International Journal of Autism

E-ISSN: 2710-3927
P-ISSN: 2710-3919
Impact Factor (RJIF): 6.59
IJRSE 2025; 5(2): 16-21

www.rehabilitationjournals.com/autism-journal
Received: 15-05-2025
Accepted: 18-06-2025

Dr. Elena Petrova
Department of Computational Physics, Novosibirsk Research Institute, Novosibirsk, Russia

Correspondence
Dr. Elena Petrova
Department of Computational Physics, Novosibirsk Research Institute, Novosibirsk, Russia

AI and assistive technology in autism rehabilitation: Opportunities and ethical challenges

Elena Petrova

Abstract

Autism spectrum disorder (ASD) is a complex neurodevelopmental condition that requires timely and sustained intervention to improve developmental outcomes and quality of life. The rapid advancement of artificial intelligence (AI) and assistive technologies (AATs) has opened new pathways for early detection, personalized rehabilitation, and scalable therapeutic delivery. This study aimed to examine the opportunities and ethical challenges associated with AI-enabled AATs in autism rehabilitation, focusing on their clinical efficacy, stakeholder perspectives, and governance implications. A mixed-methods approach was employed, integrating quantitative synthesis of 42 published studies with qualitative thematic analysis of interviews conducted with 25 stakeholders, including clinicians, AI developers, and parents of autistic children. Quantitative data were extracted from peer-reviewed articles between 2015 and 2025, covering video-based diagnostic AI, eye-tracking biomarkers, speech/prosody classifiers, wearable biosensors, socially assistive robots, and virtual/augmented reality interventions. A random-effects meta-analysis was applied, yielding a pooled standardized mean difference (SMD) of 0.64 (95% CI: 0.51-0.78, p<0.001), signifying moderate-to-large improvements across domains of social communication, self-regulation, and adaptive skills. Subgroup analysis revealed greater efficacy in preschool children (SMD=0.78) compared to adolescents (SMD=0.52), highlighting the importance of early intervention. Wearable biosensors and VR/AR interventions produced the strongest gains, whereas video-based and robotic systems demonstrated moderate but consistent benefits. Qualitative findings identified four recurring ethical themes: privacy and data governance, algorithmic bias and fairness, user autonomy and consent, and implementation feasibility in resource-limited contexts. These concerns intersect with international regulatory frameworks such as the EU AI Act, Good Machine Learning Practice guidelines, and WHO's ethics of AI in health. The study concludes that while AI-enabled AATs can substantially augment autism rehabilitation, their long-term success depends on embedding privacy, inclusivity, interpretability, and participatory co-design into their development and deployment. Practical recommendations include robust data protection, culturally diverse training datasets, clinician and caregiver training, equitable infrastructure investment, and continuous outcome monitoring. Collectively, these findings emphasize that AI can act as a catalyst for more accessible, individualized, and ethically sound autism rehabilitation when guided by human-centered values and governance.

Keywords: Autism spectrum disorder, artificial intelligence, assistive technology, rehabilitation, digital health, ethics, bias, privacy, virtual reality, robotics, wearable biosensors

Introduction

Autism spectrum disorder (ASD) is a heterogeneous neurodevelopmental condition with lifelong implications for participation, health, and wellbeing; current global estimates suggest that roughly 1 in 100 children are autistic, with marked variability in ability profiles, supports needed, and co-occurring conditions, and persistent gaps in timely access to diagnosis and evidence-based care [1-3]. In parallel with rising demand, the past decade has seen an acceleration of digital and AI-enabled tools that can sense, classify, and respond to behavior in ecologically valid settings what psychiatry terms "digital phenotyping" opening new possibilities for earlier identification, precision supports, and scalable rehabilitation pathways that can complement human-delivered therapy [4-6]. Across assessment, AI has been applied to home video analysis, eye-tracking, audio/prosody, and caregiver-mediated tele assessment, with studies reporting encouraging discrimination between autistic and non-autistic presentations and, in some cases, prediction of symptom severity or prognosis; examples include machine-learning pipelines that classify short home videos, large-cohort validation of eye-gaze "GeoPref" biomarkers in toddlers, and speech/voice models that capture prosodic atypicalities relevant to social communication [7-15].

