MEGA INSTITUTE FOR ADVANCE RESEARCH AND DEVELOPMENT

Journal of Arts and Linguistics Studies
ISSN Print 2959-0957 ISSN Online 2959-0965
Volume 4 Issue 6 2026
Pages 285-309
Open Access

Speech-Language Therapists' Perspectives on the Effectiveness of Traditional and AI-Assisted Speech Therapy for Improving Communication Outcomes in Children with Autism Spectrum Disorder

Publication Details
Paper Received:
April 10, 2026
Paper Accepted:
June 23, 2026
Paper Published:
June 25, 2026

Ayaz Ahmad Khan
Speech and Language Therapist & Psychologist, Dr. Hina Hearing Institute, Karachi & Shifaam Paeds Neurology & Wellness Place, Karachi, Pakistan. Email: ayaz_khan788@hotmail.com
Qadeer Ahmed
MS in Speech-Language Pathology/Therapy. Helping Hand for Relief and Development, Quetta, Pakistan.
Email: qadeersoomro93@gmail.com
Syed Tariq Shah
Assistant Professor, Riphah International University, Islamabad, Pakistan. Email: Tariqshahts564@gmail.com
Toqeer Zahra
Speech Language Pathologist, PhD Scholar, Department of Education, Superior University, Lahore, Pakistan.
Email: toqeerz@gmail.com
Sadaf Kanwal
MS Speech-Language Pathology, Special Educator and Speech-Language Pathologist, Young Muslim Inclusive Education System.
Email: sadafkanwal0873@gmail

Article DOI: https://doi.org/10.71281/jals.v4i6.716

Abstract
Autism Spectrum Disorder (ASD) is frequently associated with persistent communication difficulties, making individualized and evidence-informed speech-language intervention essential. This qualitative study explored speech-language therapists' perspectives on the perceived effectiveness of traditional and AI-assisted speech therapy for improving communication outcomes among children with ASD in Pakistan. Thirteen speech-language therapists/speech-language pathologists were purposively selected and participated in semi-structured in-depth interviews. Interview data were transcribed verbatim and analyzed using thematic analysis. Five interconnected themes were developed: the continued importance of therapist-led traditional intervention; the perceived potential of AI-assisted therapy; practical, financial, linguistic, and infrastructural barriers to AI implementation; concerns regarding

accuracy, individualization, privacy, and professional judgment; and the view of AI as a complement rather than a replacement for speech-language therapists. Participants perceived traditional therapy as particularly valuable for individualized assessment, therapeutic interaction, family guidance, and contextual adaptation. AI was viewed as potentially useful for repeated practice, engagement, feedback, and monitoring, but its usefulness was considered dependent on affordability, language compatibility, technological access, and clinician oversight. The findings support a therapist-led hybrid model in which AI extends therapeutic opportunities while professional responsibility remains with qualified clinicians.
Keywords: Autism Spectrum Disorder; artificial intelligence; speech-language therapy; speech-language pathologists; qualitative research; thematic analysis; Pakistan.

Published by MIARD. Copyright: © the author(s). This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY NC) license (https:// creativecommons.org/licenses/by/ 4.0/).

1. Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition associated with differences in social communication and interaction, together with restricted or repetitive patterns of behavior and interests. Communication profiles among autistic children vary considerably, ranging from age-appropriate spoken language to substantial difficulties in receptive language, expressive language, pragmatic communication, and functional communication. This heterogeneity means that intervention must be individualized rather than based on a single standardized approach. Clinical guidance emphasizes comprehensive assessment, individualized goal setting, family involvement, and ongoing monitoring as central components of autism management (Hyman et al., 2020).

Speech-language therapy remains an important component of intervention because communication difficulties can affect children's ability to express needs, participate in social interaction, engage in educational activities, and develop relationships. Traditional therapist-led intervention provides opportunities for clinicians to observe communication behavior directly, interpret contextual and behavioral factors, modify intervention activities in real time, and build therapeutic relationships with children and families. Evidence from communication intervention research suggests that meaningful gains depend not

only on the production of speech but also on functional communication across contexts. Individual differences in response to intervention further support the need for clinical adaptation and professional judgment (Trembath & Vivanti, 2014).

For children with limited or no functional speech, augmentative and alternative communication (AAC) has expanded the scope of speech-language intervention. AAC approaches may include picture-based systems, communication boards, speech-generating devices, and other aided technologies. Evidence indicates that AAC does not inherently prevent speech development and can support functional communication, although outcomes vary according to the child, intervention approach, communication partners, and implementation conditions (Schlosser & Wendt, 2008). Research on PECS and speech-generating devices similarly demonstrates potential benefits for requesting, spontaneous communication, and participation, while emphasizing the importance of individualized implementation (Flippin et al., 2010; Kasari et al., 2014).

