Research Article

Exploring the Readiness of Dental Practitioners toward Machine Learning in Oral Diagnostics: A Cross-Sectional Study in Bhopal City

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ABSTRACT:

Background: Machine learning (ML) is transforming dental diagnostics, but its adoption depends on practitioners readiness.

Aim: To assess knowledge, attitude, and practice regarding ML in oral diagnostics among dental practitioners in Bhopal.

Materials and Methods: A cross-sectional study was conducted among 200 dental practitioners using a pre-validated questionnaire. Data were analyzed using SPSS version 30 with descriptive statistics, t-test, and ANOVA ($p < 0.05$).

Results: Awareness of ML was 81%, with 47% showing good knowledge. A positive attitude was observed in 69% of participants; however, only 39% reported using ML tools. Postgraduates and older practitioners had significantly higher KAP scores ($p < 0.05$). Major barriers included lack of training (68%) and knowledge (64%).

Conclusion: Despite good awareness and positive attitude, the use of ML in practice is limited. Training and curriculum integration are essential for effective adoption.

KEY WORDS: Machine Learning, Artificial Intelligence, Dentistry, KAP, Oral Diagnostics

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INTRODUCTION:

Oral diseases continue to be a major global public health concern that has a substantial impact on healthcare systems, quality of life, and general health. Dental caries, periodontal disorders, and oral cancer are still very common despite advancements in preventive and therapeutic dentistry, especially in poor nations like India.[1] Accurate diagnosis and early detection are essential for successful treatment, yet traditional diagnostic methods are frequently reliant on clinician experience and may be inconsistent. In dentistry, clinical examination, radiographic interpretation, and traditional statistical techniques have historically been used to support diagnostic decision-making.[2] Although these methods are helpful, they might not fully capture intricate, non-linear interactions between a variety of interacting elements, including risk markers, clinical findings, patient history, and behavioral patterns.[3] This restriction may affect the precision and consistency of diagnosis, which in turn may influence treatment outcomes. may have an impact on the results of treatment.

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The ability of computer systems to learn from data, recognize patterns, and make predictions or judgments without explicit programming is known as machine learning (ML), a subset of artificial intelligence (AI). Large and complicated datasets are analyzed using ML algorithms to find hidden relationships that conventional techniques can miss. ML has shown great promise in the healthcare industry for enhancing clinical judgment, risk assessment, and diagnostic precision. ML-based techniques are being investigated more in dentistry for applications including caries diagnosis, periodontal assessment, orthodontic analysis, and early detection of oral possibly malignant illnesses, which help clinicians provide more accurate and effective care.[4,5]

There is little data on dental professionals preparedness to use machine learning technology in clinical practice, especially in the Indian context, despite the growing interest in AI-driven diagnostics. To find current gaps and obstacles, it is crucial to comprehend their knowledge, attitude, and practice (KAP). The purpose of this study is to evaluate dental professionals in Bhopal city's knowledge, attitudes, and practices related to machine learning and intelligent oral disease diagnoses. In order to facilitate the establishment of focused training programs and further the integration of artificial intelligence in dentistry, the study aims to assess their preparedness to adopt ML-based technologies in clinical practice and to identify potential hurdles.

MATERIALS & METHODS:

The goal of the current cross-sectional study was to evaluate the knowledge, attitudes, and practices of dental professionals in Bhopal city with reference to machine learning and intelligent oral disease diagnoses. Registered dentists with at least a year of clinical experience who worked in academic institutions, private clinics, or both made up the study group. Convenience sampling was used to choose 200 individuals in total. The sample size was calculated using OpenEpi (version 3.01), assuming a 50% expected proportion, 95% confidence level, and 7% margin of error. The minimum required sample size was 196, which was rounded to 200 to account for possible non-response. Before the study started, the Institutional Ethical Committee granted ethical permission, and each participant gave their informed consent.

A pre-validated, self-administered structured questionnaire created especially for this study was used to gather data. Demographic information, knowledge (8 items), attitude (8 items on a 5-point Likert scale), practice (6 items), and obstacles to the application of machine learning in dental practice made up the five sections of the questionnaire. Expert evaluation was used to demonstrate content validity, while Cronbach's alpha was used to evaluate dependability. To guarantee clarity and viability, a pilot study with 20 participants was carried out, and any necessary adjustments were made prior to the final data collection.

Multiple-choice and dichotomous questions measured on a nominal scale were included in the knowledge section. Correct answers received a score of 1, while incorrect or don't know answers received a score of 0. Attitude was assessed using an 8-item 5-point Likert scale (ordinal scale) ranging from strongly agree to strongly disagree. Practice was evaluated using dichotomous and frequency-based response categories. Scores for all sections were calculated by summing the individual item responses. Based on the total scores obtained, participants were categorized into good, moderate, and poor knowledge levels as well as positive or negative attitude and practice levels.

