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Leveraging AI for the diagnosis and treatment of autism spectrum disorder: Current trends and future prospects

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ABSTRACT

The integration of artificial intelligence (AI) into the diagnosis and treatment of autism spectrum disorder (ASD) represents a promising frontier in healthcare. This review explores the current landscape and future prospects of AI technologies in ASD diagnostics and interventions. AI enables early detection and personalized assessment of ASD through the analysis of diverse data sources such as behavioural patterns, neuroimaging, genetics, and electronic health records. Machine learning algorithms exhibit high accuracy in distinguishing ASD from neurotypical development and other developmental disorders, facilitating timely interventions. Furthermore, AI-driven therapeutic interventions, including augmentative communication systems, virtual reality-based training, and robot-assisted therapies, show potential in improving social interactions and communication skills in individuals with ASD. Despite challenges such as data privacy and interpretability, the future of AI in ASD holds promise for refining diagnostic accuracy, deploying telehealth platforms, and tailoring treatment plans. By harnessing AI, clinicians can enhance ASD care delivery, empower patients, and advance our understanding of this complex condition.

1. Introduction

Autism Spectrum Disorder (ASD) is a complex neurodevelopmental condition characterized by challenges in social interaction, communication, and restricted or repetitive behaviour (Faja and Dawson, 2017). The prevalence of ASD has been steadily increasing, with current estimates suggesting that approximately 1 in 36 children in the United States (Source: Centers for Disease Control and Prevention-2023) and about 1 in 100 worldwide (Source: World Health Organization) are diagnosed with ASD (Xu et al., 2019; Zeidan et al., 2022). The diagnosis of ASD is often challenging due to its broad spectrum of symptoms and the variability in presentation among individuals. Traditional diagnostic methods rely heavily on behavioral assessments and observational tools, which can be subjective and time-consuming (Hus and Segal, 2021; Velarde and Cárdenas, 2022a). Additionally, the treatment of ASD requires a multidisciplinary approach, including behavioural therapies, educational support, and sometimes pharmacological interventions, making it difficult to tailor individualized treatment plans effectively (Nadeem et al., 2020; Velarde and Cárdenas, 2022b).

Recent advancements in neuropsychopharmacology have shown

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that artificial intelligence (AI) can play a crucial role in enhancing our understanding and treatment of neurodevelopmental disorders (Uddin et al., 2019a; Verma et al., 2022). AI technologies, such as machine learning and data analytics, are being used to analyse large datasets from neuroimaging studies, genetic research, and clinical trials (Azevedo et al., 2023; Skampardoni et al., 2024; Zhang et al., 2005; Zhu et al., 2024). These AI applications help identify biomarkers, predict treatment responses, and optimize drug development processes, potentially leading to more targeted and effective therapies for various neurological and psychiatric conditions (Sabbagh et al., 2020). In the context of ASD, AI holds tremendous potential to revolutionize both diagnosis and treatment strategies (Shahamiri and Thabtah, 2020). AI-driven technologies, such as machine learning algorithms and natural language processing systems, can analyze vast amounts of data, including behavioral observations, neuroimaging scans, genetic markers, and electronic health records, to provide valuable insights into ASD (Gupta et al., 2022). Furthermore, advanced algorithms analyze complex datasets, such as behavioural patterns and neuroimaging results, to provide precise assessments and identify subtle signs of ASD that may be missed by traditional methods. AI facilitates personalized interventions by tailoring treatments to individual patient data and enables real-time monitoring and adjustment of therapies, ensuring that they adapt to the patient's evolving needs. Additionally, AI integrates diverse data sources, offering a comprehensive view of the patient and supporting more informed and effective therapeutic strategies.

This review provides an overview of ASD, including its clinical features based on current diagnostic and treatment approaches. Furthermore, it explores the role of AI in transforming healthcare delivery, with a specific focus on its applications in ASD diagnostics and interventions (Zhou et al., 2022). By harnessing the power of AI, clinicians and researchers aim to enhance the accuracy of ASD diagnosis, personalize treatment plans, and improve outcomes for individuals living with ASD.