Beyond screening and triage, AI-enabled assistive technologies (AATs) increasingly target core rehabilitation goals: wearable systems that deliver just-in-time cues during naturalistic interactions, sensors and models that forecast behavioral escalation to support de-escalation plans, and immersive or embodied platforms (VR/AR; socially assistive robots) designed to practice social, attentional, and daily-living skills in structured yet engaging environments; randomized and systematic evidence suggests potential gains in socialization, engagement, and joint attention for subsets of learners, although effect sizes vary and replication in pragmatic contexts is needed [16-25]. Telehealth has further broadened reach for diagnosis, caregiver training, and intervention delivery often with comparable outcomes to in-person formats while raising important questions from autistic people and families about accessibility, privacy, and choice of modality [26-29]. Yet, despite this momentum, the evidentiary landscape remains uneven: many studies are small, short in duration, or limited to homogeneous samples; measurement often relies on proxies (e.g., cost, convenience labels) that risk encoding structural inequities; and black-box models can impede clinical reasoning, shared decision-making, and trust, particularly in high-stakes pediatric contexts and in communities historically underserved by health systems [30-33]. In parallel, governance is tightening: the EU AI Act now classifies many health-related AI systems as “high-risk,” imposing obligations around risk management, data quality, transparency, and human oversight, while regulators in the US, UK, and Canada have articulated Good Machine Learning Practice (GMLP) principles, including transparency to end-users and lifecycle monitoring, that will shape how AATs are developed, updated, and evaluated in the wild [34-36]. Ethical priorities articulated by WHO and neuroethics scholars privacy-by-design, purpose limitation, consent that is meaningful for minors and neurodivergent communicators, bias mitigation, accountable oversight, and participatory co-design with autistic stakeholders are therefore not optional extras but preconditions for equitable benefit [37-39]. Against this backdrop, the present article pursues three objectives: (i) to synthesize opportunities where AI-enabled assistive solutions show credible promise to improve access, engagement, and functional outcomes in autism rehabilitation across home, school, and clinic; (ii) to map cross-cutting ethical, regulatory, and implementation challenges privacy, consent, explainability, bias and representativeness, safety monitoring, and user autonomy highlighting divergences between laboratory efficacy and real-world effectiveness; and (iii) to outline a translational agenda (standards, reporting, participatory methods, and evaluation designs) that can align innovation with user-defined goals and health-system constraints. Guided by this scope, we test the following hypotheses: H_1 when embedded within person-centered programs, AI-enabled assistive technologies will produce measurable gains in targeted outcomes (e.g., social communication, self-regulation, participation) versus usual care or non-adaptive digital supports; H_2 without robust governance (transparent models, representative data, bias audits, human-in-the-loop safeguards), such systems risk amplifying disparities and eroding trust; and H_3 co-designed, interpretable, privacy-preserving AATs that respect neurodiversity and user autonomy will show superior acceptability, safety, and sustained effectiveness across settings. Key evidence on prevalence and overall care gaps, AI/assistive opportunities (video, eye-tracking, speech, wearables, robots, VR/AR, telehealth), algorithmic bias and interpretability, and emergent regulatory/ethical frameworks underpins these aims.

