



Research Paper

Current Perceptions and Future Implications of Artificial Intelligence in Pediatric Dentistry: An Online Questionnaire Survey

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ABSTRACT

Introduction: What once seemed like science fiction is now becoming reality in dentistry. Artificial intelligence (AI) is a fast-moving technology that enables machines to perform tasks previously exclusive to humans. With AI, the entire process of analysis can be automated to assess the image as a whole to detect dental pathologies more quickly and accurately. It was revealed that adequately trained neural networks can be a boon to diagnostician as correct diagnosis is the key to a successful clinical practice. AI could shape the future of public health and dental health care delivery. The objective is to study the knowledge of Pediatric Dentist and Pediatric Postgraduate students regarding role of AI in Pediatric dentistry. Aim and Objectives: This survey was developed to evaluate the perception of Artificial Intelligence amongst Pediatric Dentists and Postgraduate students in India. Methodology: A set of close ended questions were randomly distributed to 250 Pediatric dentists and Postgraduates in India. The knowledge they had of AI was assessed by google forms, assembled and scrutinized statistically to assess any correlation amongst the variables. Results: Out of 150 assessed questionnaires from 250 invitees, with 31.60% having average AI knowledge. While 28.90% recognized AI's importance in Pediatric Dentistry, many respondents lacked awareness of AI's various applications in the field. Conclusion: Current study highlights inadequate AI awareness in pediatric dentistry. AI awareness in pediatric dentistry should be raised through collaboration, discussions, and research dissemination.

KEYWORDS: Artificial Intelligence; Pediatric Dentistry; Neural Network; Health care delivery

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I. INTRODUCTION

Artificial Intelligence (AI) originated in 1943 but was officially named by John McCarthy in 1956. It aimed to create machines capable of replicating human tasks. AI encompasses machine learning (ML) and deep learning (DL) in modern times. ML develops algorithms using data to detect and apply patterns for decision-making, while DL, a subset of ML, utilizes artificial neural networks to simulate human brain learning, notably with convolutional neural networks (CNNs) prevalent in medicine. CNNs excel in identifying anatomical structures, diagnosing dental issues, and reducing radiation in endodontics. Variants like R-CNN and mask R-CNN serve various applications across diverse fields.(1)

AI is a swiftly progressing technology that has a profound influence on the fields of science and technology. In the realm of dentistry, it plays a pivotal role, especially in areas such as imaging, ongoing health assessment, analysis of drug impacts, and the early identification of risks. AI holds the potential to optimize dental procedures, decrease expenses, and deliver personalized and preventative healthcare. It elevates the standards of dental care by enhancing the accuracy of diagnoses, visualizing treatment processes, simulating potential outcomes, and forecasting oral health concerns. Furthermore, AI models enhance the precision of

diagnoses and are extensively employed in the medical sciences, demonstrating excellence in tasks like disease identification and patient risk evaluation.(1)

AI is set to revolutionize pediatric dentistry with potential applications in behavioral pediatric practices, early orthodontic tooth movement using customized AI-driven appliances, and enhanced restorative dentistry through computer-aided design and manufacturing technology. AI-powered devices offer innovative pain control methods. Additionally, AI enhances teaching and learning processes through 4D goggles, movies, animations, and virtual reality games, serving as effective behavior modification tools for pediatric patients and educational aids for students and patients alike. As datasets expand, machine learning algorithms are expected to become more sophisticated, further advancing AI's impact in this field. (2)

As the domain of AI in dentistry continues to grow, its development is poised to leave an impression not only on young pediatric dentists but also on those presently undergoing pediatric dentistry training. It is increasingly clear that there is a demand for incorporating AI technology education into the curriculum for pediatric dental students. Therefore, it becomes imperative to conduct a survey among postgraduate students and practicing pediatric dentists in order to assess their thoughts and attitudes concerning the potential impact of AI on the field of pediatric dentistry. Hence, this survey study aimed to evaluate the perception of Artificial Intelligence amongst Pediatric Dentists in India.

