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ACCEPTANCE OF AI-ASSISTED DIAGNOSTIC RADIOGRAPHY IN DENTAL PRACTICE: A CROSS-SECTIONAL STUDY AMONG CLINICIANS

Original Research

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ABSTRACT

Background: Artificial intelligence (AI) is increasingly utilized in dental diagnostics, particularly in radiographic interpretation. Despite its demonstrated clinical potential, the successful implementation of AI in dental practice depends heavily on clinician acceptance, understanding, and trust.

Objective: To determine the acceptance, perceived benefits, and barriers to using AI-assisted radiographic interpretation tools among general dental practitioners in Lahore, Pakistan.

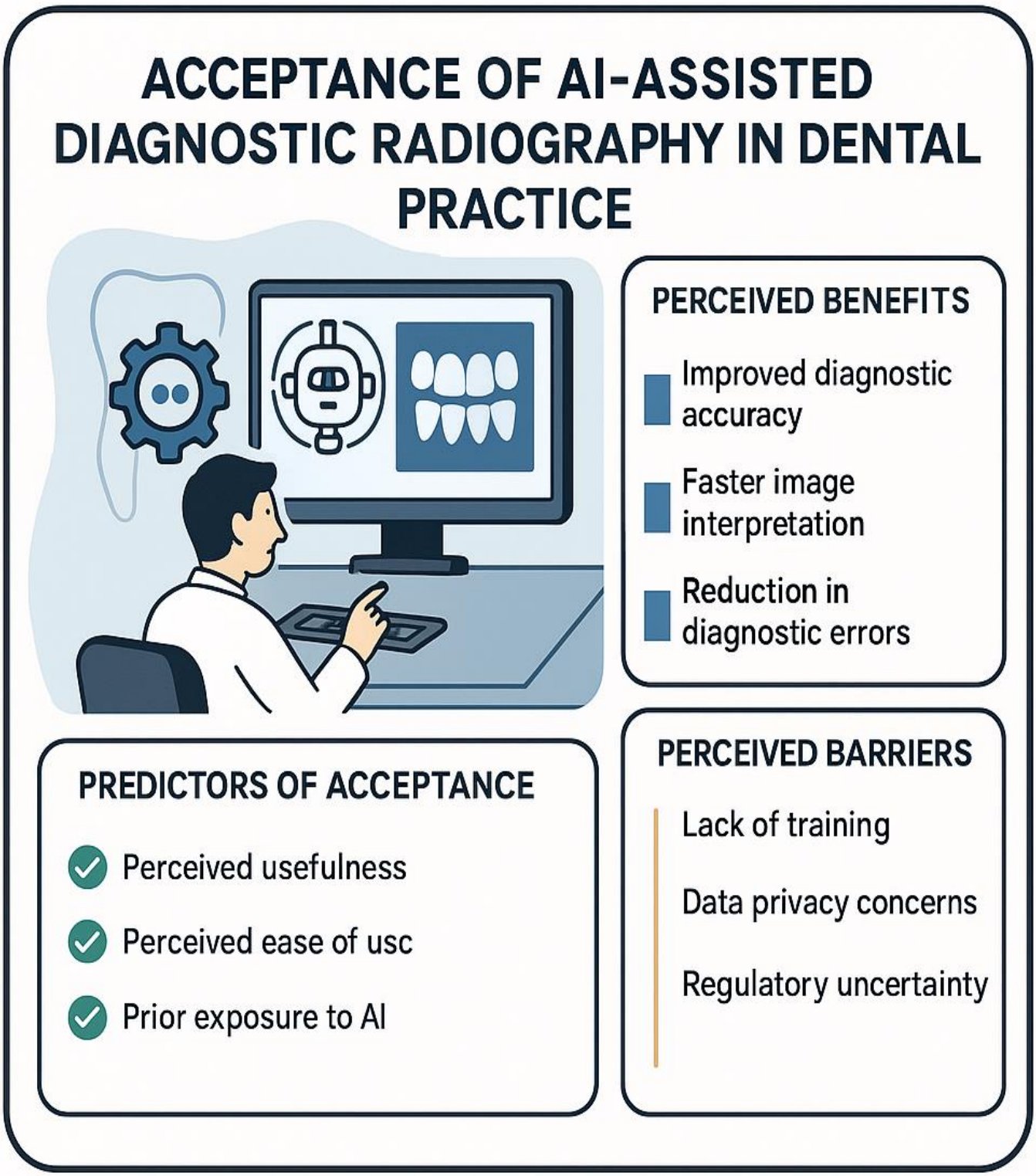
Methods: A cross-sectional survey was conducted over eight months among 412 general dental practitioners working in dental hospitals in Lahore. A structured, validated questionnaire based on the Technology Acceptance Model was used to assess attitudes toward AI tools. Data on perceived usefulness, ease of use, benefits, and barriers were collected. Descriptive statistics, independent t-tests, ANOVA, Pearson's correlation, and multiple linear regression were used for data analysis. Ethical approval was obtained from the relevant Institutional Review Board (IRB).

