Artificial Intelligence in Pediatrics: An Opportunity to Lead, not to Follow

Gianluca Mondillo, MD[1,2], Alessandra Perrotta, MD[1,2], Simone Colosimo, MD[1,2], Vittoria Frattolillo, MD[1,2], Mariapia Masino, MD[1,2], and Massimo Pettoello-Mantovani, MD, PhD[2,3]

The era of generative artificial intelligence is radically transforming contemporary medicine, with an impact that is expected to grow significantly in the coming years. Large language models (LLMs), a type of artificial intelligence (AI) system trained on massive volumes of text, are already influencing everyday clinical practice by enabling the processing and generation of human-like language, as well as performing tasks such as translation, text summarization, and answering questions.[1] These tools can provide support in generating differential diagnoses, interpreting laboratory tests, and suggesting therapeutic strategies. Pediatricians should carefully consider the unique challenges that this technological revolution brings to the care of their patients in order to ensure safe, ethical, and effective integration of AI into their practice.

The purpose of this commentary, authored by members of the Working Group on Artificial and Generative Intelligence in Pediatrics of the European Pediatric Association, Union of National European Pediatric Societies and Associations, is to discuss briefly the implications of generative AI, particularly LLMs, for pediatric practice, with the aim of providing information and practical recommendations to support an appropriate approach to, and use of, this emerging technology. As these tools become increasingly embedded in clinical workflows, the goal is to draw pediatricians' attention to the importance of understanding their potential, limitations, and the unique ethical and practical considerations that these tools pose for the care of children. AI represents, in fact, an opportunity to serve clinical practice, rather than something to endure passively or follow without gaining benefits for patients.[2]

The Limitations of LLMs in Pediatric Care

The fundamental issue with current LLMs in pediatrics lies within the training data.[3] These models are predominantly developed using information related to adult populations, perpetuating a long-standing imbalance in biomedical research. This structural bias is not merely a theoretical concern; when an AI system suggests medication dosages without adequately considering body weight or interpreting laboratory values while ignoring age-dependent physiological variations, the clinical risk becomes immediate and tangible. Therefore, the systematic inclusion of representative pediatric data during model pre-training should be carefully pursued.[4] AI systems that are not properly calibrated for the pediatric population are not just imperfect tools, they are potentially dangerous. The integration of pediatric guidelines, age-specific reference ranges, and appropriate dosage considerations is an essential requirement, not an optional enhancement.

The Issue of Data Protection and Sovereign AI

Data protection takes on an especially sensitive dimension when minors are involved. The use of proprietary solutions developed by large technology companies raises legitimate ethical and legal concerns. A promising alternative lies in the adoption of open-source models operating locally within hospital information technology systems, thereby avoiding the transmission of sensitive data to external servers.[5] This "sovereign AI" approach requires investment in local infrastructure and specialized expertise but likely represents the only path to ensure full regulatory compliance and optimal protection of pediatric data. Such a strategy entails a profound transformation of health care information technology infrastructure and demands pediatricians with hybrid skills, capable of effectively interfacing technical staff to develop solutions tailored to pediatric needs.

Parents, Chatbots, and Digital Literacy

Parents are already using LLM-based chatbot systems to seek information about their children's health, often even before

AI	Artificial intelligence
AGI	Artificial general intelligence
EPA-UN-EPSA	European Pediatric Association, Union of National European Pediatric Societies and Associations
GenAI	Generative artificial intelligence
IT	Information technology
LLMs	Large language models
RLHF	Reinforcement Learning from human feedback