II. MATERIAL AND METHOD

To assess current perceptions and future implications of Artificial Intelligence in Pediatric Dentistry, a cross-sectional questionnaire survey was conducted through Google Forms (Google LLC, Mountain View, California, United States). After obtaining ethical clearance, a self-structured questionnaire consisting of 22 questions was framed (Appendix). Among these first four questions were about demographic details including age, gender, and qualifications. The remaining 18 questions were about concerning AI related knowledge, potential impact, expectations, advantages and concerns in Pediatric Dentistry. This prospective electronic online survey was conducted between September 2023 and February 2024. Invitations were sent to a sample of 250 Pediatric Dentists and Post-Graduate Residents all over India using open source google form platform. Participants were recruited with a purposive and snowball sampling approach. Participation was voluntary, and no incentives were provided. All the participants were explained the purpose of the study and informed consent was obtained through Google Forms.

III. RESULTS

From the 250 invited participants, 180 questionnaires were answered, 30 of which were excluded as they were incomplete. A total of 150 questionnaires were assessed. As for the professions, 92 participants were Post Graduate Residents, 58 were Pediatric Dental Clinician. (Figure 1)

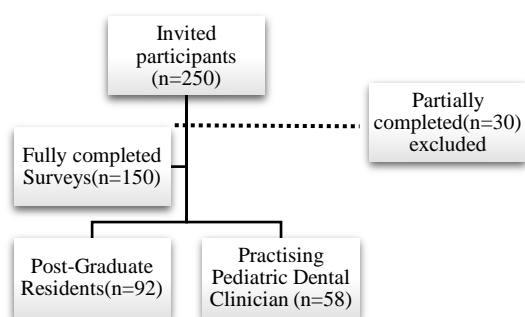


Figure 1. Flow chart describing the compilation of the survey participants.

3.1 Knowledge of Artificial Intelligence among Pediatric Dentists

The majority of respondents, accounting for 55.30%, believed that only machine learning (ML) constitutes artificial intelligence (AI), while 31.60% thought that deep learning (DL) falls under AI. A smaller subset, comprising 13.20%, correctly recognized that both ML and DL are integral components of AI. (Figure 2)

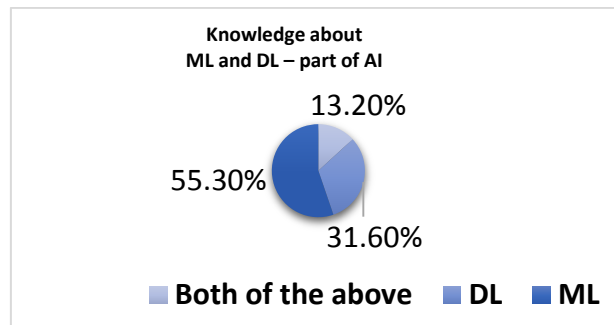


Figure 2. Knowledge about AI

Concerning the significance of AI in Pediatric Dentistry, 28.90% of respondents affirmed its importance, while a substantial majority (68.40%) remained unaware of the connection between AI and Pediatric Dentistry. (Figure 3)

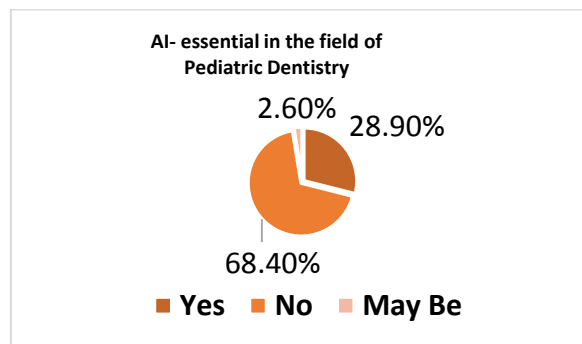


Figure 3. AI in the field of Pediatric Dentistry

3.2 Personal Preferences and Opinions regarding Artificial Intelligence

Queries about personal preferences and opinions on AI were posed to Pediatric Dentists. Approximately half (57.90%) recognized AI's role in enhancing diagnosis, whereas a notable fraction (36.80%) exhibited either a lack of awareness or uncertainty regarding AI's presence in Pediatric Dentistry (Figure 4)