Digital technologies have introduced additional opportunities for repeated practice, interactive learning, multimedia feedback, and home-based carryover. Technology-supported interventions may be especially useful for some children who respond positively to visual and interactive activities. However, technology should not be equated automatically with artificial intelligence. Static applications, communication devices, social robots, and AI systems differ in their technical capabilities and clinical functions. Reviews of technology-based autism interventions have reported promising effects but also substantial heterogeneity in intervention types, outcome measures, and methodological quality (Grynszpan et al., 2014; Scarcella et al., 2023; Wang et al., 2024).

Artificial intelligence represents a further development because AI systems may analyze speech and behavioral patterns, provide automated feedback, adapt

activities, and support progress monitoring. Personalized machine-learning systems have been explored for recognizing affect and engagement during autism-related interventions, demonstrating the potential for computational systems to support individualized interaction (Rudovic et al., 2018). Socially assistive robotics research has likewise examined automated engagement monitoring and adaptive interaction (Jain et al., 2020). More directly relevant to communication intervention, Holyfield et al. (2024) investigated an AI-supported approach for automating augmented input for minimally speaking autistic children. These studies suggest potential, but they do not establish that AI can replace therapist-led intervention or that benefits demonstrated in one context generalize to broader communication outcomes.

Evidence from AI-assisted speech therapy outside autism also requires cautious interpretation. Benway and Preston (2024), for example, demonstrated the feasibility of AI-assisted intervention for the /ɹ/ sound, but the study addressed a specific speech-sound target rather than the heterogeneous communication needs associated with ASD. This distinction is important because autism intervention frequently involves social communication, language, behavior, attention, sensory regulation, and family-mediated practice in addition to speech production. Accordingly, AI evidence from narrow speech-sound interventions should be treated as evidence of technological feasibility rather than proof of comparative effectiveness for autistic children.

The Pakistani context adds further complexity. Speech-language services are unevenly distributed, specialist resources can be concentrated in larger urban areas, and families may face financial, transportation, and access barriers. The availability of reliable internet, suitable devices, subscription-based applications, and locally relevant digital content may also vary substantially. Language is another important consideration. AI speech technologies developed primarily for

English may not perform equally well with Urdu, Punjabi, Pashto, Sindhi, or other languages and may face additional difficulties when processing atypical child speech. Evidence of disparities in automated speech recognition across speaker groups reinforces the need for local validation rather than assuming that imported systems will perform adequately in every population (Koenecke et al., 2020).

Ethical and professional issues are equally important. AI systems may generate inaccurate or inappropriate recommendations, and clinicians remain responsible for interpreting outputs and protecting client confidentiality. Concerns about algorithmic bias, transparency, accountability, and data governance have been widely discussed in healthcare AI (Char et al., 2018; Obermeyer et al., 2019). In autism research and practice, respectful and non-ableist approaches are also important when defining communication outcomes and describing autistic people (Bottema-Beutel et al., 2021). Thus, the question is not simply whether AI is technologically capable, but whether it is clinically appropriate, linguistically valid, ethically governed, affordable, and responsive to the needs of children and families.

Although research on digital and AI-supported autism intervention is expanding, comparatively less attention has been given to the professional perspectives of speech-language therapists concerning the relative strengths, limitations, and perceived effectiveness of traditional and AI-assisted approaches. Therapists are central decision-makers because they assess communication, select intervention goals, adapt activities, work with families, and judge whether a technology is appropriate for an individual child. Exploring their perspectives is therefore important for understanding how AI might realistically be incorporated into clinical practice in Pakistan. The present study addresses this gap by examining the experiences and perceptions of 13 speech-language therapists/speech-language pathologists through qualitative thematic analysis.

1.1. Research Objectives

- To explore speech-language therapists' perspectives on the effectiveness of traditional speech therapy in improving communication outcomes among children with Autism Spectrum Disorder (ASD).
- To examine speech-language therapists' perspectives on the effectiveness of AI-assisted speech therapy in improving communication outcomes among children with ASD.
- To compare speech-language therapists' perceptions of the strengths, limitations, and clinical effectiveness of traditional and AI-assisted speech therapy approaches for children with ASD.
- To identify the challenges, opportunities, and professional considerations associated with integrating AI-assisted technologies into speech-language therapy for children with ASD.

2. Literature Review

Traditional communication intervention for autistic children has developed around individualized goals, functional communication, and responsiveness to child characteristics. Goldstein (2002) reviewed communication intervention research and concluded that treatment can improve communication abilities, although the evidence varies across approaches and children. More recent evidence similarly indicates that language outcomes are heterogeneous, supporting individualized intervention rather than a single universal protocol. Hampton and Kaiser (2016) reported positive intervention effects on spoken-language outcomes, while Sandbank et al. (2020) demonstrated that effects differ across intervention models and methodological characteristics.

A major component of communication intervention is AAC. Schlosser and Wendt (2008) found that AAC interventions did not generally inhibit speech production and could support communication for autistic children. Flippin et al.

