

Clinical Perspectives

Ethics and Innovation: Artificial Intelligence and Genomics in Child Psychiatric Risk and Intervention

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Keywords: Artificial intelligence, Genomics, Child psychiatry, Precision medicine, Ethics

<https://doi.org/10.62414/001c.143206>

JAACAP Connect

Vol. 13, Issue 1, 2026

Integrating artificial intelligence (AI) and psychiatric genomics holds transformative potential for child and adolescent psychiatry, offering precision tools to enhance risk assessment and early intervention planning for behavioral and emotional problems. This Clinical Perspective explores the emerging role of AI in leveraging genomic data alongside psychosocial and environmental contexts to inform psychotherapeutic and psychopharmacological decisions. Highlighting advancements in genomic risk profiling and predictive modeling, we examine how these tools can optimize the timing, modality, and personalization of interventions. We also address critical ethical considerations, including equity, consent, privacy, and the potential for AI-driven biases to exacerbate disparities. With actionable guidance for clinicians, this piece aims to foster a nuanced understanding of the benefits and challenges of integrating AI-driven genomic insights into clinical decision-making, ensuring that technological innovation aligns with ethical and equitable care practices for vulnerable populations.

INTRODUCTION

In recent years, the progress and convergence of psychiatric genomics, understanding of gene-environment interactions, and artificial intelligence (AI) have ushered in a new era of potential in precision child psychiatry.¹ Psychiatric genomics, encompassing polygenic risk scores (PRS), epigenetic markers, and genome-wide association studies, offers insight into a child's biological predisposition to mental health conditions such as depression, ADHD, autism spectrum disorder, and schizophrenia.² Simultaneously, AI methods such as machine learning and natural language processing are rapidly evolving and being integrated into health care to process vast, multidimensional datasets and enhance clinical decision-making.

The integration of AI and genomic data, when contextualized with psychosocial and environmental information, presents a compelling opportunity to improve early identification and personalize treatment strategies in child psychiatry. However, with innovation comes responsibility: ethical concerns, access disparities, and the risk of deterministic interpretations must be carefully navigated.

This Clinical Perspective provides an overview of current advances, clinical applications, and practical considerations for child psychiatrists. We offer specific recommendations to promote thoughtful, ethically grounded implemen-

tation of these technologies as they are being researched and rapidly integrated into clinical care.

ADVANCES IN PSYCHIATRIC GENOMICS AND RISK PREDICTION

The past decade has seen significant progress in psychiatric genomics. PRS aggregate the small effects of thousands of genetic variants to estimate an individual's inherited susceptibility to psychiatric conditions. For example, higher PRS for ADHD or depression have been associated with greater symptom burden in youth, even after controlling for environmental exposures.³ Similarly, research in epigenetics has shown how adverse childhood experiences (ACEs), including abuse, neglect, and poverty, can result in gene expression changes, influencing risk trajectories.⁴ Studies have identified epigenetic alterations in genes related to stress regulation (eg, *NR3C1*, *FKBP5*) in children exposed to early adversity.⁵

Telomere biology provides another biologically relevant dimension to risk prediction in child psychiatry. Telomeres, the protective DNA-protein caps at the ends of chromosomes, shorten with cellular aging and have been increasingly studied as biomarkers of biological stress and adversity. A growing body of evidence links shortened telomere length (TL) to exposure to early life stress, maltreatment, and psychiatric symptoms, including depression, anxiety,



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and PTSD.⁶ In children, shorter TL has been observed in those exposed to violence, familial instability, and chronic stress, even in the absence of clinical diagnoses.⁷ Importantly, TL is modifiable and responsive to environmental context. Interventions that improve parental sensitivity, reduce toxic stress, or enhance social support have been associated with stabilization or slowing of telomere shortening in some populations.⁸ This suggests that telomere dynamics may not only reflect biological embedding of adversity, but also serve as a marker of intervention impact, highlighting the relevance of TL monitoring in both risk assessment and outcome evaluation.

Combining genomic, epigenetic, and telomere data can enrich risk stratification models and help identify subgroups of children who may benefit from early or more-intensive interventions. For example, a young child with high PRS for depression, stress-related epigenetic changes, and evidence of shortened telomeres may be at particular risk for early-onset mood and behavioral disorders, prompting a more proactive, personalized care plan. These emerging biomarkers offer promise for informing both psychotherapeutic and psychopharmacological approaches. However, such biomarkers must be interpreted within a developmental, environmental, and cultural framework. A comprehensive biopsychosocial approach in predictive assessment and risk modeling remains essential to avoid reductionist or deterministic interpretations.