2. Diagnosis of ASD using AI

ASD diagnosis traditionally relies on clinical assessments conducted by experienced clinicians. However, the integration of AI into ASD diagnosis offers innovative approaches for early detection and personalized assessment(Pan and Foroughi, 2024).

2.1. Behavioural analysis

AI-based systems leverage sophisticated algorithms to analyse a multitude of behavioural patterns indicative of ASD, extracted from various sources such as video recordings, wearable devices, and structured assessments (Turaev et al., 2023). These algorithms are trained to detect subtle nuances in behaviour that may signify ASD traits, including social interaction deficits, repetitive behaviours, and communication challenges. Specifically, AI can detect patterns of social interaction by analysing non-verbal cues such as eye contact, facial expressions, and gestures (Jia et al., 2024). Machine learning (ML) algorithms can identify deviations from typical social behaviour, such as reduced eye contact or atypical facial expressions, which are characteristic of individuals with ASD. Additionally, AI can analyse the frequency and intensity of repetitive behaviours, such as hand-flapping or rocking, to differentiate between ASD and neurotypical development.

Moreover, AI-powered systems excel in identifying communication challenges commonly observed in individuals with ASD (Almufareh et al., 2023). By analysing speech patterns, language use, and conversational dynamics, AI can detect difficulties in verbal communication, pragmatic language skills, and understanding of social cues. Natural language processing algorithms enable the extraction of semantic information from spoken or written language, aiding in the identification of linguistic markers associated with ASD (Corcoran et al., 2020). The strength of AI lies in its ability to process vast amounts of behavioural data with speed and accuracy, enabling the detection of subtle cues that may elude human observers. Advanced AI models can integrate information from multiple modalities, such as video analysis, physiological sensors, and wearable devices, to provide a comprehensive assessment of ASD-related behaviours (Mukherjee et al., 2024) (Fig. 1).

2.2. Neuroimaging

AI-driven analysis of neuroimaging data plays a pivotal role in enhancing early diagnosis and treatment planning for ASD (Pandya et al., 2024). By leveraging deep learning algorithms, AI can extract intricate features from structural and functional MRI scans, enabling the identification of neuroanatomical abnormalities and functional connectivity patterns associated with ASD. One significant advantage of AI-based neuroimaging analysis is its ability to detect subtle brain changes that may not be apparent to human observers (Garcia-Lopez, 2023). Deep learning algorithms excel at identifying complex patterns in neuroimaging data, allowing for the detection of structural abnormalities, such as alterations in cortical thickness or volume, and functional connectivity disruptions, which are characteristic of ASD. These AI-driven approaches provide insights into the underlying neurobiology of ASD, facilitating early diagnosis and intervention (Sun et al., 2023a). Moreover, AI enables the integration of multiple neuroimaging modalities, such as structural MRI, functional MRI, and diffusion tensor imaging (DTI), to provide a comprehensive assessment of brain structure and function in individuals with ASD. By combining information from different imaging techniques, AI-based systems can uncover unique biomarkers that may aid in the early identification of ASD (Salloum-Asfar et al., 2023) and inform personalized treatment strategies (Table 1).

2.3. Genetic markers

AI algorithms analyze genetic data to identify variants associated with ASD susceptibility and severity (Chaplot et al., 2023). Whole-genome sequencing and genome-wide association studies (GWAS) provide insights into the genetic architecture of ASD, enabling the identification of specific gene mutations and pathways implicated in the disorder. Explainable Artificial Intelligence (XAI) holds substantial promise for interpreting complex patterns and representations across various information sources. While machine learning (ML) algorithms are widely used to analyze biological data and identify potential disease biomarkers, the opaque, black-box nature of traditional ML models poses challenges in understanding and interpreting their decision-making processes. XAI addresses this issue by making the inner workings of these models more transparent, allowing researchers and clinicians to better understand how decisions are made, thereby increasing trust and enabling more informed and actionable insights in biomedical applications (Lin et al., 2021; Lundberg et al., 2020; Nahas et al., 2023). AI-driven approaches enhance our understanding of the complex genetic basis of ASD (Uddin et al., 2019b) and inform personalized interventions targeting underlying molecular mechanism (Table 2)