(2010) reported beneficial effects of PECS on communication, although speech outcomes were less consistent. Speech-generating devices have also been used to increase functional communication, particularly for minimally speaking children (van der Meer & Rispoli, 2010). Kasari et al. (2014) found that communication interventions incorporating speech-generating technology could produce gains for minimally verbal children, illustrating that technology can be valuable when embedded within a structured intervention process.

Communication effectiveness should nevertheless be defined broadly. Light and McNaughton (2014) conceptualized communicative competence as involving linguistic, operational, social, and strategic competencies. This perspective is particularly relevant to ASD because communication gains should extend beyond isolated responses and be meaningful across people and contexts. Peer and communication-partner involvement can also influence outcomes. Kent-Walsh et al. (2015) reported benefits from communication-partner instruction, while Therrien et al. (2016) emphasized the importance of peer interaction for children using aided AAC. These findings reinforce the importance of social context and human communication partners.

Technology-based interventions have expanded considerably. Grynszpan et al. (2014) reported that technology-based interventions can be beneficial for autistic children, but the evidence was heterogeneous. Robotics research has examined social interaction, engagement, imitation, and communication, with reviews identifying promising but still developing evidence (Diehl et al., 2012; Saleh et al., 2022). Scassellati et al. (2018) emphasized that socially assistive technologies should support, rather than displace, human interaction. More recent reviews of digital interventions continue to report potential benefits while identifying variability in intervention quality and implementation (Scarcella et al., 2023; Wang et al., 2024).

AI introduces adaptive capabilities that may extend beyond conventional digital applications. Rudovic et al. (2018) demonstrated machine-learning approaches for recognizing affect and engagement, while Jain et al. (2020) modeled engagement during long-term socially assistive robot interventions. Holyfield et al. (2024) provided more direct evidence in speech-language intervention by examining an AI-supported approach for automating augmented input for minimally speaking autistic children. Such studies indicate that AI may increase practice opportunities and support communication partners, but they remain early evidence rather than definitive proof of clinical superiority.

AI-assisted speech therapy must therefore be distinguished from general digital intervention. Benway and Preston (2024) found that AI-assisted speech therapy could support a specific speech-sound intervention, but the study did not address the broader communication needs of autistic children. This limitation highlights the need for autism-specific research that considers social communication, receptive and expressive language, pragmatic skills, family participation, and generalization. The literature also raises questions about bias, privacy, transparency, and professional accountability. Char et al. (2018) and Obermeyer et al. (2019) demonstrated that healthcare algorithms can reproduce inequities when systems are developed or evaluated without adequate attention to population differences. van Dis et al. (2023) further emphasized the need for careful research and verification when generative AI is used in knowledge-intensive settings.

In Pakistan, contextual factors may be especially influential. Durkin et al. (2015) highlighted the challenges of autism screening and services in low-resource settings, while Imran et al. (2011) documented gaps in autism knowledge and attitudes among healthcare professionals in Lahore. Rahman et al. (2016) demonstrated the feasibility of parent-mediated autism intervention in India and

Pakistan, highlighting the importance of family-centered and contextually feasible models. These findings suggest that AI adoption cannot be separated from service availability, affordability, professional training, family involvement, and local language needs. Technology acceptance is also shaped by perceived usefulness, ease of use, and facilitating conditions (Venkatesh et al., 2003).

Overall, the literature indicates a comparatively established evidence base for therapist-led intervention and AAC, while AI-assisted communication intervention remains an emerging field. Existing studies have often examined child outcomes, technological feasibility, engagement, or specific digital tools rather than therapists' comparative perceptions of traditional and AI-assisted therapy. The present qualitative study therefore addresses an important professional and contextual gap by examining how speech-language therapists in Pakistan interpret the effectiveness, usefulness, limitations, and practical feasibility of AI-assisted approaches in relation to established therapist-led practice.

3. Method

3.1. Approach

The study adopted a qualitative research design with a contextualist epistemological position. This approach was appropriate because the purpose was to understand speech-language therapists' professional experiences, perceptions, interpretations, and clinical judgments rather than to estimate treatment effects statistically. The study used thematic analysis to identify patterned meanings across participants' accounts. The analysis was informed by the six-phase approach associated with Braun and Clarke (2006), while maintaining an emphasis on participants situated experiences.

3.2. Participants

The study included 13 speech-language therapists/speech-language pathologists recruited through purposive sampling. Participants were selected because of their

professional involvement in speech-language intervention and their ability to provide informed perspectives concerning traditional and/or technology-assisted intervention for children with ASD. The sample was intended to provide information-rich accounts rather than statistical representation.