Results: Among respondents, 79.1% agreed AI tools were useful, 68.2% found them easy to use, and 73.4% intended to adopt them in practice. Key perceived benefits included improved diagnostic accuracy (85.7%), faster image interpretation (80.6%), and reduced diagnostic errors (77.2%). Barriers included lack of training (74.8%), data privacy concerns (71.1%), and regulatory uncertainty (68.5%). Regression analysis revealed perceived usefulness ($\beta = 0.46$), ease of use ($\beta = 0.38$), and prior exposure to AI ($\beta = 0.27$) as significant predictors of acceptance ($p < 0.001$).

Conclusion: The findings highlight a generally positive attitude among dental practitioners toward AI-assisted radiographic tools, alongside the need for structured education and clear regulations to overcome adoption barriers.

Keywords: Artificial Intelligence, Attitude of Health Personnel, Clinical Decision-Making, Dental Radiography, Diagnostic Imaging, General Practitioners, Technology Acceptance Model.

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INTRODUCTION

The integration of artificial intelligence (AI) into clinical dentistry is no longer a distant prospect but an emerging reality that is beginning to reshape the landscape of diagnostic practices. Among the various specialties within dentistry, diagnostic radiography stands out as one of the most promising areas for AI application. Radiographic interpretation, a routine and critical component of dental assessment and treatment planning, often requires sharp diagnostic acumen and experience. However, inter-operator variability, time constraints, and human error can compromise diagnostic precision (1,2). In this context, AI-powered tools offer a compelling solution by promising enhanced accuracy, efficiency, and consistency in radiographic evaluation. Despite the technological advances and demonstrated potential, the success of AI integration in clinical settings hinges on its acceptance by the end-users—general dental practitioners. Over the past decade, AI has made remarkable strides in medical imaging, with deep learning algorithms showing diagnostic capabilities that in some cases rival human experts (3). Studies have reported high sensitivity and specificity of AI systems in detecting dental caries, periodontal bone loss, and other pathologies from radiographic images, suggesting their practical utility as diagnostic adjuncts (4,5). For instance, convolutional neural networks (CNNs) have been employed to identify periapical lesions and approximate root canal lengths with high levels of precision (6). Yet, while the technological feasibility is evident, the human factors—trust, usability, perceived value, and potential disruption—play an equally critical role in determining the clinical adoption of such tools.

Dental professionals, particularly general practitioners, serve as the front line of patient care and are uniquely positioned to benefit from AI-driven diagnostic assistance. However, the readiness to incorporate such technology into routine practice is influenced by multiple factors, including perceived usefulness, ease of use, legal and ethical concerns, and the impact on clinical autonomy (7). Previous research in broader medical fields has highlighted mixed attitudes towards AI, with some clinicians expressing enthusiasm for its potential to reduce cognitive workload, while others remain skeptical, citing concerns over algorithmic opacity and loss of control over clinical decision-making (8). In dentistry, literature on this topic remains sparse and fragmented, with only a handful of studies exploring how dental professionals perceive AI-assisted tools, particularly in the domain of radiography. The rapid evolution of AI technologies has also outpaced the development of regulatory frameworks and educational curricula, creating uncertainty among clinicians about the validity, safety, and implementation protocols of AI applications (9,10). Moreover, generational differences, exposure to digital technologies during dental training, and access to continuing education may further influence acceptance levels among practitioners. Given these variables, it becomes imperative to understand the landscape of clinician perspectives to guide the development, dissemination, and adoption strategies of AI tools in dentistry.

Understanding the acceptance of AI-assisted diagnostic radiography is not merely a matter of technical compatibility but a critical evaluation of the human-technology interface. Acceptance studies rooted in models such as the Technology Acceptance Model (TAM) or Unified Theory of Acceptance and Use of Technology (UTAUT) suggest that perceived benefits and barriers significantly shape user attitudes and behavioral intentions (11). These models underscore the importance of context-specific research, especially in professional settings where the stakes involve both clinical outcomes and patient trust. Despite the growing discourse on AI in healthcare, there is a noticeable gap in literature focusing specifically on general dental practitioners and their attitudes toward AI-assisted radiographic interpretation. This gap poses a challenge to the meaningful integration of AI tools in everyday dental practice and highlights the need for empirically grounded insights into clinician perspectives. To address this void, the present study seeks to explore the acceptance, perceived benefits, and perceived barriers to using AI-assisted diagnostic radiography tools among general dental practitioners. By capturing the views of practicing clinicians, the study aims to inform strategies for effective technology implementation, support the development of user-friendly systems, and ultimately contribute to the responsible and ethical integration of AI in dental diagnostics. Accordingly, the objective of this study is to determine the level of acceptance, identify perceived benefits, and examine barriers related to the use of AI-assisted radiographic interpretation tools among general dental practitioners.