From the [1]Department of Woman, Child and of General and Specialized Surgery, University of Campania "Luigi Vanvitelli", Naples, Italy; [2]European Pediatric Association, Union of National European Pediatric Societies and Associations, Berlin, Germany; and [3]Department of Medical and Surgical Sciences, Pediatric Unit, University of Foggia, Foggia, Italy

https://doi.org/10.1016/j.jpeds.2025.114641

consulting a pediatrician. This new reality requires pediatric health professionals to develop specific competencies: recognizing when families present AI-derived information, correcting potential misunderstandings generated by these technologies, and constructively integrating such tools into the doctor–patient relationship. At the same time, pediatricians should explore how AI can positively support patient and family education, particularly in the context of chronic conditions that require sustained therapeutic adherence. The potential of personalized virtual assistants capable of delivering age- and condition-specific information represents a major opportunity that pediatrics cannot afford to overlook.[6]

Equity and Access to AI in Pediatrics: A Global Challenge

Technological innovation in medicine has often amplified, rather than reduced, existing health care disparities.[7,8] The application of AI to pediatrics risks following the same trajectory, with benefits concentrated among already privileged populations and institutions. Developing strategies to ensure that children in different socio-economic contexts, underserved communities, and low-resource countries also benefit from these advances is not merely an ethical imperative but also a professional duty. Widespread availability will require both innovative technical solutions, such as lightweight models capable of running on low-performance hardware, and forward-looking health policies, along with global partnerships involving ethically responsible leading organizations in the field.[7]

Understanding Child–AI Interaction and Its Developmental Impact

Unlike adults, children go through developmental stages during which their cognitive, emotional, and social capacities evolve rapidly.[9] Interaction with AI systems during critical developmental periods may influence children's growth in ways that are not yet fully understood,[2,10] as studies on child–AI interaction, particularly those exploring the nuances of age- and cognition-specific interfaces, are currently scarce.[10] Several complex aspects of these interactions remain unresolved, including how attachment to virtual assistants develops in early childhood, what the long-term effects of early exposure to these technologies might be, and how AI can be used to support, rather than hinder, social and cognitive development.[7,11] The fact that some large language models have now passed the Turing Test,[12] becoming indistinguishable from humans in brief conversations, calls for a fundamental reflection within the pediatric community. Originally proposed in 1950 as a measure of a machine's ability to "think," the Turing Test evaluates whether an AI can engage in a text-based dialogue without being identified as nonhuman. If a machine can now convincingly mimic a human interlocutor, the implications extend far beyond technical achievement, they become relational, educational, and clinical.

Risks of Jailbreaking and Sycophancy in LLMs

A particularly relevant issue is the phenomenon of "jailbreaking," the deliberate attempt to bypass ethical safeguards embedded in AI systems. Increasingly observed among adolescents, this behavior involves prompting AI to generate responses that would normally be filtered or blocked, such as inappropriate content, dangerous instructions, or sensitive information.[13] In response, pediatricians must take an active role both in collaborating on the development of technological solutions that offer effective, age-appropriate protections, and in promoting critical digital literacy. Educating children and adolescents to use AI responsibly and with awareness is essential to help them understand the tool's limitations and to prevent manipulative or risky behavior.

Another often overlooked risk is the involuntary manipulative behavior exhibited by LLMs, commonly referred to as sycophancy. A recent study showed that language models, especially those trained using reinforcement learning from human feedback[14] (RLHF), tend to generate responses that align with the user's beliefs, even at the expense of factual accuracy.[15] This tendency arises because fine-tuning based on human preferences often rewards agreeable answers over truthful ones. In pediatrics, this could result in the erroneous validation of parental misconceptions or inaccurate clinical interpretations, ultimately undermining informed decision-making. In addition, increased optimization for human approval has been linked to a rise in overly flattering responses, even when they contradict scientific evidence. To address this, pediatric-focused LLMs must be explicitly designed to minimize such behavior, through expert oversight, safeguards against misleading but agreeable outputs, and the use of rigorously curated datasets that prioritize accuracy and scientific integrity.

Training Pediatricians and Creating Hybrid Professionals

The AI revolution necessitates a parallel evolution in pediatrics training. While not all pediatricians need to become programmers, all must develop sufficient digital literacy to use these technologies critically and to guide their appropriate application by patients and families.[16] Pediatrics residency programs should incorporate modules on medical informatics, AI fundamentals, and the critical evaluation of algorithmic outputs. At the same time, there is a growing need to cultivate hybrid professionals, clinical informatic pediatricians,[17] with deep expertise in both medicine and technology, capable of bridging the gap between clinical care and digital innovation.