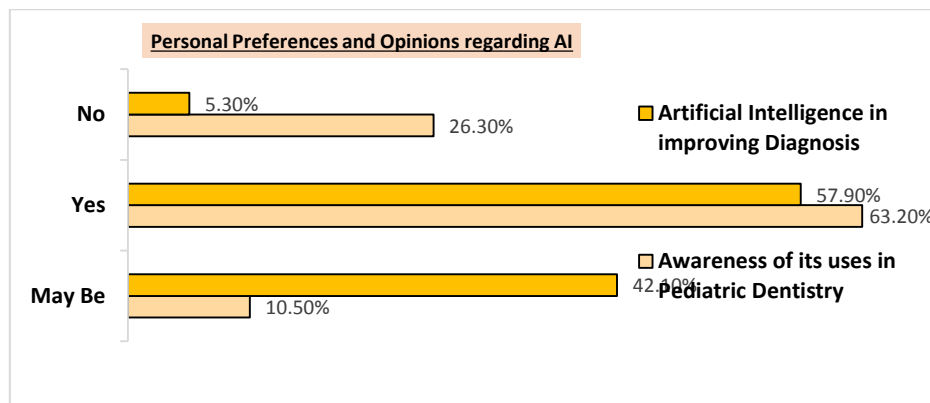


Figure 4. Personal Preferences and opinions regarding AI

3.3 Implications of AI in Pediatric Dental Practice

AI has made significant strides in the realm of Pediatric Dentistry, spanning various areas. However, it's noteworthy that both Post-Graduate Residents and Pediatric Dentists generally lacked awareness regarding AI's applications, such as assessing children's chronological age, detecting submerged primary teeth, employing human robots for pain and anxiety relief, using smartphone apps for caries detection, assisting in the dental care of Deaf children, investigating child abuse cases, and addressing dental issues in autistic children, among other potential applications. (Figure 5)

