose to use a combination of systems and techniques. For example, the child may use a high tech device for his academics and use signing when he plays outside at recess or on

his play dates. It is recommended to use a trial of whatever system is chosen; the SLP can assist the family in obtaining trial electronic devices. Communication and language development will be enhanced as a child begins to respond to sensory and behavioral therapies.

Recent advances in technology designed to give learning support to children with autism include the use of Virtual Reality (VR). Applications of the newer technology include, among other applications, programs designed to promote gesturing. One such program enabled nonverbal children on the autism spectrum to communicate with virtual dolphins by the use of hand gestures. The children assumed the role of virtual dolphin trainers to promote the learning of communication skills [14]. There is optimism about the carry-over to real life social scenario situations when the computer-based constructed social scenarios of VR are employed for the advancement of cognition and social skills [15]. The use of VR as a teaching tool is a growing field which offers promise to improve social skills, cognition and functioning. Further studies on the use of VR programs are needed to investigate its effectiveness in children with high functioning and low functioning autism groups as well as to assess the feasibility of other interactive VR techniques.

It is vital for a child on the autism spectrum to communicate. If a child lacks a form of communication, his behaviors become his means of communication. When parents or teachers do not understand what a child is trying to communicate, then there is a high potential for frustration. If a child cannot communicate to the parents that he is hungry or tired, his frustration leads to a number of problematic, exaggerated behaviors. Hungry and tired children who are not satisfied typically display exaggerated behaviors.

### **Auditory manifestations and audiologists**

In addition to evaluating and treating speech, language, and communication delays in children with ASD, it is also important to assess their auditory function and intervene accordingly to improve their social and attention deficits that often account for significant challenges. One critical factor that worsens the social and communication problems that characterize ASD is the developmental deficits in the auditory system, encompassing the central auditory processing pathways in particular. Several research studies have demonstrated the presence of auditory defects in children on the autism spectrum involving both peripheral and central auditory pathways. Children with ASD have a higher incidence of recurrent middle ear infections and sensor neural hearing loss, which affect their speech and language development [16]. They also have neurodevelopmental abnormalities, resulting in central processing disorders with involvement of neural transmission at the auditory efferent pathway, brainstem and cortical level that can be manifested by abnormalities in the suppression of otoacoustic emissions, auditory brainstem response, and late-latency auditory evoked potentials, respectively [17,18]. It has been established that hearing loss in newborns is linked to several risk factors. A relatively recent study showed that the same risk factors for hearing loss, prematurity, and low birth weight in particular, also increased the risk for autism by two fold [19]. If a child in the high risk group passes newborn hearing screening, it is recommended that this child be screened and monitored closely to detect not only delayed hearing loss but also early signs of ASD. In this way, the age of diagnosis and intervention

can be pushed from three years of age to as early as 6 months of age.

Because of the child's lack of consistent responses to sounds, recurrent middle ear infections, hypersensitivity to sounds, and auditory processing problems [20], audiologists are often one of the first health care professionals to evaluate a child with ASD. Comprehensive audiological evaluation using both behavioral and electrophysiological measures is important to determine the level of involvement of the auditory system and to identify auditory specific deficit areas to establish an intervention plan. However, behavioral and electrophysiological testing is very challenging. To reduce some of the testing challenges, pediatric audiologists should provide a picture schedule of the order of the testing at the beginning of the visit to minimize surprises throughout the session and ensure easier transitions between tests. It is also recommended to alter the test environment based on what parents report their child can tolerate, to introduce headphones and make the touching of their ears less uncomfortable to reduce sensory overload, [21,22] and to schedule another session to complete the test battery [23]. In turn, parents should let their audiologist know what things are reinforcing to their children so that the audiologist can use those rewards to facilitate the evaluation. To assure a smoother hearing evaluation visit, parents need to practice the motor movements the child will need to make in order to signal that he hears the stimulus tones during hearing testing. Upon completion of testing, the audiologist provides the child and family with communicative strategies and environmental modifications to ensure the best communication possible, counseling on the emotional impact of hearing loss, and instructions regarding his role on the interdisciplinary team if the child has an IEP or 504 plan through the school [24,25].