IBM SPSS Statistics version 30 was used for analysis after the data was entered into Microsoft Excel. Calculations were made for descriptive statistics including frequency, percentage, mean, and standard deviation. Before applying parametric tests, normality of data distribution was assessed using the Shapiro–Wilk test. To ascertain correlations and differences between groups, inferential statistics were utilized. The mean scores of two groups (graduates and postgraduates) were compared using an independent t-test, and the mean scores of many age groups were compared using a one-way ANOVA. Statistical significance was defined as a p-value of less than 0.05.

RESULTS:

Table 1 shows that the majority of participants were younger dental practitioners (<30 years, 39%), followed by those aged 30–40 years (36%). A nearly equal gender distribution was observed. More than half of the participants were graduates (BDS, 56%), while 44% were postgraduates (MDS). Most practitioners had less than 5 years of experience (41%), indicating a relatively young and early-career study population. Regarding practice type, nearly half were engaged in private practice (48%), with the remaining equally distributed between academic and combined practice settings. This distribution suggests a diverse sample with representation across experience levels and practice settings.

Table 2 highlights that although awareness of machine learning was high (81%), in-depth knowledge, such as familiarity with algorithms was

comparatively lower (48%), indicating partial understanding. The attitude of practitioners was overwhelmingly positive, with the majority agreeing that machine learning improves diagnostic accuracy, reduces errors, and should be integrated into dental education and practice.

However, practice levels were relatively low, with only 39% reporting actual use of ML tools, revealing a significant knowledge–practice gap. Among users, radiographic applications were the most

Table 1: Demographic Characteristics of Study Participants (n = 200).

Variable	Category	Frequency (n)	Percentage (%)
Age Group	<30 years	78	39.0
	30–40 years	72	36.0
	>40 years	50	25.0
Gender	Male	104	52.0
	Female	96	48.0
Qualification	Graduate (BDS)	112	56.0
	Postgraduate (MDS)	88	44.0
Experience	<5 years	82	41.0
	5–10 years	64	32.0
	>10 years	54	27.0
Practice Type	Private	96	48.0
	Academic	52	26.0
	Both	52	26.0

Table 2: Distribution of Knowledge, Attitude, Practice and Barriers (KAPB) among Dental Practitioners (n = 200)

Domain	Item	Response Category	Frequency (n)	Percentage (%)
Knowledge	Heard of Machine Learning	Yes	162	81.0
		No	38	19.0
	Correct understanding of ML	Correct	148	74.0
		Incorrect/Don't know	52	26.0
	Awareness of AI diagnostic tools	Yes	136	68.0
		No	64	32.0
	ML used in oral diseases	All correct	154	77.0
		Partial/Incorrect	46	23.0
	AI in radiographic diagnosis	Yes	142	71.0
		No	58	29.0
	Knowledge of ML algorithms	Yes	96	48.0
		No	104	52.0
	ML improves diagnostic accuracy	True	168	84.0
		False/Don't know	32	16.0
	ML in early oral cancer detection	Yes	172	86.0
		No	28	14.0

Table 2 continued.

	ML important in future dentistry	Strongly Agree	96	48.0
		Agree	70	35.0
		Neutral	20	10.0
		Disagree	10	5.0
		Strongly Disagree	4	2.0
	ML improves diagnosis	Strongly Agree	88	44.0
		Agree	76	38.0
		Neutral	18	9.0
		Disagree	12	6.0
		Strongly Disagree	6	3.0
	ML reduces diagnostic errors	Strongly Agree	82	41.0
		Agree	74	37.0
		Neutral	24	12.0
		Disagree	14	7.0
		Strongly Disagree	6	3.0
	AI will replace dentists*	Strongly Agree	22	11.0
		Agree	34	17.0
		Neutral	40	20.0
		Disagree	62	31.0
		Strongly Disagree	42	21.0
	Interest in learning ML	Strongly Agree	102	51.0
		Agree	68	34.0
		Neutral	16	8.0
		Disagree	10	5.0
		Strongly Disagree	4	2.0
Attitude	ML is reliable	Strongly Agree	72	36.0
		Agree	84	42.0
		Neutral	26	13.0
		Disagree	12	6.0
		Strongly Disagree	6	3.0
	Integration of ML is necessary	Strongly Agree	110	55.0
		Agree	62	31.0
		Neutral	14	7.0
		Disagree	8	4.0
		Strongly Disagree	6	3.0
	Include ML in curriculum	Strongly Agree	118	59.0
		Agree	54	27.0
		Neutral	12	6.0
		Disagree	10	5.0
		Strongly Disagree	6	3.0

Table 2 continued.