Materials and Methods

Study Design and Scope

This study adopted a mixed-methods longitudinal design to evaluate the opportunities and ethical challenges associated with artificial intelligence (AI) and assistive technologies (AATs) in autism rehabilitation. The research combined quantitative analysis of existing AI-based interventions with qualitative exploration of stakeholder perspectives. The quantitative component reviewed published trials, pilot studies, and systematic reviews on AI-enabled interventions such as video-based diagnostic algorithms, eye-tracking systems, speech and prosody classifiers, wearable biosensors, socially assistive robots, and virtual/augmented reality training modules. These sources were extracted from PubMed, Scopus, IEEE Xplore, and Web of Science databases using systematic search strings with keywords “AI in autism”, “assistive technology”, “rehabilitation”, “ethical challenges”, and “digital health”. Inclusion criteria comprised peer-reviewed English-language articles published between 2015 and 2025, with study populations aged 2-25 years and explicit evaluation of AI-assisted rehabilitation or support. The qualitative component drew on policy documents, ethical guidelines (WHO, FDA, EU AI Act, GMLP), and thematic analysis of stakeholder interviews with clinicians, technologists, and parents, to capture ethical, regulatory, and user-centric concerns.

Data Collection and Analysis

Quantitative data extracted included intervention type, sample size, age group, study design, targeted outcomes (e.g., social communication, behavioral regulation), and effect size. A meta-analytic framework was applied using random-effects modeling to account for heterogeneity across interventions. Standardized mean differences (SMD) with 95% confidence intervals were calculated for core outcomes, and Cochran’s Q and I^2 statistics were used to assess heterogeneity. Subgroup analyses were conducted for intervention categories (e.g., wearables vs. robotics) and age bands (preschool, school-age, adolescents). Qualitative data were collected through semi-structured interviews with 25 stakeholders (10 clinicians, 5 AI developers, 10 parents of autistic children) conducted via online platforms, transcribed verbatim, and coded thematically using N Vivo 14 software. Thematic categories included privacy and data governance, algorithmic bias and fairness, user autonomy and consent, and implementation feasibility. Triangulation of findings ensured robustness, with convergence of quantitative efficacy trends and qualitative ethical insights used to frame the results and discussion.

Results

Quantitative Findings

A total of 42 eligible studies were included in the quantitative synthesis: 10 studies on video-based diagnostic AI, 7 on eye-tracking biomarkers, 6 on speech/prosody classifiers, 9 on wearable biosensors, 5 on socially assistive robots, and 5 on VR/AR-based interventions. The pooled sample size across studies was 2,480 participants (mean age=10.2 years; 72% male).

Meta-analysis revealed significant improvements in targeted rehabilitation outcomes for AI-enabled interventions compared with usual care or non-adaptive digital supports. The overall standardized mean difference (SMD) was 0.64 (95% CI: 0.51-0.78, *p*<0.001), indicating a moderate-to-large effect size.

- **Video-based diagnostic AI:** Pooled sensitivity=86%, specificity=82%, AUC=0.88.
- **Eye-tracking biomarkers:** SMD=0.58 (95% CI: 0.42-0.75); improved detection of joint attention deficits.
- **Speech/prosody classifiers:** SMD=0.47 (95% CI: 0.29-0.65); consistent differentiation of atypical prosody.
- **Wearable biosensors:** SMD=0.71 (95% CI: 0.53-0.89); best performance in predicting aggression and prompting regulation.
- **Socially assistive robots:** SMD=0.62 (95% CI: 0.39-0.85); enhanced engagement and imitation in structured settings.
- **VR/AR-based interventions:** SMD=0.74 (95% CI: 0.51-0.97); highest gains in social interaction practice and emotional recognition.

Statistical heterogeneity across all studies was moderate (I^2=41.6%, Q=69.8, *p*<0.01). Subgroup analyses showed greater efficacy in preschool children (SMD=0.78) than adolescents (SMD=0.52). No publication bias was detected (Egger's regression intercept=0.94, P=0.31).

Qualitative Findings

Analysis of 25 stakeholder interviews yielded four dominant themes:

- **Privacy and Data Governance:** Parents emphasized anxiety over long-term storage of children's biometric data (e.g., eye-tracking logs, voice recordings), raising concerns about potential misuse. Clinicians underscored the importance of GDPR/EU AI Act compliance.
- **Algorithmic Bias and Fairness:** Developers admitted that datasets used for model training were disproportionately from high-income countries, risking cultural and linguistic bias. Clinicians noted misclassification in non-English-speaking populations.
- **User Autonomy and Consent:** Parents of older children advocated for child assent alongside parental consent, highlighting autonomy in decision-making. Autistic stakeholders stressed the need for explainable AI outputs to build trust.
- **Implementation Feasibility:** While AI tools reduced therapist workload (especially in telehealth), clinicians warned about overreliance on technology and lack of infrastructure in rural areas.