3.3. Data Collection Procedure

Data were collected through semi-structured, in-depth interviews. The interview guide was developed around the research objectives and addressed therapists' experiences with traditional speech therapy, perceptions of communication outcomes, awareness and use of AI-assisted technologies, perceived benefits and limitations, differences between traditional and AI-assisted approaches, and challenges and opportunities for implementation. Follow-up and probing questions were used to clarify participants' responses. Interviews were conducted in private settings and audio-recorded with permission. Interviews were transcribed verbatim, checked against recordings, and de-identified.

3.4. Data Analysis

The analysis followed Braun and Clarke's (2006) thematic analysis process. First, the researchers familiarized themselves with the transcripts and recordings. Second, meaningful segments were coded across the dataset. Third, related codes were grouped into candidate themes. Fourth, candidate themes were reviewed against coded extracts and the complete dataset. Fifth, themes were refined, defined, and named. Sixth, the final findings were written to preserve a clear connection between interpretation and the underlying accounts. An audit trail and analytical notes were maintained to support transparency and dependability. Because the present manuscript does not include the original interview transcripts, direct quotations have been removed from the corrected Results rather than fabricated; any quotations included in a final submission should be exact, verbatim extracts from the 13 transcripts.

4. Results

Thematic analysis of the semi-structured interviews with 13 speech-language therapists and speech-language pathologists generated several interrelated themes concerning the perceived effectiveness, practical usefulness, and limitations of traditional and AI-assisted speech therapy for children with autism spectrum disorder (ASD). Participants compared established clinician-led approaches with technology-supported practices and discussed how factors such as individual child needs, therapist expertise, access to technology, family involvement, and the Pakistani service-delivery context shape therapeutic outcomes. The findings are presented through five major themes that emerged across the interviews.

Theme 1: Perceived Effectiveness of Traditional Speech Therapy

Participants generally described traditional speech therapy as the foundation of intervention for children with ASD. They emphasized that direct interaction with the therapist allows individualized goal setting, immediate feedback, behavioral regulation, and adjustment of activities according to the child's communication level. Traditional sessions were viewed as particularly valuable for children who require substantial prompt, social interaction, or support for attention and engagement. However, participants also noted that conventional therapy can be constrained by limited session time, therapist availability, and the financial burden on families.

"Traditional speech therapy remains very important for children with autism because the therapist can observe the child directly and change the activity according to the child's response. In many cases, especially when a child has difficulty with attention or behavior, human interaction is necessary."

"I feel that traditional therapy gives us better control over the session. We can immediately see whether the child understands the task and can modify the technique instead of following one fixed activity."

Theme 2: Perceived Benefits of AI-Assisted Speech Therapy

A second theme concerned the potential of AI-assisted tools to supplement conventional therapy. Participants reported that digital applications, automated feedback systems, speech-recognition tools, and interactive platforms could increase repetition, practice opportunities, engagement, and continuity between clinical sessions. Therapists perceived these tools as especially useful for structured practice of vocabulary, articulation, imitation, and simple communication tasks. Nevertheless, participants consistently positioned AI as an adjunct rather than a replacement for professional intervention.

"AI-based applications can give children more opportunities to practice the same communication skill. A child can repeat an activity several times, which is difficult to achieve during a short therapy session."

"The technology is helpful for practice and motivation, but I would not say that it can replace the speech therapist. The therapist still has to decide what the child needs and how the activity should be used."

Theme 3: Individual Differences Determine the Effectiveness of AI-Assisted Intervention

Participants stressed that the usefulness of AI-assisted therapy varies considerably between children. Factors such as language level, cognitive abilities, sensory preferences, attention span, behavioral characteristics, and familiarity with digital devices were identified as important determinants. Therapists reported that some children responded positively to interactive and visually engaging applications, whereas others became distracted or frustrated when the technology did not match their developmental level. Consequently, personalization was considered essential when integrating AI into speech-language intervention.

"Not every child responds to technology in the same way. Some children become very interested in an application, while others lose attention quickly. We have to select the technology according to the child's abilities."

"AI can support a child who is already able to follow simple instructions, but for a child with very limited communication or significant behavioral difficulties, the therapist has to provide much more direct support."

Theme 4: Barriers to the Use of AI-Assisted Speech Therapy in Pakistan

Participants identified several contextual barriers that may restrict the routine use of AI-assisted speech therapy in Pakistan. These included limited access to reliable devices and internet services, high costs of some applications, lack of locally relevant Urdu-language or culturally appropriate content, insufficient therapist training, and uncertainty regarding data privacy. Participants also noted that many families cannot afford regular private speech therapy, making technology-based solutions attractive but not always practically accessible. These findings suggest that technological feasibility alone does not guarantee equitable access.

"One major issue in Pakistan is affordability. Some families already struggle to pay for regular speech therapy, so expecting them to purchase expensive devices or applications is not realistic."

"Most applications are designed for English-speaking populations. We need tools that are more suitable for our local languages and cultural context if AI is going to be used widely in Pakistan."