ROLE OF AI IN EARLY INTERVENTION PLANNING

AI offers powerful tools to integrate genomic, clinical, behavioral, and contextual data into dynamic risk models. Machine learning algorithms have the potential to identify patterns that human clinicians may miss, such as subtle symptom clusters predictive of later psychopathology, or generate risk stratification models that consider interactions between genetic and environmental factors.

To illustrate a hypothetical scenario, a 5-year-old with behavioral dysregulation, a family history of bipolar disorder, and high ADHD PRS undergoes comprehensive assessment. An AI-driven platform integrates this information with teacher reports, parental stress levels, and school and socioeconomic context. The system predicts a high likelihood of developing significant mood instability by adolescence and suggests early behavioral parent training, targeted school supports, and (as this area also evolves) biomarker-informed medication trials if symptoms persist.

These tools hold promise to educate and advise families on risk, reduce trial-and-error approaches, improve medication matching, and monitor treatment response using real-time data. For example, wearable devices and digital phenotyping tools have the potential to feed data back into models that adjust predictions and intervention recommendations. Importantly, this vision for AI would not replace clinician judgment but rather serve as a supplement, providing structured decision support that enhances, rather than overrides, the art of psychiatric care.

ETHICAL CONSIDERATIONS

While the integration of AI and genomics offers substantial clinical benefits, it also introduces complex ethical challenges that must be addressed thoughtfully.

Equity and access remain pressing concerns. Genomic research has disproportionately involved populations of European ancestry, limiting the applicability and accuracy of PRS for diverse children, with ongoing inclusivity efforts including the Polygenic Risk Methods in Diverse Populations Consortium and the 1000 Genomes Project.⁹ Similarly, AI models trained on unrepresentative datasets risk perpetuating existing health disparities by yielding less accurate predictions for underserved groups.¹⁰ Without intentional efforts to diversify data sources and validate models across populations, these tools may inadvertently reinforce inequities in psychiatric diagnosis and care.

Informed consent and privacy are also central. Genomic testing and AI-driven analysis often involve data that are longitudinal, familial, and sensitive. Clinicians must ensure that caregivers and, when appropriate, youth themselves understand the potential implications of testing, including incidental findings, future insurability, and familial risk. Privacy protections must extend beyond traditional medical records to include large-scale, interoperable databases and AI systems that may retain or repurpose data.

Risks of overreliance and stigmatization must be mitigated. There is a danger of interpreting risk scores or AI-generated predictions as deterministic, particularly when applied to young children. Labeling a child as “genetically high risk” may lead to stigma, self-fulfilling prophecies, or excessive surveillance, even in the absence of clinical symptoms. Clinicians must remain vigilant to the psychosocial impact of these designations and communicate findings with nuance. Strategies to address these concerns may include establishing multidisciplinary review processes, integrating culturally sensitive approaches to risk communication, and involving patients and families in decisions about data use and interpretation.

CURRENT PRACTICAL CHALLENGES

Several barriers currently limit the integration of AI and genomic tools into routine child psychiatric practice. Cost and infrastructure remain major obstacles. Genetic testing, biomarker assays, and AI-based platforms may not be covered by insurance and often require technical infrastructure that is not yet widely available in many clinical settings. Smaller practices, rural clinics, and resource-limited systems are particularly disadvantaged, risking an expanding gap in care quality. Lack of data standardization impedes interoperability across electronic health records, research databases, and clinical tools. Clinicians need access to user-friendly, integrated platforms that synthesize genomic, behavioral, and environmental data in real time. Development of such systems requires close collaboration between clinicians, informaticians, and policymakers.

Scientific validation is another critical challenge. While early findings are promising, more longitudinal and real-

Table 1. Practical Guidance for Clinical Genomic and AI Tools in Child Psychiatry

Recommendation	Description
Use data as probabilistic, not deterministic	Interpret genomic and AI-derived information as indicators of relative risk, not definitive diagnoses, to avoid over-pathologizing or stigmatizing children.
Balance biological and contextual factors	Incorporate genetic, epigenetic, and AI-derived data alongside psychosocial, developmental, and environmental information in all clinical decisions, including early intervention planning.
Engage families in clear, culturally sensitive communication	Discuss risk and intervention strategies transparently and collaboratively, using developmentally appropriate, culturally informed language to support informed consent and trust.
Seek ethical and genetic consultation when needed	In complex or sensitive cases, consult with ethics committees and genetic counselors to ensure responsible interpretation and application of findings.
Pursue ongoing training and education	Stay informed on advances in psychiatric genomics, AI-based tools, gene-environment interaction, and digital ethics to maintain competency and critical awareness.
Use technology to support, not replace, clinical care	Employ AI and biomarker tools to enhance, rather than supplant, individualized, relationship-based, and empathic psychiatric practice.

world studies are needed to assess the predictive validity, clinical utility, and long-term outcomes of AI- and genomics-informed care. This is particularly true for children and adolescents, whose developmental trajectories add complexity to predictive modeling. Looking forward, interdisciplinary collaboration will be essential. Psychiatrists, geneticists, data scientists, ethicists, and community advocates must collaborate to build ethical, equitable, and clinically useful tools. Involvement of families and youth in shaping these innovations will also help ensure that the future of precision psychiatry reflects patient-centered values.