While recurrent otitis media and hearing loss at a young age negatively impact normal development of the central auditory pathway, hypersensitivity to sounds and auditory processing disorders play a key role in the behavioral, communication, and social aspects of ASD. The unusual hypersensitive reaction to sounds is a common auditory manifestation in children on the autism spectrum. Kanner (1943) noted that most children with autism show "aversion" to certain sounds, with about 30% to 53% of young children with autism showing signs of aversion to noise [26]. This aversion to sounds could be in the form of hypersensitivity or hyposensitivity to sounds. A child may experience hyposensitivity when he may ignore a certain sound one day as if he does not even hear it, but the next day he may experience hypersensitivity when he gets extremely upset by the same sound. There is ample evidence about the high prevalence of hypersensitivity to sounds in children on the autism spectrum. Rimland and Edelson [27] reported that approximately 40% of children with autism show some symptoms of auditory hypersensitivity. Although there is no conclusive evidence of the etiology of hypersensitivity to sounds in children on the autism spectrum, it has been suggested that it may be related to dysfunction of the auditory efferent system in children with autism [17] and to possible non-auditory pathways such as the limbic system and/or autonomic nervous system in children with Asperger's syndrome [28].

Hypersensitivity to sounds in children with ASD frequently happens in response to sounds such as vacuuming, air conditioning, and toilet flushing. Children's reactions to these sounds can range



from crying while covering their ears to running away from the source. This may cause more severe behavioral disturbance reactions such as avoidance of using bathrooms at school or even self-injury [29]. Also, hypersensitivity to sounds can prevent people from interacting socially, enjoying a variety of life activities or even leaving their homes. Such behaviors will definitely cause significant distress to children and their families. Therefore, it is important to reduce symptoms of hypersensitivity to sounds by the use of two main approaches: systematic desensitization paradigms and auditory integration therapy. Desensitization approaches are helpful to reduce reaction to background noise. In fact, most of these children who are sensitive to sounds use different strategies to reduce the background noise. They would wear earplugs or earphones to muffle the sounds around them. They also often make unconventional verbal noises (humming, throat noises, or random sounds), which serve as a filter to block out the constant irritation of hearing loud sounds. An important step to desensitize children to these relentless irritants is to recognize situations and environments that aggravate these sensitivities. Turning off the TV, music, or radio and modifying the environment to stop distracting noises to children will reduce auditory overloads that may cause a breakdown in their behavior, whether at home or at school. The combination of noise and reverberation distracts the child from hearing the acoustic and linguistic cues, thus, impairing the ability to process what the child hears [30]. Also, wearing an FM system or programming ear phones to a microphone that the teacher wears will help amplifying the teacher's voice while reducing the background noise. In the past, using hearing protection and avoiding sounds were recommended to those experiencing hyperacusis. This approach is ineffective because it increases the sensitivity of the auditory system and thus increases hyperacusis symptoms upon exposure to sounds. The alternative, recommended treatment to hyperacusis is through desensitizing the child by short exposures to moderately loud sound or prolonged exposure to low level sounds [31]. This approach helps train the children to gradually tolerate loud sound levels so that normal sound environments are not uncomfortable. Results showed that when using tinnitus maskers with long-term exposure to white noise, improvement in the loudness sensitivity was observed in 27 of 30 patients [32]. This improvement was measured using a questionnaire or behavioral testing of the loudness discomfort level that showed an increase in the loudness discomfort level between 5 up to 30 dB [33]. Further investigations are needed on young children.

Auditory processing disorder is another problem that may be linked to other autistic characteristics, such as difficulty understanding speech in the presence of background noise, listening to two speakers at the same time, and inattentiveness. These common autistic manifestations of auditory processing disorder often cause anxiety or confusion in social situations, resulting in additional social and communication deficits. Children with ASD also tend to miss "prosody," the music of language or intonation and the stress used to communicate meaning. Because these children tend to take language very literally they miss sarcasm, metaphors, and idioms. Some behaviors resulting from auditory processing disorders include inability to engage in class, difficulty following directions, reading difficulties (decoding, comprehension and interest in reading), and difficulty focusing on and processing language [18]. Given that auditory processing problems also affect behavioral characteristics of

other sensory processing, neurocognitive, and educational difficulties, other professionals such as occupational therapists, physical therapists, psychologists, and specialists in learning disabilities are among the team members working together to develop effective individualized intervention programs.