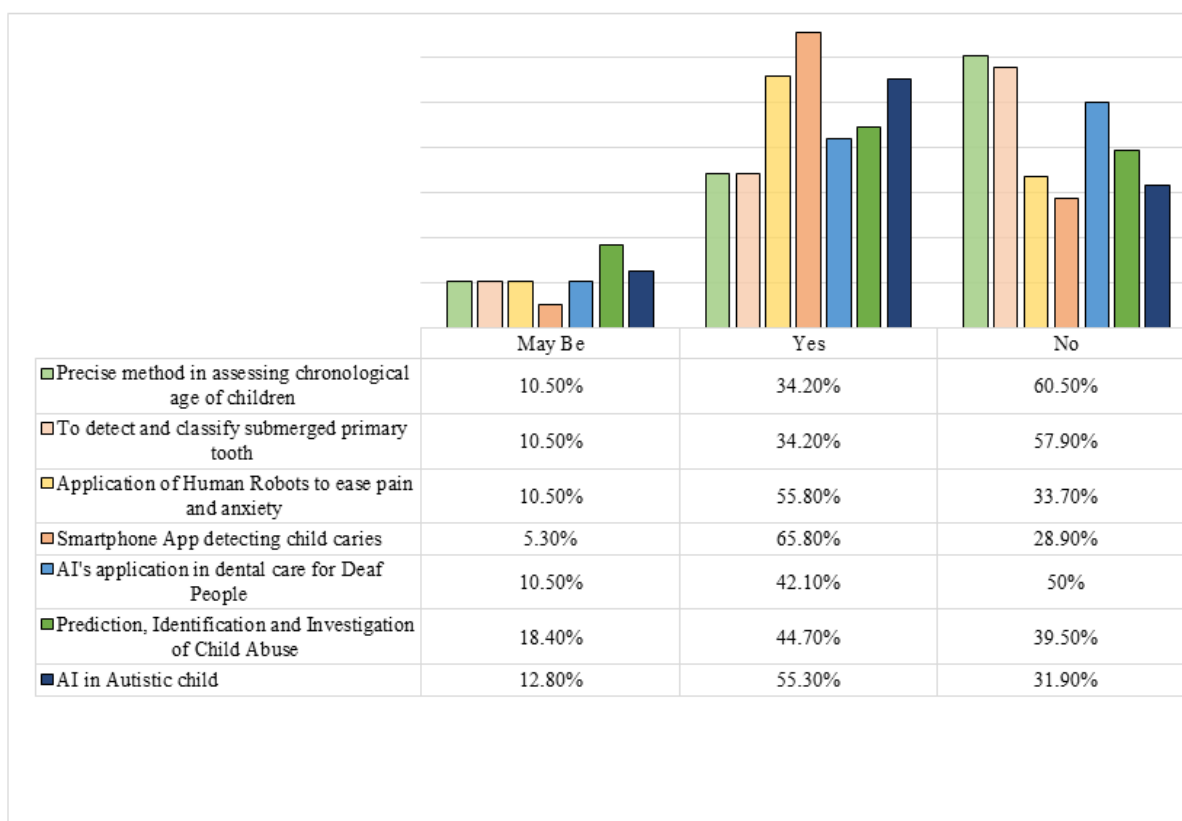


Figure 5. Implications of AI in Pediatric Dental Practice

IV. DISCUSSION

During the global epidemic era, oral health issues have significantly affected a large population of children, emphasizing the importance of early diagnosis, prevention, and treatment. The rapid advancement of artificial intelligence (AI) has led to its integration into traditionally human-specialized areas. This AI-driven progress has revolutionized healthcare by enhancing patient care and enabling precise diagnoses. In pediatric dentistry, there is a growing demand for the ability to deliver treatment while providing effective behaviour counseling, especially in the area of pediatric dental care. Hence this study was conducted to evaluate the perception of Artificial Intelligence amongst Pediatric Dentists in India using 18 closed ended questionnaires.

Our findings shows that 68.4% participants were not aware of the connection between AI and Pediatric Dentistry. On the contrary research carried out by Shiva Thulasi et al. (3) and Swed et al. (4) revealed that over 70% of dental participants had knowledge about artificial intelligence (AI). However, in our current investigation, only 31.60% were aware that Machine Learning and Deep Learning are components of AI. This disparity underscores the importance of comprehending both the capabilities and constraints of AI. It is crucial for pediatric dentists to understand what AI can and cannot accomplish within their profession. To make informed decisions about the integration of AI technologies into their practice, staying updated on the latest advancements and research is essential.

Among the researchers, nearly half (57.90%) acknowledged the role of AI in improving diagnostic processes. In a manner consistent with our findings, Sulthan et al. (5) reported that over 40% of researchers believed that AI could be beneficial in clinical research and related decision-making. The integration of AI into everyday life is exemplified by personal assistants like Siri, Alexa, and Google Assistant, as well as its presence in automated public transportation, aircraft, and video games (6). Several factors that could significantly influence awareness of AI in pediatric dentistry include exposure to pertinent information, professional networks, and ongoing education. Pediatric dentists who actively follow industry news, engage in conferences, and participate in online discussion forums are likely to possess a heightened awareness of AI's potential applications.