ACTIONABLE IMPLICATIONS FOR CLINICIANS

As such challenges are overcome and genomic and AI technologies become more available, clinicians must develop a working knowledge of how to evaluate and incorporate them responsibly into practice. Practical recommendations are outlined in [Table 1](#). These tools should be used as clinical aids—not replacements—for empathic, individualized care. First, PRS and other biomarkers should be viewed as probabilistic tools, not definitive diagnoses. A high PRS may increase vigilance and monitoring but should not drive treatment decisions in isolation. Similarly, TL or epigenetic markers may signal cumulative stress exposure but require contextualization with behavioral, relational, and environmental assessments.

Clinicians should routinely integrate biological, psychosocial, and contextual factors in all clinical decisions, including AI-supported risk assessment and early intervention planning. This includes considering family history, trauma exposure (including patterns of intergenerational trauma), school environment, and social determinants of health. For example, a child with elevated genetic risk but strong family support and low environmental stress may require a different approach than one with similar genetic risk but ongoing adversity.

Clear and collaborative communication with families is essential. Parents and caregivers should be informed about the purpose, limitations, and implications of genomic test-

ing and AI-informed recommendations. Using developmentally appropriate and culturally sensitive language helps foster transparency, trust, and engagement. In ethically complex cases, such as when genomic findings impact other family members or caregivers disagree about testing, clinicians should consult with ethics committees or genetics professionals to guide decision-making.

Finally, clinicians should pursue continuing education in psychiatric genomics, gene-environment interactions, AI-supported data interpretation, and digital health ethics. As these technologies evolve, the clinical workforce must remain equipped to critically assess their validity, limitations, and ethical implications.

CONCLUSION

The integration of AI and psychiatric genomics holds significant promise for transforming child and adolescent psychiatry. By enabling earlier risk identification, personalizing early (and potentially preventative) interventions, and refining treatment strategies, these tools may improve outcomes and reduce the burden of delayed and trial-and-error care.

However, with this promise comes a responsibility to implement these tools thoughtfully. Ethical concerns, such as equity, informed consent, privacy, and potential stigmatization, must remain at the forefront. Clinicians play a central role in ensuring that emerging technologies are applied in ways that enhance, rather than compromise, developmental and culturally sensitive care. Child psychiatrists must engage critically with emerging technologies, remain attuned to the developmental and cultural contexts of their patients, and advocate for systems that prioritize both scientific innovation and human dignity.

Ultimately, the responsible adoption of these technologies requires a balance of scientific innovation and ethical vigilance. As the field advances, child and adolescent psychiatrists must remain both critical and curious, ensuring that precision tools serve the best interests of children and families across diverse contexts.

PLAIN LANGUAGE SUMMARY

Artificial intelligence and psychiatric genomics offer the potential to personalize early interventions in child psychiatry, integrating biological, behavioral, and contextual data. But their clinical use must be guided by ethical safeguards, cultural sensitivity, and commitment to equity in access and outcomes.

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FUNDING

The authors report no funding for this work.

DISCLOSURE

The authors report no biomedical financial interests or potential conflicts of interest.

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Conceptualization: Diab Ali (Lead). Writing – original draft: Diab Ali (Lead). Writing – review & editing: Deepika Shaligram (Lead). Supervision: Deepika Shaligram (Lead).

ACKNOWLEDGEMENT

This article is part of a special Clinical Perspectives series that will shed a new and focused light on clinically important topics within child and adolescent psychiatry. The series discusses the care of children and adolescents with psychiatric disorders from a new vantage point, including populations, practices, or clinical topics that may be otherwise overlooked. The series was edited by JAACAP Deputy Editor Lisa R. Fortuna, MD, MPH, MDiv, JAACAP Connect Editor David C. Saunders, MD, PhD, and JAACAP Editor-in-Chief Douglas K. Novins, MD.

Submitted: May 10, 2025 EST. Accepted: July 25, 2025 EST.

Published: August 13, 2025 EST.

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