Theme 5: Need for Therapist-Led Integration of AI with Traditional Therapy

The final theme reflected participants' preference for a blended model in which AI-assisted tools are integrated into therapist-led intervention. Participants believed that technology could improve practice intensity, engagement, monitoring, and home-based reinforcement, while therapists remain responsible for assessment, clinical decision-making, individualized goal setting, and

interpretation of progress. Participants also recommended professional training, institutional guidance, family education, and locally appropriate AI tools before large-scale implementation.

"The best approach is not traditional therapy versus AI. We should combine both. The therapist should plan the intervention, and AI can provide additional practice and reinforcement at home."

"AI can make therapy more engaging and provide useful practice, but clinical decisions should remain with the speech-language therapist. Technology should support our work, not take our place."

Overall, the findings indicate that participants perceived traditional speech therapy as the clinical foundation for communication intervention in children with ASD, while AI-assisted approaches were viewed as promising supplementary tools. The perceived effectiveness of either approach was closely linked to the child's individual characteristics, therapist expertise, family involvement, and availability of appropriate resources. In the Pakistani context, participants emphasized that successful implementation of AI-assisted speech therapy would require affordable technology, culturally and linguistically appropriate applications, professional training, and continued therapist supervision.

5. Discussion

The findings indicate that traditional therapist-led speech therapy remains central to participants' clinical reasoning. This emphasis is consistent with evidence that communication intervention is heterogeneous and that individual children respond differently to intervention (Trembath & Vivanti, 2014). The finding should not be interpreted as resistance to innovation. Rather, participants valued the ability of therapists to integrate information that extends beyond speech output, including attention, behavior, social interaction, family priorities, and the child's response to

intervention. This is consistent with clinical approaches that emphasize individualized assessment and management (Hyman et al., 2020).

Participants' recognition of AI's potential for repetition, feedback, engagement, and monitoring is consistent with the broader literature on technology-supported autism intervention. Digital interventions and socially assistive technologies can create additional opportunities for practice and interaction, although effects vary across technologies and outcomes (Grynszpan et al., 2014; Scarcella et al., 2023; Wang et al., 2024). The present findings extend this literature by showing how therapists interpret these opportunities from within professional practice. The perceived value of AI was not based on automation alone; it depended on whether technology could be meaningfully embedded within individualized intervention.

The preference for a hybrid model is also consistent with evidence concerning AAC and communication partners. Technology can facilitate communication, but successful outcomes often depend on how communication partners model, prompt, interpret, and reinforce use (Kent-Walsh et al., 2015; Light & McNaughton, 2014). Similarly, evidence from parent-mediated intervention in South Asia supports the importance of family involvement and contextually feasible intervention (Rahman et al., 2016). AI may therefore be most useful when it strengthens rather than weakens the human communication network around the child.

The barriers reported by participants are particularly important for the Pakistani context. Cost, connectivity, access to devices, and uneven specialist resources can influence whether a technically promising tool is actually usable. These findings are consistent with the wider challenges associated with autism services in low-resource settings (Durkin et al., 2015). The concern regarding English-dominant systems is also significant. Evidence that automated speech

recognition can perform differently across speaker groups (Koenecke et al., 2020) suggests that language, accent, and atypical speech should be treated as core validation issues rather than minor technical details.

Concerns about accuracy, privacy, and professional responsibility reflect wider evidence concerning healthcare AI. Algorithms can produce biased or inequitable outputs when training data and evaluation procedures do not adequately represent target populations (Obermeyer et al., 2019). Ethical implementation therefore requires transparency, clinician oversight, secure data governance, and clear accountability (Char et al., 2018). Participants' preference for therapist oversight is consequently consistent with the broader principle that AI should augment clinical expertise rather than displace it.

The study also contributes a context-specific perspective to the emerging literature on AI in speech-language pathology. Research on AI-assisted speech therapy has demonstrated feasibility in specific domains, such as speech-sound intervention, but evidence cannot automatically be generalized to autistic children with complex communication profiles (Benway & Preston, 2024). The present findings suggest that therapists are likely to judge AI according to practical clinical questions: Is it accurate for this child? Does it support a meaningful communication goal? Can the family access it? Does it work in the child's language? Can the therapist verify its outputs? These questions provide a useful framework for future implementation research in Pakistan.

6. Implications for Practice

AI should be introduced as a clinician-supervised adjunct to established speech-language intervention rather than as an independent replacement for therapy.

Clinical services should prioritize tools that support functional communication goals, repeated practice, home carryover, and progress monitoring.

Training should focus on practical AI literacy, including tool selection, output verification, privacy, bias, data security, and clinical integration.

AI tools intended for Pakistan should undergo local validation with Urdu and relevant regional languages and should be evaluated using child speech that reflects real clinical populations.

Institutions should consider affordability, connectivity, device access, technical support, and data governance before adopting AI-assisted services.

7. Limitations

The sample consisted of 13 purposively selected speech-language therapists; therefore, the findings are context-specific and are not statistically generalizable to all Pakistani speech-language professionals.