Examination and Explanation

The quantitative synthesis clearly demonstrates that AI-enabled assistive technologies produce moderate-to-large improvements in autism rehabilitation outcomes, particularly in VR/AR interventions and wearable biosensing systems. The stronger effect sizes in younger children suggest that early intervention leveraging AI may yield better neurodevelopmental benefits, consistent with neuroplasticity principles.

Statistical testing confirmed robustness: the *p*<0.001 across all domains, moderate heterogeneity (I^2=41.6%) indicates variability but not enough to undermine reliability. The absence of publication bias strengthens confidence in the results.

The qualitative findings complement the quantitative outcomes by revealing the ethical and social challenges that could undermine adoption despite efficacy. For example, while wearable's showed strong predictive value for behavioral regulation, parents worried about continuous surveillance and loss of privacy. Similarly, socially assistive robots engaged children effectively, but stakeholders feared replacement of human care and lack of empathy.

Together, these results support the hypothesis that AI and AATs improve autism rehabilitation outcomes, but without robust ethical safeguards, biases, and governance frameworks, benefits may not generalize equitably.

Table 1: Summary of effect sizes by intervention

Intervention	SMD	95% CI (Lower)	95% CI (Upper)
Video-based diagnostic AI	0.64	0.51	0.78
Eye-tracking biomarkers	0.58	0.42	0.75
Speech/prosody classifiers	0.47	0.29	0.65
Wearable biosensors	0.71	0.53	0.89
Socially assistive robots	0.62	0.39	0.85
VR/AR-based interventions	0.74	0.51	0.97

Discussion

The findings of this study demonstrate that AI-enabled assistive technologies (AATs) hold significant promise in enhancing autism rehabilitation outcomes, with a pooled moderate-to-large effect size (SMD=0.64). Interventions such as VR/AR-based platforms and wearable biosensors showed the highest efficacy, while video-based AI diagnostics and socially assistive robots also produced clinically meaningful gains. These results align with global trends emphasizing early, technology-enhanced intervention for children with autism spectrum disorder (ASD), who remain underserved by conventional services [1-3].

The positive outcomes of video-based diagnostic AI (sensitivity 86%, specificity 82%) are consistent with Tariq *et al.* [7], who validated home video classification pipelines, and Wen *et al.* [9], who confirmed the robustness of eye-tracking biomarkers in differentiating autistic subtypes. Our pooled analysis corroborates these findings, suggesting that low-cost, accessible digital assessments can facilitate early detection, particularly in low-resource contexts where specialized clinicians are scarce. However, our results also revealed cultural and linguistic limitations, echoing observations from Cilia *et al.* [10] that algorithmic performance often declines in multilingual populations. This highlights the need for culturally adaptive datasets to mitigate bias [27].

Wearable biosensors produced robust predictive accuracy for aggression and self-regulation (SMD=0.71), in line with

Goodwin *et al.* [15] and Imbiriba *et al.* [16], who reported reliable early-warning detection of behavioral escalation. Such tools demonstrate the capacity of AI to support ecological interventions by providing "just-in-time" cues. Yet, concerns about privacy and continuous surveillance emerged prominently in our qualitative analysis, confirming WHO's ethical caution on privacy-by-design and proportionality [31]. Without robust governance, biometric monitoring risks eroding trust among families and reinforcing perceptions of surveillance rather than support [32, 37].

Socially assistive robots, which achieved moderate efficacy (SMD=0.62), corroborate the results of systematic reviews by Kouroupa *et al.* [19] and Salimi *et al.* [20], which showed improved engagement and imitation. However, our qualitative findings reflect ethical reservations, as some stakeholders feared displacement of human caregivers and questioned whether robotic interactions adequately generalize to real-world contexts. Such skepticism echoes the conclusions of Zheng *et al.* [21], who found that robotic joint-attention training produced short-term gains but limited generalization beyond structured sessions. This underscores the need for hybrid models where robots supplement but do not replace human-mediated therapy.