In the field of Pediatric Dentistry, artificial intelligence has achieved remarkable progress with applications extending to a range of areas. These include evaluating the chronological age of children (7,8), identifying submerged primary teeth (9),utilizing humanoid robots for pain and anxiety management (10), employing smartphone apps for caries detection (11), aiding in dental care for Deaf children (12), to predict and classify early childhood caries (13), to detect plaque on primary teeth (14), to classify mesiodens in primary or

mixed dentition (15), automated detection and numbering of deciduous teeth in children (16), to segment and detect ectopic eruption of first permanent molars in early mixed dentition (17), permanent tooth germ detection (18), examining cases of child abuse, addressing dental concerns in autistic children, and numerous other potential uses. In our current study, it is worth noting that both Post-Graduate Residents as well as Pediatric Dentists demonstrated a lack of awareness concerning the applications of AI in the field of pediatric dentistry.

It is clear that AI technology is bound to encounter challenges in replacing medical doctors or dentists. These challenges encompass several factors, such as AI's incapacity to engage in high-level discussions with individuals to establish trust, provide reassurance, and express empathy. Furthermore, in the diagnostic process, dentists remain indispensable, particularly in handling ambiguous scenarios that require collecting medical histories, conducting physical examinations, and fostering further discussions (19)

Given the potential impact of AI technology on the future of the healthcare industry, there is a compelling need to incorporate these topics into educational curricula. Our study's outcomes underscore the necessity to integrate AI into dental education and spread awareness by conducting webinars, workshops and other educational programmes. Our findings are consistent with other research, demonstrating that students in the field recognize the significance of AI solutions and exhibit an eagerness to grasp emerging technologies (20,21). Notably, Pauwels et al. documented a decrease in skepticism after delivering lectures on AI (22). Further training in this domain has the potential to reduce negative attitudes toward AI and facilitate its acceptance as a valuable tool in the daily routines of practitioners. To promote AI within dental education, it is essential to engage all stakeholders in the development process and establish a robust legal and ethical framework. Participants emphasized that the fundamental principles of AI should be incorporated into dental curricula and spread awareness, aligning with prior studies in the literature (23)

V. CONCLUSION

The current study reveals that there is a lack of adequate awareness about AI in the field of pediatric dentistry. Consequently, efforts need to be made to enhance awareness about AI through collaboration with pediatric dental associations, research institutions, and technology companies. Promoting discussions and providing educational resources related to AI can be instrumental in this regard. The dissemination of research papers, publications, and presentations on AI in pediatric dentistry can play a significant role in raising awareness among pediatric dental students.

Given the rapid evolution of the AI field and the continuous development of new applications and tools, it is crucial for pediatric dentists interested in integrating AI into their practice to stay informed about the latest advancements in AI technology. To ensure that the future of pediatric dentistry thrives in this era of revolutionary AI, it is imperative to update the curriculum to incorporate AI-related topics and skills.