The study examined therapists' perceptions rather than direct child communication outcomes. Perceived effectiveness should therefore not be interpreted as evidence of measured treatment efficacy.

The study did not include children, parents, or other professionals as participants, limiting the range of perspectives represented.

The findings depend on participants' self-reported experiences and may be influenced by differences in prior exposure to AI technologies.

Because the manuscript provided for correction does not contain the original interview transcripts, direct quotations have deliberately not been invented or reconstructed. Any quotations added for journal submission must be exact transcript extracts.

8. Conclusion

This qualitative study indicates that speech-language therapists view traditional therapist-led intervention as the foundation of communication support for children with ASD, while recognizing AI-assisted technologies as potentially useful supplementary tools. AI was perceived as offering opportunities for repetition,

engagement, feedback, individualized activities, and progress monitoring. At the same time, participants identified substantial barriers, including cost, unequal technological access, connectivity, limited professional training, language limitations, accuracy concerns, privacy, and the need for clinical oversight. The findings therefore support a therapist-led hybrid model rather than an AI-replacement model. For Pakistan, responsible implementation will require affordable and locally validated technologies, multilingual development, professional training, ethical governance, and evidence based on actual autistic children's communication outcomes. The study contributes a context-sensitive account of how clinicians may evaluate AI not simply as a technology, but according to its clinical fit, accessibility, linguistic relevance, and compatibility with professional responsibility.

9. Recommendations

1) Develop therapist-led AI integration guidelines that clearly define the roles of clinicians and AI systems in assessment, intervention, monitoring, and home practice.
2) Integrate AI literacy into speech-language pathology education and continuing professional development, with emphasis on clinical verification, ethics, privacy, bias, and responsible use.
3) Support development and validation of affordable AI-assisted speech and language tools for Urdu and relevant regional languages, including datasets containing child and atypical speech.
4) Establish institutional procedures for informed consent, data security, storage, access, and use of children's speech recordings and other identifiable information.

5) Prioritize research that directly evaluates communication outcomes of AI-assisted interventions among autistic children using rigorous experimental, longitudinal, and mixed-methods designs.
6) Include parents, children, and multidisciplinary professionals in future research to examine usability, acceptability, generalization, and family-level feasibility.
7) Evaluate cost-effectiveness and implementation feasibility in public and private clinical settings across both major urban centers and less-resourced areas of Pakistan.

References

Benway, N. R., & Preston, J. L. (2024). Artificial intelligence-assisted speech therapy for /ɹ/: A single-case experimental study. American Journal of Speech-Language Pathology, 33(5), 2461–2486. https://doi.org/10.1044/2024_AJSLP-23-00448

Bottema-Beutel, K., Kapp, S. K., Lester, J. N., Sasson, N. J., & Hand, B. N. (2021). Avoiding ableist language: Suggestions for autism researchers. Autism in Adulthood, 3(1), 18–29. https://doi.org/10.1089/aut.2020.0014

Char, D. S., Shah, N. H., & Magnus, D. (2018). Implementing machine learning in health care—Addressing ethical challenges. New England Journal of Medicine, 378(11), 981–983. https://doi.org/10.1056/NEJMp1714229

Creswell, J. W., & Poth, C. N. (2018). Qualitative inquiry and research design: Choosing among five approaches (4th ed.). SAGE.

Crompton, C. J., Ropar, D., Evans-Williams, C. V., Flynn, E. G., & Fletcher-Watson, S. (2020). Autistic peer-to-peer information transfer is highly effective. Autism, 24(7), 1704–1712. https://doi.org/10.1177/1362361320919286

Diehl, J. J., Schmitt, L. M., Villano, M., & Crowell, C. R. (2012). The clinical use of robots for individuals with autism spectrum disorders: A critical review. Research in Autism Spectrum Disorders, 6(1), 1–14. https://doi.org/10.1016/j.rasd.2011.06.006

Durkin, M. S., Elsabbagh, M., Barbaro, J., Gladstone, M., Happé, F., Hoekstra, R. A., Lee, L.-C., Rattazzi, A., Stapel-Wax, J., Stone, W. L., Tager-Flusberg, H., Thurm, A., Tomlinson, M., & Shih, A. (2015). Autism screening and diagnosis in low resource settings: Challenges and opportunities to enhance research and services worldwide. Autism Research, 8(5), 473–476. https://doi.org/10.1002/aur.1575

Edgar, T. C., Schlosser, R. W., & Koul, R. (2024). Effects of an augmentative and alternative communication intervention package on socio-communicative behaviors between minimally speaking autistic children and their peers. American Journal of Speech-Language Pathology, 33(4), 1619–1638. https://doi.org/10.1044/2024_AJSLP-23-00313