2.4. Protein markers

Recent advances in AI and ML have revolutionized biomarker research, enabling the analysis of large-scale proteomic data with unprecedented accuracy and efficiency. AI-driven approaches can identify subtle patterns and correlations within complex datasets, uncovering potential biomarkers that may be overlooked using traditional methods. Previous studies, have observed abnormal expressions of complement and coagulation pathway proteins in the peripheral blood of children with ASD. This suggests that the complement pathway may be activated in the periphery of children with ASD. Additionally, changes in certain complement proteins have also been detected in the brains of children with ASD and in animal models. These observations indicate that the

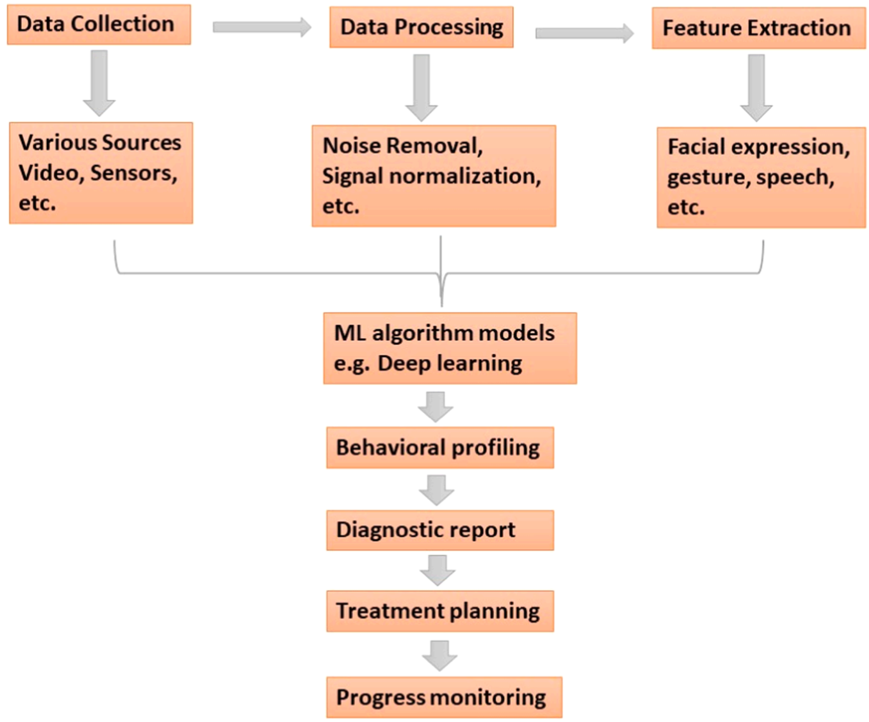

Fig. 1. Diagnosis of ASD using AI.

complement system could play a crucial role in the pathogenesis of ASD. The 45 differentially expressed proteins identified in plasma from children with ASD and healthy controls (Cao et al., 2023; Shen et al., 2019; Zhang et al., 2023). This has significant implications for the early diagnosis and personalized treatment of ASD, as protein biomarkers can reflect various aspects of the disorder, including genetic predispositions, environmental influences, and individual variations in symptom presentation (Table 3).

2.5. Electronic Health Records (EHR)

AI applications in electronic health records streamline ASD diagnosis by analyzing clinical data, including medical history, diagnostic assessments, and comorbidities. Natural language processing techniques extract structured information from unstructured clinical narratives, facilitating automated screening and risk stratification for ASD. AI-driven EHR systems improve diagnostic accuracy, enhance clinical decision-making, and optimize resource allocation in healthcare settings (Elhaddad and Hamam, 2024).