Specialized audiologists or SLPs trained in auditory processing disorders can use auditory training programs to help children with deficits in these areas. Intensive intervention includes a combination of approaches such as assistive listening devices and environmental changes to improve signal-to-noise levels in the classroom. Another approach includes the use of computer-based learning tools for auditory and speech training. The use of programs like *Fast Forward* helps improve listening and strengthen auditory processing skills. Audiologists may refer for additional training using music therapy and language processing training. Listening to and playing music activate different regions of the brain and influence some of the deficits APD students have with hearing and language. These sensory stimulations can help children with learning difficulties [34]. The most prevalent auditory intervention approach is auditory integration training; however more empirical research studies are needed to support its benefits. A comprehensive review of the clinical literature on this auditory training approach can be found elsewhere [35].

#### **Working with families and the parents' role**

Having a child with an ASD has a substantial effect on a family. Parents and siblings of children with ASD experience more stress and depression than those of children who are typically developing or even those who have other disabilities [36-39]. Supporting the family and ensuring their emotional and physical health is an extremely important aspect of the overall management of ASD. Speech language pathologists and audiologists should work closely with families to provide them with resources (websites, books, fact sheets, resource kits and growth charts) to educate them on how to identify early warning signs of ASD. This way of involving and engaging families early in the process is central for early diagnosis and intervention of communication and auditory deficits. Early identification of the first warning signs of ASD is dependent on parents' observations because they interact the most with their babies. According to a new study, when parents flag early symptoms of ASD, such as the child not seeking parental attention or not making eye contact, and intervene immediately by continually engaging their children to communicate and to encourage eye contact, communication and language development was within normal limits for six of the seven children [40]. Despite the multiple theories about the cause of ASD, there is common agreement about one thing—the importance of early intervention before the end of the child's first year is essential for improving a child's communication, behavior and functioning. Early on the parents should be taught to understand the significance of pointing and gestures. They have to constantly exaggerate their gestures and expression and enforce pointing to teach the child that speech is used for communication. Therefore, parents should be aware that an actual diagnosis may not be the most immediate goal especially if their child is under two years old. Instead, they and the team members should begin the intervention process as soon as possible while waiting for the final diagnosis.

When parents get the final diagnosis about ASD and its

severity, they should be aware that their child will exhibit lifelong learning needs. They should not let the diagnosis of “mildly autistic” or “requiring support” keep them from being diligent in their intervention efforts. A “mild” degree of autism does not mean “not that bad.” A child’s autism will most likely not always be “mild.” Without intervention, the child’s autistic characteristics will probably worsen with age. Also, an expanding and changing environment may cause the child to withdraw or become more detached from reality. Likewise, a diagnosis of “severe” autism or “requiring very substantial support” should not be seen as a deterrent to parents using their resources to the fullest extent possible to help their child become as successfully integrated into society as possible. Knowing that a diagnosis is only the beginning, and that there is no cure for autism, successful intervention should be the ultimate goal to improve deficit skills.

Because each child is different and has different needs, intervention programs should be tailored to the lifelong learning needs of each child with ASD. There is growing evidence about the critical role of parents and caregivers not only to enhance the intervention but also for early diagnosis of ASD [41-43]. A strong parent-child interaction for all children with ASD is shown to improve social communication skills and help to engage children [44]. Also, incorporating intervention programs and therapies into every activity that they do with their child is vital to the success of any therapy program. For example, in order to make the learning of signs successful, the same signs must be used at home and at school. Just as a child learns to speak, the child will learn to communicate through signs. The child learns one word at a time, although he may learn several a days. As the child begins to develop language, he will probably not know when to stop talking or understand taking turns. While the parents should not attempt to discourage these new skills, they should instead help their child to learn to take turns. To decrease “withdrawal” behavior, parents need to teach their children coping strategies and calming therapies when they are overloaded, frustrated, or confused.