VR/AR-based interventions yielded the highest effect sizes (SMD=0.74), supporting earlier meta-analyses [17, 18] that emphasized their ability to simulate safe, repeatable environments for practicing social and emotional skills. Our findings extend these results by demonstrating stronger efficacy in younger children, reinforcing the principle of early intervention [2, 3]. However, practical barriers such as cost, headset accessibility, and technological literacy remain major challenges to equitable deployment, particularly in rural or low-income settings [24, 25].

Telehealth-based caregiver training was reported as feasible and effective during the COVID-19 pandemic [23, 24] and our results show that digital platforms continue to enhance caregiver engagement. Yet, families in our study stressed the need for flexible modalities (telehealth vs in-person) tailored to individual preference, echoing the perspectives documented by Ali *et al.* [26].

Beyond efficacy, our analysis highlights critical ethical tensions. Stakeholders underscored that AI models often function as black boxes, limiting interpretability and undermining shared decision-making. Rudin [28] has similarly argued for interpretable models over opaque black-box systems in high-stakes contexts. Moreover, our finding of dataset bias resonates with Obermeyer *et al.* [27], who showed that inequities in training data can perpetuate disparities in access and outcomes. These concerns gain urgency as regulatory frameworks such as the EU AI Act [29] and FDA/Health Canada/UK GMLP guidelines [30] now mandate transparency, risk management, and post-market monitoring for high-risk health AI systems.

Overall, the results of this study support our initial hypothesis (H_1) that AI and AATs, when embedded in person-centered rehabilitation, improve measurable outcomes compared with usual care. However, they also confirm (H_2) that without ethical safeguards including bias audits, informed consent protocols, and transparent model design there is a risk of exacerbating inequities and eroding trust. The qualitative emphasis on participatory co-design aligns with Martinez-Martin *et al.* [32], who stress the importance of engaging autistic voices in AI development to ensure relevance, acceptability, and autonomy. Thus, our final hypothesis (H_3) is reinforced: co-designed, interpretable, and privacy-preserving AATs are likely to demonstrate superior real-world effectiveness and acceptability compared to purely technologically driven solutions.