In a lack of clearly identifiable biomarkers, the present highest standard in medical diagnosis is based on behavioural assessments made by medical professionals. The accuracy and reliability of these results are called into doubt when subjectivity is taken into consideration, which can be caused by disparities in academic education and circumstances. Such limitations in the existing diagnostic system highlight the need for a unique technique that may give rapid, reliable evaluations while also providing a well-rounded knowledge of the varied phenotype in each individual with ASD (Song et al., 2019). Previous research aimed to establish a more objective way for identifying ASD by assessing major aspects associated with the disease utilising a variety of data modalities and AI. Artificial intelligence is projected to intervene to alleviate the issues with ASD recovery brought on by a lack of healthcare facilities and expensive therapy. The use of AI in the effective, highly accurate, and very stable medical diagnosis of autism is growing in popularity (Sun et al., 2021).

3. AI-driven therapeutic interventions

AI in medicine is transforming healthcare by using advanced technology to personalize and enhance treatments. Through machine learning and real-time data analysis, these interventions offer tailored solutions that improve effectiveness and adapt to individual needs, revolutionizing therapy and rehabilitation across various conditions.

3.1. Augmentative communication systems

AI-powered augmentative communication systems integrate sophisticated natural language processing (NLP) algorithms to decode user inputs and generate contextually appropriate speech or text output (Mehta et al., 2023). These systems employ deep learning techniques to analyze linguistic patterns and user preferences, enabling real-time customization of communication interfaces. At the molecular level, AI algorithms optimize neural network architectures to enhance language prediction and generation, facilitating effective communication for individuals with ASD by augmenting their expressive and receptive language skills (Kohli et al., 2022). Additionally, neuroimaging studies reveal neural plasticity and functional changes in language-related brain regions following AAC intervention, suggesting potential molecular mechanisms underlying language acquisition and improvement in individuals with ASD.

3.2. Virtual reality-based social skills training

Virtual reality (VR) platforms leverage AI-driven simulations to create immersive social environments that mimic real-life scenarios (Hughes-Roberts et al., 2022). Advanced machine learning algorithms embedded within VR systems analyze user interactions and facial expressions to provide personalized feedback and adaptive training interventions. Molecular studies indicate that VR-based social skills training modulates neural circuits involved in social cognition and emotional processing, leading to neuroplastic changes in brain regions such as the prefrontal cortex and amygdala (Chai et al., 2021). Furthermore, neurobiological investigations demonstrate alterations in

Table 1
Neuroimaging Biomarkers Identified by AI in ASD.

Neuroimaging Biomarker	AI Technique	Key Findings	Reference
Cortical Thickness	Convolutional Neural Networks	Identifies cortical thinning in ASD, notably in the prefrontal cortex and temporal lobes.	(Khundrakpam et al., 2017)
Functional Connectivity	Graph Convolutional Networks	Detects disrupted connectivity in the default mode and salience networks in ASD.	(Wang et al., 2021)
White Matter Integrity	Deep Learning Algorithms	Reveals white matter abnormalities, including reduced fractional anisotropy in the arcuate fasciculus and inferior longitudinal fasciculus in ASD.	(Chen et al., 2023)
Brain Activation Patterns	Long Short-Term Memory Networks	Identifies hypoactivation in the superior temporal sulcus and fusiform gyrus during face processing tasks in ASD.	(Xu et al., 2020)
Brain Morphometry	Generative Adversarial Networks	Shows differences in brain volumes, with increased gray matter volume in the amygdala and decreased volume in the anterior cingulate cortex in ASD.	(Xu and Ju, 2023)
Brain Connectivity	Recurrent Neural Networks	Characterizes alterations in inter-regional connectivity patterns, revealing disrupted functional networks implicated in ASD.	(Wei et al., 2022)
Resting-State fMRI	Autoencoders	Uncovers aberrant resting-state functional connectivity patterns in ASD, including reduced synchronization within the default mode network.	(Zhu et al., 2022)
Diffusion Tensor Imaging	Convolutional LSTM Networks	Detects microstructural alterations in white matter tracts, such as decreased fractional anisotropy and increased mean diffusivity, indicative of ASD.	(Li et al., 2021)

oxytocin receptor gene expression and oxytocin signaling pathways following VR-based interventions, suggesting a potential molecular basis for improved social functioning and emotional regulation in individuals with ASD (Kadir et al., 2023).