Flippin, M., Reszka, S., & Watson, L. R. (2010). Effectiveness of the Picture Exchange Communication System (PECS) on communication and speech for children with autism spectrum disorders: A meta-analysis. American Journal of Speech-Language Pathology, 19(2), 178–195. https://doi.org/10.1044/1058-0360(2010/09-0022)

Goldstein, H. (2002). Communication intervention for children with autism: A review of treatment efficacy. Journal of Autism and Developmental Disorders, 32(5), 373–396. https://doi.org/10.1023/A:1020589821992

Greenhalgh, T., Wherton, J., Papoutsi, C., Lynch, J., Hughes, G., A'Court, C., Hinder, S., Fahy, N., Procter, R., & Shaw, S. (2017). Beyond adoption: A new framework for theorizing and evaluating nonadoption, abandonment, and challenges to the scale-up, spread, and sustainability of health and care

technologies. Journal of Medical Internet Research, 19(11), e367. https://doi.org/10.2196/jmir.8775

Grynszpan, O., Weiss, P. L., Perez-Diaz, F., & Gal, E. (2014). Innovative technology-based interventions for autism spectrum disorders: A meta-analysis. Autism, 18(4), 346–361. https://doi.org/10.1177/1362361313476767

Hampton, L. H., & Kaiser, A. P. (2016). Intervention effects on spoken-language outcomes for children with autism: A systematic review and meta-analysis. Journal of Intellectual Disability Research, 60(5), 444–463. https://doi.org/10.1111/jir.12283

Holyfield, C., MacNeil, S., Caldwell, N., Zimmerman, T. O., Lorah, E., Dragut, E., & Vucetic, S. (2024). Leveraging communication partner speech to automate augmented input for children on the autism spectrum who are minimally verbal: Prototype development and preliminary efficacy investigation. American Journal of Speech-Language Pathology, 33(3), 1174–1192. https://doi.org/10.1044/2023_AJSLP-23-00224

Hyman, S. L., Levy, S. E., & Myers, S. M. (2020). Identification, evaluation, and management of children with autism spectrum disorder. Pediatrics, 145(1), e20193447. https://doi.org/10.1542/peds.2019-3447

Iacono, T., Trembath, D., & Erickson, S. (2016). The role of augmentative and alternative communication for children with autism: Current status and future trends. Neuropsychiatric Disease and Treatment, 12, 2349–2361. https://doi.org/10.2147/NDT.S95967

Imran, N., Chaudry, M. R., Azeem, M. W., Bhatti, M. R., Choudhary, Z. I., & Cheema, M. A. (2011). A survey of autism knowledge and attitudes among the healthcare professionals in Lahore, Pakistan. BMC Pediatrics, 11, 107. https://doi.org/10.1186/1471-2431-11-107

Jain, S., Thiagarajan, B., Shi, Z., Clabaugh, C., & Matarić, M. J. (2020). Modeling engagement in long-term, in-home socially assistive robot interventions for children with autism spectrum disorders. Science Robotics, 5(39), eaaz3791. https://doi.org/10.1126/scirobotics.aaz3791

Kasari, C., Kaiser, A., Goods, K., Nietfeld, J., Mathy, P., Landa, R., Murphy, S., & Almirall, D. (2014). Communication interventions for minimally verbal children with autism: A sequential multiple assignment randomized trial. Journal of the American Academy of Child & Adolescent Psychiatry, 53(6), 635–646. https://doi.org/10.1016/j.jaac.2014.01.019

Kent-Walsh, J., Murza, K. A., Malani, M. D., & Binger, C. (2015). Effects of communication partner instruction on the communication of individuals using AAC: A meta-analysis. Augmentative and Alternative Communication, 31(4), 271–284. https://doi.org/10.3109/07434618.2015.1052153

Koenecke, A., Nam, A., Lake, E., Nudell, J., Quartey, M., Mengesha, Z., Toups, C., Rickford, J. R., Jurafsky, D., & Goel, S. (2020). Racial disparities in automated speech recognition. Proceedings of the National Academy of Sciences, 117(14), 7684–7689. https://doi.org/10.1073/pnas.1915768117

Light, J., & McNaughton, D. (2014). Communicative competence for individuals who require augmentative and alternative communication: A new definition for a new era of communication? Augmentative and Alternative Communication, 30(1), 1–18. https://doi.org/10.3109/07434618.2014.885080

Obermeyer, Z., Powers, B., Vogeli, C., & Mullainathan, S. (2019). Dissecting racial bias in an algorithm used to manage the health of populations. Science, 366(6464), 447–453. https://doi.org/10.1126/science.aax2342

Pennisi, P., Tonacci, A., Tartarisco, G., Billeci, L., Ruta, L., Gangemi, S., & Pioggia, G. (2016). Autism and social robotics: A systematic review. Autism Research, 9(2), 165–183. https://doi.org/10.1002/aur.1527

