Significance of AI and ML for Parents of Pediatric Patients: Literature Review

Dhwani Patel¹, Dr. Parth Pandya²

¹Intern, ²MDS

¹Department of Pedodontics and Preventive Dentistry , ²Tobacco Cessation Centre

1,2 Government Dental College and Hospital, Ahmedabad, India - 380016

Abstract: This literature review explores the current state and future prospects of Artificial Intelligence (AI) in pediatric healthcare, particularly in the context of pediatric dentistry. While AI has made significant strides in adult medicine, its application in pediatric care remains under explored. The review highlights the unique challenges and opportunities in utilizing AI to support parents of pediatric patients, addressing issues ranging from diagnosis and treatment to emotional and financial stress. Focused on dental health, the discussion encompasses AI's potential in personalized and timely services, enhancing communication and education, and empowering parents and children to manage their health effectively. The review also emphasizes the integration of Machine Learning (ML) with AI, showcasing its role in predicting oral health status and treatment needs. Ethical considerations and the need for ongoing research to validate AI models in pediatric dentistry are acknowledged. The overarching conclusion underscores the transformative potential of AI in pediatric healthcare, emphasizing the necessity of tailored applications, ethical guidelines, and continued research for optimal integration into pediatric dental practice.

Index Terms: Artificial Intelligence (AI), Machine Learning (ML), Parental Education

I. INTRODUCTION

AI, or artificial intelligence, refers to the ability of machines or software to carry out tasks that typically necessitate human intelligence, like learning, reasoning, and decision-making. Presently, AI has found applications in numerous areas of medicine and dentistry, including diagnosis, treatment, prevention, and research. The term ”AI” was coined by John McCarthy in 1955. However, this technology is mainly developed and used for adult patients, yet one area that has to receive more attention is the use of AI in pediatric healthcare. Pediatric healthcare poses unique challenges and opportunities for AI, as children have different physiological, developmental, and psychological characteristics than adults. Moreover, parents play a crucial role in the health of their children. Parents of pediatric patients face many challenges and difficulties, such as diagnosing problems, finding treatment, providing proper care, coping with emotional and financial stress, and supporting their children's development and well-being. However, AI could offer solutions to some of these problems by providing personalized, timely, and convenient services, enhancing communication and education, and empowering parents and children to manage their health.

This literature review aims to examine the current state and future directions of AI applications for parents of pediatric patients/children and to discuss the benefits, limitations, and ethical implications of using AI in this context. The review is organized as follows:

Section 1 provides a brief overview of AI concepts and methods.
Section 2 reviews the existing and emerging AI applications in medicine and dentistry, with a focus on pediatrics.
Section 3 analyses the challenges and opportunities of AI for parents of pediatric patients/children.
Section 4 concludes with some recommendations and suggestions for future research.

II. REVIEW OF LITERATURE

Section 1, overview of AI concepts and methods:
AI is not a new concept, but it has gained a lot of attention and popularity in recent years due to the rapid advances in technology and data. Even, AI can help a parent and provide knowledge to better understand their children's health, specifically dental health. Currently, there is significant development and use of AI in the dentistry field, but pediatric dentistry might get the most benefits from it. As AI may play a vital role in this field by providing accurate and personalized solutions. AI and Machine Learning (ML) have the capacity to streamline numerous cognitive duties carried out by dental practitioners. These tasks include sensing, analyzing oral language, interpreting X-rays, forecasting oral diseases, and making decisions. AI's significance in pediatric dentistry is highlighted, with potential to transform various
aspects of dental care for children. Applications include restorative dentistry, plaque detection, endodontic and orthodontic procedures, anesthesia, prediction models, diagnosis, treatment planning, and data management. AI could detect oral health issues, aid decision-making, and improve parental understanding. While promising, AI in pediatric dentistry is still in early stages, with ongoing research. It's seen as a valuable tool for enhancing patient and healthcare professional experiences, but human expertise remains essential in healthcare.

ML is a branch of AI that allows computers to learn from data such as pictures and short-form (SF) to improve AI logical thinking. ML is a powerful tool that can analyze images, detect dental problems, generate personalized reports, provide diagnoses and treatment plans, offer prevention strategies, and furnish relevant information and resources for pediatric dental health. There has been much research completed that uses ML to develop toolkits and evaluate answers to help a parent understand and preliminary find health issues in their children. Wang build "an oral health assessment toolkit to Predict Children's Oral Health Status Index (COHSI) Score and Referral for treatment needs (RFTN) of oral health."[1] This toolkit consists of an SF survey that can be completed by the child, their parent, or both. And based on the answer, "ML predicts the probability of a child's oral health status and need for treatment."[1] While ML is a powerful tool, it faces the challenge of requiring a large sample, typically exceeding 5000, to train programs and establish stable algorithms, particularly in obtaining adequate pictures for each problem to train the system. The ML algorithm's accuracy depended on survey question design, oral health literacy of children and parents, survey timing, and algorithm refinement. The article demonstrates how AI and ML techniques aid parents in managing their children's oral health by predicting disease status and providing comprehensive understanding through questionnaire responses and visual data, empowering informed decisions and timely dental care-seeking. Also, ML can reduce the need for costly and invasive dental procedures by detecting and preventing dental problems early.