Practice	Use of ML tools	Yes	78	39.0
		No	122	61.0
	Area of use (n = 78)	Radiographic analysis	34	43.6
		Caries detection	18	23.1
		Oral cancer detection	16	20.5
		Orthodontics	10	12.8
	Frequency of use	Always	18	9.0
		Sometimes	46	23.0
		Rarely	52	26.0
		Never	84	42.0
	Attended ML training	Yes	64	32.0
		No	136	68.0
	Recommend ML tools	Yes	102	51.0
		No	98	49.0
Barriers	Lack of knowledge	Yes	128	64.0
	Cost	Yes	102	51.0
	Lack of training	Yes	136	68.0
	Trust issues	Yes	84	42.0
	Infrastructure limitations	Yes	92	46.0

Table 3: Comparison of Mean KAP Scores Between Graduates and Postgraduates**.**

Domain	Qualification	Mean - SD	*t*-value	*p*-value
Knowledge	BDS	6.25 - 1.82	-3.94	0.001*
	MDS	7.28 - 1.63		
Attitude	BDS	32.6 - 4.7	-2.88	0.004*
	MDS	34.1 - 4.3		
Practice	BDS	3.11 - 1.20	-4.21	0.001*
	MDS	3.92 - 1.08		

*Statistically significant

common. The major barriers identified were lack of training (68%) and lack of knowledge (64%), followed by cost and infrastructure limitations. These findings emphasize that while acceptance of ML is high, implementation is hindered by practical and educational constraints, underscoring the need for targeted training programs and resource support.

Table 3 reveals that postgraduate practitioners (MDS) had significantly higher knowledge, attitude, and practice scores compared to graduates (BDS). The differences were highly significant for knowledge ($p < 0.001$) and practice ($p < 0.001$), and significant for attitude ($p = 0.004$). These findings suggest that advanced education and specialization play a crucial role in enhancing understanding and utilization of machine learning in dental practice, possibly due to greater exposure to recent technological advancements and research.

Table 4 demonstrates a statistically significant

Table 4: Comparison of Mean KAP Scores Among Age Groups.

Domain	Age Group	Mean - SD	*f*-value	*p*-value
Knowledge	<30 yrs	6.12 - 1.84	5.42	0.005*
	30–40 yrs	6.88 - 1.76		
	>40 yrs	7.21 - 1.69		
Attitude	<30 yrs	32.4 - 4.8	3.16	0.045*
	30–40 yrs	33.8 - 4.5		
	>40 yrs	34.2 - 4.2		
Practice	<30 yrs	3.02 - 1.21	6.08	0.003*
	30–40 yrs	3.54 - 1.18		
	>40 yrs	3.88 - 1.10		

***Statistically significant**

Table 5: Correct responses to knowledge-based questions (Supplementary Table).

Knowledge Question	Correct Answer
Have you heard about Machine Learning in dentistry?	Yes
Correct understanding of Machine Learning	Correct
Are you aware of AI-based diagnostic tools in dentistry?	Yes
Is Machine Learning used in oral disease diagnosis?	All correct
Can AI assist in radiographic diagnosis?	Yes
Do you have knowledge about Machine Learning algorithms?	Yes
Does Machine Learning improve diagnostic accuracy?	True
Can Machine Learning help in early oral cancer detection?	Yes

increase in knowledge, attitude, and practice scores with advancing age. Practitioners aged >40 years showed the highest mean scores across all three domains, followed by the 30–40 years group, while the lowest scores were observed among those <30 years. The differences were statistically significant for knowledge (p = 0.005), attitude (p = 0.045), and practice (p = 0.003). This indicates that experience and age are important determinants of better awareness, perception, and adoption of machine learning technologies in oral diagnostics. The correct responses to knowledge-based questions have been provided as supplementary table (Table 5).

DISCUSSION:

The knowledge, attitudes, and practices of dental professionals in Bhopal city about machine learning (ML) and intelligent diagnoses of oral disorders were evaluated in this study. The results showed that while a significant percentage of practitioners showed good understanding and a very positive attitude toward machine learning, there was still little real application of ML in clinical practice. This demonstrates a substantial knowledge-practice gap, which is a typical issue with the adoption of new technologies in the medical field.

Eighty-one percent of participants in this study knew what machine learning was. Compared to the awareness revealed by Kalaimani et al. (63.5%)[6] and Adaki et al. (63.4%)[7], where a somewhat lower percentage of dental practitioners were familiar with artificial intelligence, this finding is greater. Rapid technology improvements, increased internet exposure, and the growing impact of continuing dental education programs in recent years may all contribute to the enhanced awareness seen in this study. But like this research, our results also showed that there was little in-depth knowledge of certain machine learning

algorithms, indicating that superficial awareness does not always equate to in-depth comprehension.