3.3. Robot-assisted therapies

AI-powered robots serve as interactive companions and therapeutic aids for individuals with ASD, utilizing advanced sensor technologies and machine learning algorithms to perceive and respond to user behavior. These robots employ reinforcement learning algorithms to adapt their behaviors and communication strategies based on individual preferences and therapeutic goals (Rudovic et al., 2018). Beyond assisting with ASD diagnosis, AI has also been employed in the treatment of ASD. AI-driven robots, intelligent mechanical devices, and smart wearable technologies have shown promise in enhancing social skills and daily living abilities in individuals with ASD. These innovations can provide personalized interventions, support social interactions, and improve the overall quality of life for those on the autism spectrum (Sun et al., 2023b). At the molecular level, studies show that robot-assisted therapies modulate neuroendocrine pathways, including the hypothalamic-pituitary-adrenal (HPA) axis and the oxytocinergic system, leading to changes in stress response and social bonding

Table 2
Genetic Marker Analysis in ASD using AI.

Genetic Marker	AI Technique	Key features	Reference
SCN1A	Machine Learning	Identifies ASD-associated mutations in SCN1A.	(Karunakaran et al., 2020)
CNTNAP2	Deep Learning	Detects rare variants in CNTNAP2 linked to ASD.	(Nudel et al., 2021)
MET	Natural Language Processing	Extracts MET gene mutations associated with ASD from health records.	(Fu et al., 2023)
SHANK3	Network Analysis	Uncovers molecular pathways involving SHANK3 in ASD.	(Vyas et al., 2021)
NRXN1	Machine Learning	Identifies rare variants in NRXN1 as ASD risk factors.	(Iyshwarya et al., 2022)
NLGN3	Deep Learning	Detects NLGN3 mutations impacting ASD pathophysiology.	(Sledziowska et al., 2020)
MECP2	Natural Language Processing	Extracts clinical data to understand MECP2-related ASD phenotypes.	(Samaco et al., 2005)

Table 3
Protein marker analysis in ASD using AI.

Biomarker	Study Findings	AI Techniques Used	Reference
Neurofilament Light (NfL)	Elevated levels of NfL in ASD patients compared to controls; potential marker for neuroinflammation and neurodegeneration	Machine learning algorithms for classification and regression analysis	(Brambilla, 2003)
Brain-Derived Neurotrophic Factor (BDNF)	Decreased plasma BDNF levels in ASD; associated with cognitive and behavioral impairments	Support vector machines and random forest classifiers	(Shen et al., 2022)
Oxytocin (OT)	Reduced oxytocin levels correlated with social deficits in ASD; potential target for therapeutic intervention	Deep learning models for pattern recognition	(Parker et al., 2017)
Reelin	Altered reelin expression in ASD brain tissues; involved in synaptic plasticity and neuronal migration	Neural network-based approaches for data integration and analysis	(Fatemi et al., 2018)
S100B Protein	Elevated serum S100B levels indicating astroglial activation in ASD; linked to neuroinflammation	AI-driven clustering and feature selection techniques	(Al-Ayadhi et al., 2015)
Insulin-Like Growth Factor−1 (IGF−1)	Reduced IGF−1 levels in ASD associated with impaired growth and neurodevelopment	Predictive modelling using AI algorithms	(Mills et al., 2022)
Cytokines (e.g., IL−6, TNF-α)	Dysregulated cytokine profiles in ASD indicating immune system involvement; IL−6 and TNF-α linked to severity of symptoms	AI techniques for multi-omics data analysis	(Goines and Ashwood, 2013)

(Snell-Rood and Snell-Rood, 2020). Additionally, genetic analyses reveal alterations in gene expression profiles associated with synaptic plasticity and neurodevelopmental processes following robot-assisted interventions, highlighting the potential molecular mechanisms underlying behavioural improvements in individuals with ASD (Sun et al., 2023c, 2023d).