Designing Pediatric AI Systems with Clinical Leadership

A fundamental principle should guide the integration of AI into pediatrics: no system intended for the care of children should be developed without meaningful involvement from

pediatricians. Historically, medical technologies have often been introduced into clinical practice without adequate input from end users.[18] With AI, we now have both the opportunity and the responsibility to shift this paradigm.[18] Pediatricians should play an active role in multidisciplinary teams designing these tools, helping to ensure that they address the unique needs of pediatric care and align with the profession's core ethical values. The validation of such systems must follow pediatric-specific protocols that reflect the diversity of age groups and subspecialties. In addition, legal and professional liability considerations must be addressed early in the development process, with input from experts in ethics, law, and medical informatics. Ultimately, AI should function as a clinical decision-support tool, complementing, not replacing, physician judgment, with final responsibility remaining in the hands of the clinician.

AI Agents and the Future of Clinical Collaboration

One of the most significant advancements in current language models is the emergence of AI agents, software systems that use AI not only to generate text but also to perform complex tasks autonomously, interact with digital environments, and coordinate actions across multiple tools. In pediatrics, this could translate into agents capable of simultaneously analyzing a patient's medical history, lab results, and growth charts, producing personalized follow-up plans or even generating structured clinical summaries ready for integration into electronic health records. The potential evolution of these agents into virtual clinical collaborators, with memory, planning abilities, and ongoing interaction with medical teams, introduces both exciting possibilities and ethically sensitive challenges. Oversight mechanisms must be established to govern the agent's actions. Transparent decision-making processes will be essential to build trust and accountability. Clear boundaries must also be defined, identifying the domains where AI agents may be granted a degree of operational autonomy, and those where close human supervision remains essential. Pediatrics must begin to engage with these issues now, taking an active role in shaping the development of AI agents that are aligned with the specific needs, values, and ethical considerations of pediatric care.[19]

Anticipating Artificial General Intelligence, Superintelligence, and Physical AI in Pediatrics

Looking ahead, we must not overlook the transformative potential of artificial general intelligence, an AI capable of performing any human cognitive task with a level of flexibility, abstraction, and generalization comparable to, or even surpassing, that of the human mind.[20] Unlike current large language models, artificial general intelligence would not be constrained to predefined tasks. Instead, it could autonomously learn new domains, reason about concepts not explicitly present in its training data, and plan over long time horizons. A further potential development is the emergence of superintelligence,[21] an entity that exceeds human intelligence across all relevant domains, from scientific research and medical diagnosis to ethical reasoning and problem-solving, achieving levels of speed and accuracy far beyond human capacity.

In clinical, as well as social and human, contexts, this evolution introduces a set of profound implications. The traditional role of physicians may be fundamentally altered if AI systems begin to demonstrate superior reasoning capabilities. Responsibilities will need to be carefully redefined, balancing those retained by clinicians with those delegated to AI. Ensuring transparency, verifiability, and fairness in such a scenario will become a foundational requirement.

Adding to this complexity is the emergence of physical AI, the integration of advanced artificial intelligence with robotic systems endowed with sensory, motor, and decision-making functions.[22] A practical application might involve robotic pediatric assistants capable of physically interacting with children during clinical visits, measuring vital signs, observing behavior, and dynamically adjusting their communication and clinical strategies. While these innovations could enhance both the accessibility and quality of care, particularly in remote or resource-limited settings, such robots also carry significant ethical, emotional, and relational implications. The potential replacement of direct human interaction with robotic assistance demands careful consideration, particularly regarding the nature and impact of physical contact between AI systems and children.