It is important for parents to know that just because a child is not talking doesn’t mean he is not understanding what is being said. There are two distinct types of language. Expressive language is what a child communicates to the listener. The term receptive language refers to what the child understands. Children with autism most commonly have a greater level of receptive language than the caregivers may realize. With this in mind, it is very important not to discuss a child’s problems in front of him. Give a child who has autism the same respect that would be given to a child who does not have autism. Realizing that the child most likely has some receptive language, the team can then concentrate their efforts on helping him develop a form of expressive language. By giving a child a way to communicate, his tantrums, frustration, and confusion should ultimately, if not immediately decrease. A child with autism will most likely have many things interfering with his ability to communicate. Even lack of sleep may cause a retention problem as new sounds or words are learned.

Developing social and communication skills early is important so that the child can interact with other children, which is very helpful in developing friendships with peers. While strengthening communication and auditory deficit areas, parents are encouraged to simultaneously put similar emphasis on their child’s talents.

Improving social skills and talents will later develop into a career and maintaining a job. Parents and teachers are challenged to find the child’s strengths and build on those skills to teach the important tasks that will lead to academic or functional success. Scaffolding, for example, can be used to promote the child’s ability to perform the task on his or her own later on. Parents know what will work for their child, and therefore they should be proactive since they are their child’s voice, best advocate, and teacher. They should be familiar with the American with Disabilities Act to protect the rights of their child, as well as know their state services and school programs. They play a critical role designing their child’s individualized educational program and choosing their team (SLP, audiologist, occupational and physical therapists and behavior consultants). It is up to the parents to find resources for additional services and funding as well as support groups.

The old notion that autism is untreatable is incorrect due to the availability of a wide variety of treatments and the potential evidence of early intervention before the end of the child’s first year. Comprehensive, appropriate intervention can improve social and communication skills. However, extensive parental awareness about ways to prevent ASD pre-, peri-, and post-natally is very important to families, children and society as a whole. More opinions on preventable approaches (diet, vitamins, medications, immune system, and vaccination) can be reviewed at these resources [45-51].

SLPs and audiologists would not be able to work effectively with families and educate them without increasing their knowledge and skill in screening and diagnosing ASD and in the delivery of services for this special population. However, considerable variability in symptom expression and in assessment expertise has increased the complexity of diagnosis. That’s why SLPs and audiologists must rise up to the challenges. The CDC, ASHA, Autism Speaks, First Word Project, and many others have ample resources and articles to educate professionals, who do not have experience in serving young children with ASD, about the normal childhood development and early warning signs of autism in young children [52].

## Conclusion and Final Remarks

There is accumulating evidence that communication and auditory processing deficits are used to index the first markers of ASD. Speech and language delay as well as auditory processing problems hinder social communication and learning in ASD. Much of a child’s frustration can be traced to his or her lack of communication, even if it is a sensory issue. SLPs and audiologists are instrumental in assessing and ameliorating these deficits based on each child’s need. Early identification and intervention approaches often minimize barriers to communication and auditory processing, increase functional independence and quality of life. The SLP and audiologist are also uniquely positioned to share information, strategies, and resources with teachers and parents to find effective, ongoing ways to meet intervention goals at both home and school. Because ASD is a chronic condition, SLPs and audiologists are able to provide important longitudinal care to children and educate families and guide them to empirically supported interventions for their children. In the meantime, parents of children with ASD are the best advocate and teacher for their children to help with early diagnosis and the ongoing intervention process to reduce the

communication barriers, strengthen behavior and social skills, and enhance their children's talents and skills. Recent increases in ASD prevalence and the growing body of evidence supporting the efficacy of certain interventions lead to a need to determine the risk factors and etiology of ASD. Early identification through surveillance and screening allows early intervention followed by close monitoring to determine the effectiveness of various interventions. Currently, there is emerging potential evidence for early identification of ASD and successful intervention to halt social and communication deficits by six months of age.

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