***“AI won't replace professionals...
But pediatric dentists who use AI will probably replace those who don't”***

REFERENCES

- [1]. Vishwanathaiah S, Fageeh HN, Khanagar SB, Maganur PC. Artificial Intelligence Its Uses and Application in Pediatric Dentistry: A Review. *Biomedicines*. 2023 Mar 5;11(3):788.
- [2]. Baliga Ms. Artificial intelligence - The next frontier in pediatric dentistry. *J Indian Soc Pedod Prev Dent*. 2019;37(4):315.
- [3]. Thulasi MS, Sowjanya B, Sreenivasulu K, Kumar MR. Knowledge Attitude and Practices of Dental Students and Dental Practitioners Towards Artificial Intelligence. *Int J Intell Syst Appl Eng*. 2022 Oct 15;10(1s):248–53.
- [4]. Swed S, Alibrahim H, Elkalagi NKH, Nasif MN, Rais MA, Nashwan AJ, et al. Knowledge, attitude, and practice of artificial intelligence among doctors and medical students in Syria: A cross-sectional online survey. *Front Artif Intell*. 2022 Sep 29;5:1011524.
- [5]. Knowledge and attitude of artificial intelligence (AI) technology among clinical researchers in the Kingdom of Saudi Arabia | *International journal of health sciences* [Internet]. [cited 2023 Oct 15]. Available from: <https://sciencescholar.us/journal/index.php/ijhs/article/view/9513>
- [6]. Mintz Y, Brodie R. Introduction to artificial intelligence in medicine. *Minim Invasive Ther Allied Technol*. 2019 Mar 4;28(2):73–81.
- [7]. Zaborowicz K, Biedziak B, Olszewska A, Zaborowicz M. Tooth and Bone Parameters in the Assessment of the Chronological Age of Children and Adolescents Using Neural Modelling Methods. *Sensors*. 2021 Sep 8;21(18):6008.
- [8]. Zaborowicz M, Zaborowicz K, Biedziak B, Garbowski T. Deep Learning Neural Modelling as a Precise Method in the Assessment of the Chronological Age of Children and Adolescents Using Tooth and Bone Parameters. *Sensors*. 2022 Jan 14;22(2):637.
- [9]. A pilot study of a deep learning approach to submerged primary tooth classification and detection. *Int J Comput Dent*. 2021 Feb 26;24(1):1–9.
- [10]. Kasimoğlu Y, Kocaaydın S, Batu Ş, İnce G, Tuna-İnce EB. The Impact of a Humanoid Robot on Children's Dental Anxiety, Behavior and Salivary Amylase Levels: A Randomized Clinical Trial. *J Pediatr Res*. 2023 Jun 23;10(2):132–41.
- [11]. Xiao J et al. *Assess_A_Smartphone_App_AICaries_that_uses_artific.pdf*. 2021.

- [12]. Campos V, Cartes-Velásquez R, Bancalari C. Development of an app for the dental care of Deaf people: Odontoseñas. *Univers Access Inf Soc*. 2020 Jun;19(2):451–9.
- [13]. Park YH, Kim SH, Choi YY. Prediction Models of Early Childhood Caries Based on Machine Learning Algorithms. *Int J Environ Res Public Health*. 2021 Aug 15;18(16):8613.
- [14]. You W, Hao A, Li S, Wang Y, Xia B. Deep learning-based dental plaque detection on primary teeth: a comparison with clinical assessments. *BMC Oral Health*. 2020 Dec;20(1):141.
- [15]. Ahn Y, Hwang JJ, Jung YH, Jeong T, Shin J. Automated Mesiodens Classification System Using Deep Learning on Panoramic Radiographs of Children. *Diagnostics*. 2021 Aug 15;11(8):1477.
- [16]. Kılıc MC, Bayrakdar IS, Çelik Ö, Bilgir E, Orhan K, Aydın OB, et al. Artificial intelligence system for automatic deciduous tooth detection and numbering in panoramic radiographs. *Dentomaxillofacial Radiol*. 2021 Sep 1;50(6):20200172.
- [17]. Zhu H, Yu H, Zhang F, Cao Z, Wu F, Zhu F. Automatic segmentation and detection of ectopic eruption of first permanent molars on panoramic radiographs based on nnU-Net. *Int J Paediatr Dent*. 2022 Nov;32(6):785–92.
- [18]. Kaya E, Gunec HG, Aydın KC, Urkmez ES, Duranay R, Ates HF. A deep learning approach to permanent tooth germ detection on pediatric panoramic radiographs. *Imaging Sci Dent*. 2022;52(3):275.
- [19]. Krittanawong C. The rise of artificial intelligence and the uncertain future for physicians. *Eur J Intern Med*. 2018 Feb 1;48:e13–4.
- [20]. Yüzbaşıoğlu E. Attitudes and perceptions of dental students towards artificial intelligence. *J Dent Educ*. 2021;85(1):60–8.
- [21]. Wood EA, Ange BL, Miller DD. Are We Ready to Integrate Artificial Intelligence Literacy into Medical School Curriculum: Students and Faculty Survey. *J Med Educ Curric Dev*. 2021 Jan 1;8:23821205211024078.
- [22]. Attitude of Brazilian dentists and dental students regarding the future role of artificial intelligence in oral radiology: a multicenter survey [Internet]. [cited 2023 Oct 15]. Available from: <https://www.birpublications.org/doi/epdf/10.1259/dmfr.20200461>
- [23]. Pinto dos Santos D, Giese D, Brodehl S, Chon SH, Staab W, Kleinert R, et al. Medical students' attitude towards artificial intelligence: a multicentre survey. *Eur Radiol*. 2019 Apr 1;29(4):1640–6.