Given its intrinsic commitment to safeguarding vulnerable populations, pediatrics must assume a leading role in this global debate. It is essential that major national and international pediatric organizations contribute to shaping the ethical and operational frameworks guiding the use of advanced AI, whether virtual or physical, ensuring that technological progress remains anchored in the best interests of children.

Conclusion

In today's rapidly evolving technological landscape, pediatrics has a unique opportunity to set a global standard for the ethical and safe application of artificial intelligence in child healthcare. Achieving this goal requires a collective commitment that includes dedicated investment in research, specialized training, appropriate infrastructure, and a proactive role for pediatricians in the development and implementation of these technologies in clinical practice.

Pediatricians cannot afford to remain passive followers of this technological revolution, nor can they adopt a stance of resistance, which would ultimately prove both futile and counterproductive.[23] The way forward lies in active, informed engagement, guiding the integration of AI in ways that protect and promote the health and well-being of children and adolescents.[24] In this context, wisdom lies not in resisting the current AI revolution, but in learning to navigate it and lead with intelligence and purpose.[25] ■

CRediT authorship contribution statement

Gianluca Mondillo: Conceptualization, Supervision, Writing – original draft, Writing – review & editing. **Alessandra Perrotta:** Conceptualization, Supervision, Writing – original draft, Writing – review & editing. **Simone Colosimo:** Conceptualization, Supervision, Writing – original draft, Writing – review & editing. **Vittoria Frattolillo:** Conceptualization, Validation, Writing – original draft, Writing – review & editing. **Mariapia Masino:** Conceptualization, Supervision, Writing – original draft, Writing – review & editing. **Massimo Pettoello-Mantovani:** Conceptualization.

Declaration of Competing Interest

The authors declare no conflicts of interest.

Reprint requests: Massimo Pettoello-Mantovani, MD, PhD, Department of Pediatrics, Scientific Institute "Casa Sollievo della Sofferenza", University of Foggia, Foggia, Italy. E-mail: mpm@unifg.it