AI has significantly changed the practice of dentistry, with computer-based diagnosis and radiological applications. AI is already common in adult dental care, is anticipated to greatly benefit pediatric restorations in terms of time and appearance. It could revolutionize pain management, potentially leading to needle-free dentistry for children. Additionally, AI tools like 4D goggles and virtual reality games could enhance education, especially for behavior modification in pediatric patients. Overall, AI can provide parents of pediatric patients with more efficient and less invasive dental experience for their children, from AI-driven orthodontic appliances and restorative procedures to pain-free treatments and educational tools.

Section 2, existing and emerging AI applications in medicine and dentistry:
AI, with its subsets of ML and deep learning, is revolutionizing pediatric dentistry by enhancing diagnostic accuracy, reducing manual errors, and facilitating personalized preventive care plans for children's oral health. Specifically, AI has been found helpful for dental diagnosis/classification, cephalometric landmark identification, early childhood caries patterns, chronological age assessment in children, facial attractiveness in cleft patients, dental plaque detection, and oral health education. AI is reshaping traditional dentistry, particularly in pediatric care, due to its data analysis capabilities. While authors highlight AI’s accuracy and potential in aiding pediatric dentists and parents, they stress the need for further research to validate its effectiveness with larger samples.

AI is changing the way dentists work, making diagnoses more accurate and treatment planning more efficient. It mentions two important types of AI: Convolutional Neural Networks (CNN) and Machine Learning (ML), which are used a lot in dentistry. CNNs are especially good at analyzing dental images like X-rays and 3D scans, while ML helps dentists make better decisions. AI is leading to new technologies like robotic assistance and better record-keeping [4]. In pediatric dentistry, AI can help with delicate procedures, improve diagnoses, and make visits less scary for kids. As AI gets better, its role in dentistry, especially for children, is likely to keep growing.

III. DISCUSSION

Section 3, challenges & opportunities of AI for parents of pediatric patients:
The potential of AI in pediatric healthcare is vast and largely untapped. With its ability to learn, reason, and make decisions, AI can address the unique challenges in pediatric healthcare. These differences necessitate a different approach to healthcare, one that AI is well-equipped to provide.

However, the use of AI in pediatric healthcare is still in its early stages, and there are various challenges and ethical concerns to address. Issues like data privacy, informed consent, and how AI decisions affect children's health and wellbeing need careful consideration. These ethical issues will become more important as AI becomes more involved in healthcare. Overall, more research is needed to understand the advantages and limitations of AI in this field. There are many potential future developments for AI in pediatric healthcare, including creating more advanced AI models for diagnosis and treatment, combining AI with other technologies like telemedicine and wearables, and establishing ethical guidelines for AI use in pediatric dentistry.

AI has the potential to revolutionize pediatric healthcare. Future research should focus on developing AI applications that are specifically designed for pediatric healthcare. They assist dentists by creating personalized treatment plans based on patient data and predict disease progression, allowing for proactive interventions. By analyzing patient information
such as medical history, genetics, and lifestyle factors, AI provides valuable insights into treatment outcomes. AI tools streamline patient appointments and reminders. They automatically send reminders, reducing the likelihood of missed appointments and improving overall patient satisfaction [3]. It is also crucial to involve parents in developing and implementing these applications, as they play a crucial role in their children's health. By doing so, it can be ensured that AI is used to its full potential in pediatric healthcare, ultimately improving the health and well-being of children. Also, future research should focus on developing more sophisticated AI models, integrating AI with other technologies, and establishing ethical guidelines for its use. This will ensure that the benefits of AI in pediatric healthcare are realized while minimizing potential risks.

IV. CONCLUSION

Section 4, recommendations and suggestions for future research:

In conclusion, the potential of Artificial Intelligence (AI) in pediatric healthcare is significant, offering personalized and timely services that can revolutionize the field. Its ability to learn, reason, and make decisions can be leveraged to provide personalized, timely, and convenient services, enhancing communication and education and empowering parents and children to manage health more effectively. While AI presents promising solutions to challenges faced by parents of pediatric patients, ethical considerations, such as data privacy and the impact on children's well-being, must be carefully addressed. Therefore, there is a need for more research to understand the benefits and limitations of these applications fully. Future research should prioritize the development of AI applications tailored explicitly for pediatric healthcare, involving parents in the process. The ongoing integration of AI with other technologies and the establishment of ethical guidelines will contribute to realizing the full benefits of AI in pediatric healthcare, improving the health and well-being of children while minimizing potential risks. With further research and development, AI can be fully harnessed to improve pediatric healthcare and the lives of children and their parents.

References