APPENDIX

QUESTIONNAIRE

Knowledge Of Artificial Intelligence

1. Which of the following is often used to describe machines (or computers) that mimic "cognitive" functions associated with the human mind?

- a. **Artificial Intelligence**
- b. Virtual Intelligence
- c. Robotics

2. What are the components of Artificial Intelligence?

- a. Machine Learning
- b. Deep Learning
- c. **Both of the above**

3. Which of the following is a popular class of Deep Learning Algorithm composed of small communicating neurons in layers for retrieving digital information?

- a. **Artificial Neural Network (ANN)**
- b. Convolutional Neural Network (CNN)
- c. Recurrent Neural Network (RNN)

4. Which of the following processes digital signal such as sound, image and video?

- a. Artificial Neural Network (ANN)
- b. **Convolutional Neural Network (CNN)**
- c. Recurrent Neural Network (RNN)

Personal Preferences and Opinions regarding Artificial Intelligence

5. Would you rather use Digital Data or Physical Data?

- a. Neither
- b. Physical
- c. **Digital**

6. Do you think it is used in Pediatric Dentistry?

- a. Maybe
- b. No
- c. **Yes**

7. Do you think Artificial Intelligence can improve diagnosis?

- a. May be
- b. No
- c. **Yes**

8. Are you inclined to learn Artificial Intelligence to improve Treatment Planning?

- a. May be
- b. No
- c. **Yes**

Implications of Artificial Intelligence In Pediatric Dentistry

9. Artificial Intelligence in the form of Smartphone App can be used to detect child caries. Have you ever implemented it?

- a. May be
- b. No
- c. Yes**

10. Artificial Intelligence has been used in various pediatric dental assessment and diagnosis listed below. Please tick the following modalities as per your understanding.

i. An Automated Machine Learning Algorithm (AutoML) is developed for children's classification according to Early Childhood Caries (ECC). Have you utilized it?

- a. May be
- b. No
- c. Yes**

ii. Convolutional Neural Network (CNN) can be used as precise method in assessing chronological age of children. Do have any experience assessing it?

- a. May be
- b. No
- c. Yes**

iii. Artificial Intelligence can be used to detect and classify submerged primary tooth. Have you practiced the same?

- a. May be
- b. No
- c. Yes**

iv. Artificial Intelligence uses a tool for automatic deciduous tooth detection and numbering. Have you ever used this tool?

- a. May be
- b. No
- c. Yes**

v. Have you implemented Artificial Intelligence in Prediction, Identification and Investigation of Child Abuse?

- a. May be
- b. No
- c. Yes**

vi. Have you employed the Dental Care Application for Deaf Individuals?

- a. May be
- b. No
- c. Yes**

Future Implications of Artificial Intelligence

11. Do you believe Artificial Intelligence should be implemented in more fields of Pediatric Dentistry?

- a. May be
- b. No
- c. Yes**

12. Do you think Artificial Intelligence is the "Next Frontier" in Pediatric Dentistry?

- a. May be
- b. No
- c. Yes**

13. Do you think the need of spreading more awareness about Artificial Intelligence among Pediatric Dentist?

- a. May be
- b. No
- c. Yes**

****Options in bold and underlined are the correct answers of the each question respectively****