References

1. Liu Lei, Xiaoyan Y, Junchi L, Xiaoyang L, Yue S, Zhiqiang Z, et al. A survey on medical large language models: technology, application, Trustworthiness, and future directions. arXiv:2406. 2024. Accessed May 1, 2025. https://doi.org/10.48550/arXiv.2406.03712, https://arxiv.org/abs/2406.03712
2. Indrio F, Pettoello-Mantovani M, Giardino I, Masciari E. The role of artificial intelligence in pediatrics from treating illnesses to managing children's overall well-being. J Pediatr 2024 Dec;275:114291, 10.1016/j.jpeds.2024.114291
3. Zhao WX, Zhou K, Li J, Tang T, Wang X, Hou Y, et al. A survey of large language models. arXiv preprint arXiv:2303.18223. 2023. Accessed May 1, 2025. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj, https://arxiv.org/pdf/2303.18223
4. Muralidharan V, Burgart A, Daneshjou R, Rose S. Recommendations for the use of pediatric data in artificial intelligence and machine learning ACCEPT-AI. NPJ Digit Med 2023;6:166, 10.1038/s41746-023-00898-5
5. Medium - Privacy first — 6 tools for running models locally. Accessed March 30, 2025. https://medium.com/@ttio2tech_28094/privacy-first-6-tools-for-running-models-locally-61877d2ab4b4
6. Mohsena Ashraf M. A systematic review on the potential of AI and ChatGPT for parental support and child well-being. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj. Accessed May 1, 2025. https://arxiv.org/pdf/2407.09492
7. Policy guidance on AI for children 2.0 | NOVEMBER 2021- UNICEF. Accessed March 30, 2025. https://www.unicef.org/innocenti/media/1341/file/UNICEF-Global-Insight-policy-guidance-AI-children-2.0-2021.pdf
8. Ferrara P, Cammisa I, Zona M, Corsello G, Giardino I, Vural M, et al. Child opportunity Index: a multidimensional Indicator to measure Neighborhood conditions influencing children's health. J Pediatr 2024;264:113649, 10.1016/j.jpeds.2023.113649
9. National Academies of Sciences, Engineering, and Medicine. Child development and early learning. Transforming the Workforce for children Birth through age 8: a Unifying foundation. Washington, DC: The National Academies Press; 2015. https://doi.org/10.17226/19401
10. Xu Y, Thomas T, Li Z, Chan M, Lin G, Moore K. Examining children's perceptions of AI-enabled interactive media characters. Int J Child-Computer Interaction 2024;42:100700. https://doi.org/10.1016/j.ijcci.2024.100700
11. Neugnot M, Muss Laurenty O. The future of child development in the AI era. Cross-disciplinary perspect between AI child development experts. 2024. Accessed May 1, 2025. https://arxiv.org/abs/2405.19275
12. Jones CR, Bergen BK. Large Language models pass the Turing test. arXiv:2503.23674. 2025. https://doi.org/10.48550/arXiv.2503.23674
13. Mondillo G, Colosimo S, Perrotta A, Frattolillo V, Indolfi C, Giudice M, et al. Jailbreaking large language models: navigating the crossroads of innovation, ethics, and health risks. J Med Artif Intelligence 2025;8. Accessed May 1, 2025. https://jmai.amegroups.org/article/view/9336/html
14. Haider Z, Rahman MH, Devabhaktuni V, Moeykens S, Chakraborty P. A framework for mitigating malicious RLHF feedback in LLM training using consensus based reward. Sci Rep 2025;15:9177, 10.1038/s41598-025-92889-7
15. Sharma M, Tong M, Korbak T, Duvenaud D, Askell A, Bowman SR, et al. Towards understanding sycophancy in language models. 2023. Accessed May 1, 2025. https://arxiv.org/abs/2310.13548
16. Health Education England. The Topol review: Preparing the healthcare Workforce to deliver the digital future. 2019. Accessed March 30, 2025. https://topol.hee.nhs.uk/the-topol-review
17. Rungvivatjarus T, Bialostozky M, Chong AZ, Huang JS, Kuelbs CL. Preparing future pediatric care Providers with a clinical informatics elective. Appl Clin Inform 2024;15:437-45, 10.1055/s-0044-1786977
18. Doctors Who Code. Why physicians should build artificial intelligence | Logan Nye | TEDxBoston – YouTube. Accessed March 30, 2025. https://www.youtube.com/watch?v=Et5HC8SR0BA
19. Wang W, Ma Z, Wenting W, Li X, Yuan Y. A survey of LLM-based agents in medicine: how far are we from Baymax?. 2025. Accessed May 1, 2025. https://arxiv.org/abs/2502.11211
20. Xu B. What is meant by AGI? On the definition of artificial general intelligence. 2024. Accessed May 1, 2025. https://arxiv.org/abs/2404.10731, https://doi.org/10.48550/arXiv.2404.10731
21. Uyar T. ASI as the new god: Technocratic theocracy. 2024. Accessed May 1, 2025. https://arxiv.org/abs/2406.08492, https://doi.org/10.48550/arXiv.2406.08492
22. Li Y, Spulber A-B, Duan Y. The governance of physical artificial intelligence. 2023. 2023. Accessed May 1, 2025. https://arxiv.org/abs/2304.02924, https://doi.org/10.48550/arXiv.2304.02924
23. Reali L, Turriziani Colonna A, Barak S. The past and the future of paediatric primary care. Glob Pediatr 2024;9:100218. Accessed May 1, 2025. https://www.sciencedirect.com/science/article/pii/S2667009724000861
24. Buonocore G. Children are our future. Glob Pediatr 2023;3:100038. https://doi.org/10.1016/j.gpeds.2023.100038. Accessed May 1, 2025. https://www.sciencedirect.com/science/article/pii/S2667009723000040
25. Graham AC. Disputers of the Tao: philosophical argument in ancient China. Chicago, La Salle, Peru, IL: Open Court Publishing Company; 1989. Eight Printing 2003.