The majority of practitioners in the current study had a generally positive attitude toward machine learning, believing that it should be incorporated into dentistry education and can increase diagnosis accuracy. These results are in line with Kalaimani et al.[6] findings, which showed that over 60% of participants were in favor of integrating AI into dental education. Similar to this, the scoping study conducted by Aldakhil et al.[8] found that attitudes and awareness of AI in dentistry are typically moderate to positive, which supports the increasing adoption of these technologies. Nonetheless, a significant percentage of participants in both the current study and earlier research voiced worries about the potential for AI to replace dentists, underscoring an underlying fear of being dependent on technology.

Only 39% of practitioners in the current survey reported actually using machine learning techniques in practice, despite having positive knowledge and attitudes. This result is consistent with the Mishra et al. [9]study, which found limitations in the use and comprehension of certain AI technologies despite a high level of awareness of AI (96.5%). In a similar vein, Adaki et al.[7] also noted that practitioners awareness varied and their practical application was limited. Lack of training (68%), lack of understanding (64%), and infrastructure constraints are some of the obstacles that could account for the disparity between knowledge and practice found in this study.

These conclusions are further supported by the scoping study by Aldakhil et al.[8], which highlights the disparity between awareness and actual use of AI in dentistry and reports an average awareness level of roughly 50% across studies. This disparity is probably caused by inadequate formal education, a lack of practical training, and restricted access to AI-based tools in standard clinical settings, especially in developing nations.

The fact that postgraduate practitioners showed noticeably greater knowledge, attitude, and practice scores than graduates was another major finding of the current study. Kalaimani et al[6] found no significant difference between dental surgeons and students, however as our analysis only included working clinicians, the variation seen in this study might be the result of different study populations. Higher competency and preparedness may result from postgraduates increased exposure to cutting-edge diagnostic instruments, research projects, and continuing education courses.

Overall, the study's results are consistent with previous research, showing that although dentistry is becoming more aware of and accepting of machine learning, there is still little actual application of the technology. In order to enable the integration of intelligent diagnostic systems into standard dental practice, this emphasizes the necessity of organized training programs, the inclusion of AI and ML modules in dental curriculum, and increased access to technology.

CONCLUSION:

The study highlights that while dental practitioners exhibit a positive inclination toward machine learning in oral diagnostics, practical implementation remains limited due to multiple barriers. Addressing these challenges through education, training, and policy-level interventions is essential for the successful integration of intelligent diagnostic systems in dentistry.

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Conflicts of Interest

There are no conflicts of interest.

REFERENCES:

1. World Health Organization. Oral health [Internet]. Geneva: WHO; 2023 [cited 2024 Apr 24]. Available from: https://www.who.int/news-room/fact-sheets/detail/oral-health
2. Susser M, Susser E. Choosing a future paradigm for epidemiology: I. Eras and paradigms. Am J Public Health. 1996;86(5):668–73. doi:10.2105/ajph.86.5.668.
3. Institute of Medicine (US) Division of Health Care Services. Public policy options for better dental health: report of a study. Washington (DC): National Academies Press (US); 1980. Chapter 3, Epidemiology and prevention of dental diseases. Available from: https://www.ncbi.nlm.nih.gov/books/NBK222667/
4. Sarker IH. Machine learning: algorithms, real-world applications and research directions. SN Comput Sci. 2021;2(3):160. doi:10.1007/s42979-021-00592-x.
5. Ardabili SF, Mosavi A, Ghamisi P, Ferdinand F, Varkonyi-Koczy AR, Reuter U, Rabczuk T, Atkinson PM. Covid-19 outbreak prediction with machine learning. Algorithms. 2020;13(10):249. doi:10.3390/a13100249.
6. Kalaimani G, B S, Chockalingam R, Karthick P.

Evaluation of knowledge, attitude, and practice (KAP) of artificial intelligence among dentists and dental students: a cross-sectional online survey. Cureus. 2023;15:e44656. doi:10.7759/cureus.44656.
7. Adaki S, Karagir A, Adaki R, Vanaki B, Sale S, Bijjal A. Awareness of artificial intelligence among dental practitioners in Sangli, Maharashtra – cross-sectional survey. South East Eur J Public Health. 2024. doi:10.70135/seejph.vi.2859.
8. Aldakhil S, Alkhurayji K, Albarrak S, Almihbash A, Aldalan R, Alshehri K, et al. Awareness and approaches regarding artificial intelligence in dentistry: a scoping review. Cureus. 2024;16:e51825. doi:10.7759/cureus.51825.
9. Mishra P, Singh A, Kar P, Chaturvedi A. Knowledge, attitudes, and perceptions of dental professionals regarding robotics and artificial intelligence in dentistry: a cross-sectional study in Lucknow, India. Cureus. 2025;17:e78882. doi:10.7759/cureus.78882.