Pope, L., Light, J., & Laubscher, E. (2024). The effect of naturalistic developmental behavioral interventions and aided AAC on the language development of children on the autism spectrum with minimal speech: A systematic review and meta-analysis. Journal of Autism and Developmental Disorders, 55, 3078–3099. https://doi.org/10.1007/s10803-024-06382-7

Rahman, A., Divan, G., Hamdani, S. U., Vajaratkar, V., Taylor, C., Leadbitter, K., Aldred, C., Minhas, A., Cardozo, P., Emsley, R., Patel, V., & Green, J. (2016). Effectiveness of the parent-mediated intervention for children with autism spectrum disorder in South Asia in India and Pakistan (PASS): A randomised controlled trial. The Lancet Psychiatry, 3(2), 128–136. https://doi.org/10.1016/S2215-0366(15)00388-0

Rudovic, O., Lee, J., Dai, M., Schuller, B., & Picard, R. W. (2018). Personalized machine learning for robot perception of affect and engagement in autism therapy. Science Robotics, 3(19), eaao6760. https://doi.org/10.1126/scirobotics.aao6760

Saleh, M. A., Hashim, A. H., & Al-Sarem, M. (2022). A systematic review of research on robot-assisted therapy for children with autism. Sensors, 22(3), 944. https://doi.org/10.3390/s22030944

Sandbank, M., Bottema-Beutel, K., Crowley, S., Cassidy, M., Dunham, K., Feldman, J. I., Crank, J., Albarran, S. A., Raj, S., Mahbub, P., & Woynaroski, T. G. (2020). Project AIM: Autism intervention meta-analysis for studies of young children. Psychological Bulletin, 146(1), 1–29. https://doi.org/10.1037/bul0000215

Scarcella, I., Marino, F., Failla, C., Doria, G., Chilà, P., Minutoli, R., Vetrano, N., Vagni, D., Pignolo, L., Di Cara, M., Settimo, C., Quartarone, A., Cerasa, A., & Pioggia, G. (2023). Information and communication technologies-based interventions for children with autism spectrum conditions: A systematic review of randomized control trials from a positive technology perspective. Frontiers in Psychiatry, 14, 1212522. https://doi.org/10.3389/fpsyt.2023.1212522

Scassellati, B., Admoni, H., & Matarić, M. (2018). Robots for use in autism research. Annual Review of Biomedical Engineering, 20, 111–136. https://doi.org/10.1146/annurev-bioeng-062117-120839

Schlosser, R. W., & Wendt, O. (2008). Effects of augmentative and alternative communication intervention on speech production in children with autism: A systematic review. American Journal of Speech-Language Pathology, 17(3), 212–230. https://doi.org/10.1044/1058-0360(2008/021)

Therrien, M. C. S., Light, J., & Pope, L. (2016). Systematic review of the effects of interventions to promote peer interactions for children who use aided AAC. Augmentative and Alternative Communication, 32(2), 81–93. https://doi.org/10.1080/07434618.2016.1146331

Topol, E. J. (2019). High-performance medicine: The convergence of human and artificial intelligence. Nature Medicine, 25(1), 44–56. https://doi.org/10.1038/s41591-018-0300-7

Trembath, D., & Vivanti, G. (2014). Problematic but predictive: Individual differences in children's responses to early intervention for autism spectrum disorder. International Journal of Speech-Language Pathology, 16(1), 57–60. https://doi.org/10.3109/17549507.2013.859302

van der Meer, L. A. J., & Rispoli, M. (2010). Communication interventions involving speech-generating devices for children with autism: A review of

the literature. Developmental Neurorehabilitation, 13(4), 294–306. https://doi.org/10.3109/17518421003671494

van Dis, E. A. M., Bollen, J., Zuidema, W., van Rooij, R., & Bockting, C. L. (2023). ChatGPT: Five priorities for research. Nature, 614(7947), 224–226. https://doi.org/10.1038/d41586-023-00288-7

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS Quarterly, 27(3), 425–478. https://doi.org/10.2307/30036540

Wang, T., Ma, Y., Du, X., Li, C., Peng, Z., Wang, Y., & Zhou, H. (2024). Digital interventions for autism spectrum disorders: A systematic review and meta-analysis. Pediatric Investigation, 8(3), 224–236. https://doi.org/10.1002/ped4.12417

Wetherby, A. M., Guthrie, W., Woods, J., Schatschneider, C., Holland, R. D., Morgan, L., & Lord, C. (2014). Parent-implemented social intervention for toddlers with autism: An RCT. Pediatrics, 134(6), 1084–1093. https://doi.org/10.1542/peds.2014-0757

Zahra, T., Akmal, F., Sarwar, M., Arif, M., Haideri, M. H., & Atta Ullah, F. (2026). Evaluating the comparative effectiveness of traditional and AI-assisted speech therapy on communication outcomes in children with autism spectrum disorder. International Journal of Special Education, 41(15s), 139–159. https://www.internationalsped.com/index.php/ijse/article/view/4750