Augmentative communication systems use advanced technology to improve language skills by adjusting how they communicate in real-time. Virtual reality (VR) creates interactive environments for practicing social skills, giving personalized feedback to boost social and emotional abilities. Studies show that VR changes brain areas and hormone signalling involved in these skills (Badke et al., 2022; Faria et al., 2016; Frolli et al., 2022; Gutiérrez-Martín et al., 2022; Kolk et al., 2023; Nijman et al., 2023). Robot-assisted therapies use AI to interact and adjust behaviors, impacting stress and social bonding (DiPietro et al., 2019; Marino et al., 2020; Rasouli et al., 2022; Sung et al., 2015). Together, these AI-based methods are making great strides in enhancing communication, social skills, and overall therapy for people with ASD.

4. Challenges and opportunities

Navigating the landscape of AI-driven therapeutic interventions for ASD presents a spectrum of challenges and opportunities, ranging from data privacy concerns to the promotion of interdisciplinary collaboration (Almufareh et al., 2024). Data privacy concerns loom large as AI technologies rely heavily on vast datasets for training and refinement. Ensuring the protection of sensitive personal information while harnessing the power of these datasets is paramount (Rehan, 2024). Robust data encryption, anonymization techniques, and adherence to stringent privacy regulations are essential to mitigate risks and foster trust among stakeholders. Model interpretability emerges as a critical challenge in AI-driven interventions for ASD. The complexity of AI algorithms often obscures the rationale behind their decisions, hindering clinicians' ability to understand and trust their recommendations (Albahri et al., 2023). Advancing interpretability techniques, such as attention mechanisms and model visualization tools, can enhance transparency and facilitate the integration of AI insights into clinical practice.

Interdisciplinary collaboration emerges as a key opportunity in advancing AI-driven interventions for ASD (Alexander Obaigbena et al., 2024). Bridging the gap between AI experts, clinicians, educators, and caregivers fosters holistic approaches that address the multifaceted needs of individuals with ASD. By leveraging diverse perspectives and expertise, interdisciplinary teams can design more effective interventions tailored to the unique strengths and challenges of each individual (Stokols et al., 2008). Addressing these challenges and embracing interdisciplinary collaboration unlocks opportunities to harness the full potential of AI in transforming the landscape of ASD interventions. By prioritizing data privacy, enhancing model interpretability, and fostering interdisciplinary collaboration, we can develop AI-driven interventions that are ethically sound, clinically impactful, and person-centered, ultimately improving outcomes and quality of life for individuals with ASD and their families (Hirani et al., 2024). To prevent unpredictable behavior in AI applications, extensive research is needed. AI devices should also undergo thorough risk assessments and be subject to the same regulatory oversight as other medical equipment before they are approved for clinical use (Ray et al., 2022).

Computational technology as well as data science possess the power to completely change diagnostic categorization. Significant data gathering is made possible by digital technologies, and the expandable, quick, and computerised classification of medical disorders is made possible by developments in AI and ML. Autism diagnosis is a difficult and costly procedure. The information-driven decision-making strategies for understanding the behaviours that are most prominent in differentiating children with autism from neurologically typically developing kids (Washington et al., 2020). Early indicators of autism can be detected by current pen-and-paper-based diagnostic procedures. Thankfully, a template can be trained to identify autism because of the link between face traits and the condition. A robot psychotherapist can appropriately explain the outcomes by using this paradigm. methods that are centred around data detection that may be used to assess the behavioural distinctions among subjects and controls, such as automated vision and eye tracking (Salhi et al., 2022).

5. Future directions

The future of AI-driven interventions for ASD is poised for transformative advancements across several key fronts. Longitudinal monitoring emerges as a pivotal trajectory, facilitating continuous tracking of individuals with ASD over time. Leveraging AI-enabled analytics, longitudinal studies offer insights into the dynamic trajectories of ASD symptoms, treatment responses, and developmental outcomes. By capturing nuanced changes and individual variations, longitudinal monitoring enhances our understanding of ASD progression and informs personalized interventions tailored to evolving needs. Telehealth platforms represent a burgeoning frontier in ASD intervention delivery, especially in the wake of the COVID-19 pandemic. AI-powered telehealth solutions enable remote access to diagnostic assessments, therapeutic interventions, and support services, transcending geographical barriers and enhancing accessibility for individuals with ASD and their families. Embracing telehealth platforms fosters flexibility, convenience, and continuity of care, empowering individuals with ASD to receive timely and equitable services regardless of their location. Personalized treatment plans emerge as a cornerstone of future ASD interventions, driven by advances in AI-enabled precision medicine.