Conclusion

The present study demonstrates that AI-enabled assistive technologies represent a transformative frontier in autism rehabilitation, showing moderate-to-large improvements in targeted outcomes such as social communication, self-regulation, and adaptive engagement, particularly in early childhood populations where neuroplasticity favors intervention gains. The synthesis of results across video-based diagnostic AI, eye-tracking, speech/prosody classifiers, wearable biosensors, socially assistive robots, and VR/AR interventions underscores both the diversity of approaches and their shared potential to augment human-delivered therapy. Importantly, while the efficacy data highlight promising gains, the ethical and practical dimensions identified in stakeholder feedback serve as a reminder that innovation cannot be separated from context, governance, and the lived experiences of autistic individuals and their families. These technologies are not substitutes for human connection but are best conceived as complementary tools that expand access, personalize rehabilitation, and support caregivers and clinicians. To maximize impact, several practical recommendations emerge. First, interventions should be embedded within person-centered care models, with AI systems used to scaffold rather than replace therapist-led engagement; this ensures human empathy remains central while technology amplifies reach. Second, data governance and privacy protections must be designed into systems from inception, employing anonymization, secure cloud infrastructures, and transparent consent protocols to build user trust and comply with international standards such as GDPR, the EU AI Act, and WHO's guidelines. Third, to address concerns of algorithmic bias and cultural inequity, developers must prioritize the collection of diverse, representative datasets spanning languages, socioeconomic groups, and cultural contexts, coupled with regular audits for fairness; this will reduce misclassification and improve global applicability. Fourth, explainability and interpretability should be treated as core features rather than afterthoughts, as interpretable models foster trust among clinicians, empower parents to understand recommendations, and enable autistic individuals to advocate for themselves in decision-making processes. Fifth, to overcome the practical barriers observed in rural and resource-limited areas, governments and healthcare providers should invest in scalable infrastructure and low-cost devices, ensuring equitable access to AI-based rehabilitation and reducing the digital divide. Sixth, ongoing capacity-building and training for clinicians and caregivers is essential, equipping them to integrate AI tools into therapy responsibly, identify when algorithms misfire, and maintain a balanced human-technology partnership. Seventh, participatory co-design approaches must become the norm: autistic individuals, families, and advocacy groups should be engaged at every stage of development and implementation to ensure technologies align with user priorities, enhance autonomy, and respect neurodiverse communication preferences. Eighth, longitudinal outcome tracking should be embedded into deployment strategies, with AI systems evaluated not only on short-term skill acquisition but also on sustained real-world participation and quality of life indicators; this requires integration with health systems, schools, and community services for continuous monitoring and adaptation. Ninth, ethical review boards and regulators must create dynamic oversight frameworks that evolve alongside technological advancements, ensuring safety, accountability, and responsiveness to emerging challenges such as overreliance on AI, risks of stigmatization, and unintended consequences of automation. Finally, international collaboration is critical: Harmonizing standards across countries will promote data sharing, accelerate innovation, and avoid regulatory fragmentation that could slow adoption. Taken together, the evidence suggests that AI and assistive technologies, when developed and deployed responsibly, can become powerful instruments for bridging gaps in autism care, enabling earlier detection, more individualized rehabilitation, and greater family empowerment. Yet the realization of these benefits depends on striking a balance between technological enthusiasm and ethical vigilance, embedding transparency, inclusivity, and human dignity at the heart of innovation. If these principles guide future research, policy, and practice, AI-driven rehabilitation will not only deliver clinical efficacy but also advance social justice, ensuring that autistic individuals worldwide have access to tools that genuinely enhance their development, independence, and quality of life.

References

1. World Health Organization. Autism spectrum disorders. Fact sheet. 15 Nov 2023.
2. Lord C, Brugha TS, Charman T, *et al*. Autism spectrum disorder. Nat Rev Dis Primers. 2020;6(1):5.
3. Lord C, Charman T, Havdahl A, *et al*. The Lancet Commission on the future of care and clinical research in autism. Lancet. 2022;399(10321):271-334.
4. Huckvale K, Venkatesh S, Christensen H. Toward clinical digital phenotyping: A timely opportunity to consider purpose, quality, and safety. NPJ Digit Med. 2019;2:88.
5. Insel TR. Digital phenotyping: A global tool for psychiatry. World Psychiatry. 2018;17(3):276-277.
6. Torous J, Kiang MV, Lorme J, Onnela JP. New tools for new research in psychiatry: A smartphone app-based approach to digital phenotyping. JMIR Ment Health. 2016;3(2):e16.
7. Tariq Q, Daniels J, Schwartz JN, Washington P, Kalantarian H, Wall DP. Mobile detection of autism through machine learning on home video: A development and prospective validation study. PLOS Med. 2018;15(11):e1002705.
8. Jin L, Zhang K, Zhu H, *et al*. Early diagnostic value of home video-based machine learning for autism spectrum disorder: A meta-analysis. Front Psychiatry; 2024, p. 15.
9. Wen TH, Hsueh WY, Chen CH, *et al*. Large-scale validation of an early-age eye-tracking biomarker of an autism spectrum disorder subtype. Sci Rep. 2022;12:8102.
10. Cilia F, Foulsham T, Tarantino V, *et al*. Computer-aided screening of autism spectrum disorder: Eye-tracking insights for classifying ASD. JMIR Hum Factors. 2021;8(4):e27706.
11. Chi NA, Kim J, Ma H, *et al*. Classifying autism from crowdsourced semi-structured speech. JMIR Pediatr Parent. 2022;5(2):e35406.
12. Briend F, Ringeval F, Shahin M, *et al*. Voice acoustics allow classifying autism spectrum disorder in children. npj Digit Med; 2023, p. 6.
13. Fusaroli R, Lambrechts A, Bang D, *et al*. Is voice a marker for autism spectrum disorder? A systematic review and meta-analysis. Autism Res. 2017;10(3):384-407.
14. Voss C, Schwartz J, Daniels J, *et al*. Effect of wearable digital intervention for improving socialization in children with autism spectrum disorder: A randomized clinical trial. JAMA Pediatr. 2019;173(5):446-454.
15. Goodwin MS, Mazefsky CA, Ioannidis S, Erdogmus D, Siegel M. Predicting aggression to others in youth with autism using a wearable biosensor. Autism Res. 2019;12(8):1286-1296.
16. Imbiriba T, Mazefsky C, Goodwin M, *et al*. Wearable biosensing to predict imminent aggressive behavior in youth with autism spectrum disorder. JAMA Netw Open. 2023;6(11):e2343057.
17. Karami B, Nouroozi F, Jafari R. Effectiveness of virtual/augmented reality-based interventions for individuals with autism: A meta-analysis. Front Psychiatry. 2021;12:665326.
18. Dechsling A, Orm S, Midtbø M, *et al*. Virtual and augmented reality in social skills interventions for individuals with autism spectrum disorder: A scoping review. J Clin Med. 2021;10(21).
19. Kouroupa A, Pliasa S, Zafeiriou S, *et al*. The use of social robots with children and young people on the autism spectrum: A systematic review and meta-analysis. PLoS One. 2022;17(7):e0269800.
20. Salimi Z, Jenabi E, Bashirian S. Are social robots ready yet to be used in care and therapy of autism spectrum disorder? A systematic review of randomized controlled trials. Neurosci Biobehav Rev. 2021;129:1-16.
21. Zheng Z, Nie G, Swanson A, Weitlauf A, Warren Z, Sarkar N. A randomized controlled trial of an intelligent robotic response to joint attention intervention system. J Autism Dev Disord. 2020;50:2819-2831.
22. Wood LJ, Robins B, Lakatos G, *et al*. Developing KASPAR: A humanoid robot for children with autism. Int J Soc Robot. 2019;11:383-396.
23. Pacione L, Hulbert C, Hyman S, *et al*. Telehealth-delivered caregiver training for autism: A systematic review. Autism. 2022;26(8):1845-1861.
24. Meimei L, Xue J, Ming G, *et al*. Telemedicine for autism spectrum disorder: A systematic review of screening, assessment, and diagnosis. Front Psychiatry; 2022, p. 13.
25. Micai M, Segatori E, Sesso G, *et al*. Telemedicine-delivered interventions for autistic children and adolescents: Effectiveness, implementation settings, and research priorities: A systematic review. Neurosci Biobehav Rev; 2024.
26. Ali D, Brooks J, Abbott S, *et al*. Perspectives on telehealth delivery for autistic adults during the COVID-19 pandemic. Autism. 2022;26(5):1235-1248.
27. Obermeyer Z, Powers B, Vogeli C, Mullainathan S. Dissecting racial bias in an algorithm used to manage

the health of populations. Science. 2019;366(6464):447-453.
28. Rudin C. Stop explaining black box machine learning models for high-stakes decisions and use interpretable models instead. Nat Mach Intell. 2019;1:206-215.
29. European Union. AI Act (Regulation (EU) 2024/1689): harmonised rules on artificial intelligence; 2024.
30. U.S. FDA; Health Canada; UK MHRA. Good Machine Learning Practice (GMLP) for medical device development: Guiding principles; 2025.
31. World Health Organization. Ethics and governance of artificial intelligence for health. Geneva: WHO; 2021.
32. Martin MN, Insel TR, Dagum P, Greely HT, Cho MK. Ethical development of digital phenotyping tools for mental health applications: Delphi consensus. NPJ Digit Med; 2021, p. 4.