For the purpose of precisely and accurately diagnosing diseases, treating them, and administering medications, artificial intelligence methods must be used in the establishment or development of personalised medicine. In the medical sector, the significance of a precise diagnosis cannot be overstated, since an incorrect or inaccuracy diagnosis has major consequences for the patient's course of treatment. However, in order to solve this issue—namely, obtaining an accurate diagnosis—AI algorithms were employed. The possibility of bias in algorithms must be addressed in AI applications for personalised medicine, particularly when using heterogeneous populations. Preventing discrepancies in healthcare outcomes requires ensuring equitable representation of various demographic groups that can be overcome by utilizing AI.

While diagnostic behaviour for ASD may not become evident until late in the infant's second year of life, in certain instances, the neuropathology linked to ASD may start much earlier in pregnancy. Therefore, biomarkers may help identify those who are at risk of acquiring ASD before screening behaviours are definitively established. A number of biomarkers are being created as instruments for diagnosis. While many of these biomarkers are still not sufficiently well investigated to produce estimates of the related risk of getting ASD after birth, there are several possible biomarkers to anticipate the possibility of developing ASD before birth. AI may be used to properly correlate the symptoms of ASD with its biomarker (Frye et al., 2019; Tang et al., 2023).

By integrating multi-dimensional data streams, including genetic profiles, neuroimaging data, and behavioural assessments, AI algorithms decipher intricate patterns and identify tailored interventions optimized for each individual's unique needs and characteristics. Personalized treatment plans prioritize holistic approaches that consider the interplay of genetic, environmental, and psychosocial factors, maximizing therapeutic outcomes and promoting lifelong well-being for individuals with ASD. In this trajectory, the convergence of longitudinal monitoring, telehealth platforms, and personalized treatment plans heralds a paradigm shift in ASD intervention paradigms. By harnessing the power of AI to enable continuous monitoring, remote delivery, and personalized care, we can usher in a future where individuals with ASD receive timely, targeted, and holistic interventions that optimize their developmental trajectories and enhance their quality of life.

6. Conclusion

The integration of AI holds immense promise in revolutionizing interventions for ASD. AI-driven approaches offer opportunities to enhance early detection, facilitate personalized treatment, and improve outcomes for individuals with ASD. Despite challenges in data privacy and model interpretability, interdisciplinary collaboration and technological advancements pave the way for innovative solutions. Moving forward, embracing longitudinal monitoring, telehealth platforms, and personalized treatment plans will further optimize ASD interventions, fostering improved quality of life and holistic support for individuals with ASD and their families. Through concerted efforts and continued innovation, AI stands as a transformative force in shaping the future landscape of ASD interventions.

CRediT authorship contribution statement

Spandana Rajendra Kopalli: Software, Data curation. **Brijesh Taksande:** Supervision, Software, Resources. **Aman Upaganlawar:** Validation, Supervision. **Parjinder Kaur:** Validation. **Sridevi Chigurupati:** Validation. **Sandip Rahangdale:** Methodology, Data curation. **Deepak Nathiya:** Software, Validation. **Roopashree R.:** Data curation, Formal analysis. **Barkha Goyanka:** Software. **Sushruta Koppula:** Writing – review & editing, Validation, Data curation, Conceptualization. **Nitu Wankhede:** Writing – original draft, Software, Data curation, Conceptualization. **Madhu Shukla:** Data curation, Formal analysis. **Mayur Kale:** Writing – original draft, Formal analysis, Data curation, Conceptualization. **Mohammad Khalid:** Software, Formal analysis. **Milind Umekar:** Supervision, Resources.

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