METHODS

This cross-sectional study was conducted over a duration of eight months in selected dental hospitals located in Lahore, with the objective of determining the acceptance, perceived benefits, and barriers associated with the use of AI-assisted radiographic interpretation tools among general dental practitioners. The study was designed to capture a broad and representative view of practicing dental clinicians' perceptions and experiences, with emphasis on the real-world clinical settings in which these technologies are likely to be implemented. The study population comprised general dental practitioners currently employed in dental hospitals within Lahore. A purposive sampling strategy was used to identify participants who were actively involved in radiographic interpretation as part of

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their clinical duties. Inclusion criteria included licensed general dental practitioners with at least one year of clinical experience and regular use of dental radiographs in practice. Dentists currently undergoing postgraduate specialty training, as well as those not involved in diagnostic radiography, were excluded to ensure a homogenous sample focused specifically on the target group of interest.

To determine the appropriate sample size, a sample size estimation was performed using Cochran's formula for cross-sectional studies, assuming a 50% prevalence rate for acceptance of AI tools (given limited prior data), a 95% confidence interval, and a 5% margin of error. This yielded a minimum sample size of 384 participants. Anticipating a 10% non-response rate, the final target sample was adjusted to 422. A total of 430 clinicians were invited to participate in the study, with 412 fully completing the questionnaire and included in the final analysis (2,3). Data collection was performed using a structured, pre-validated self-administered questionnaire developed through a rigorous review of existing literature on technology acceptance in healthcare and dentistry. The questionnaire was designed in English and structured into four sections: demographic information, acceptance of AI-assisted radiographic tools, perceived benefits, and perceived barriers. The acceptance component was based on the constructs of the Technology Acceptance Model (TAM), including perceived usefulness and perceived ease of use, assessed using a five-point Likert scale ranging from "strongly disagree" to "strongly agree." The perceived benefits section assessed attitudes toward diagnostic accuracy, workflow efficiency, and decision-making support, while the perceived barriers section included concerns such as data privacy, legal liability, ethical considerations, and potential loss of clinical autonomy (12). Prior to the full-scale data collection, a pilot study involving 30 practitioners was conducted to test the reliability and internal consistency of the questionnaire. Cronbach's alpha values for each section ranged from 0.78 to 0.85, indicating acceptable to good reliability. The pilot data were not included in the final analysis but informed minor modifications to item wording for clarity and consistency.

Ethical approval for the study was obtained from the Institutional Review Board (IRB). Participation was entirely voluntary, and written informed consent was obtained from all respondents prior to enrollment. Participants were assured of the confidentiality of their responses and the anonymous reporting of findings. The data collected were entered and analyzed using IBM SPSS Statistics version 26. Descriptive statistics were used to summarize demographic variables and response frequencies. The normality of data was assessed using the Shapiro-Wilk test, and all continuous variables were found to be normally distributed. For inferential analysis, independent sample t-tests and one-way ANOVA were employed to compare mean acceptance scores across demographic variables such as age, gender, years of experience, and prior exposure to AI technologies. Pearson's correlation coefficient was used to explore relationships between perceived usefulness, ease of use, and overall acceptance scores. Additionally, multiple linear regression analysis was conducted to identify predictors of acceptance, including demographic and attitudinal variables. Categorical variables related to perceived benefits and barriers were analyzed using chi-square tests to determine significant associations with acceptance levels. A p-value of <0.05 was considered statistically significant throughout the analysis. The methodological approach of this study was designed to provide robust and generalizable insights into the attitudes of general dental practitioners in Lahore regarding AI-assisted radiographic interpretation. The combination of validated measurement tools, appropriate statistical techniques, and ethical rigor ensures the credibility and replicability of the findings.

RESULTS

The final sample comprised 412 general dental practitioners from dental hospitals across Lahore. The majority were male (55.3%), with a mean age of 34.2 years (±6.8), and an average of 8.5 years (±4.2) of clinical experience. Prior exposure to AI-assisted tools was reported by 32% of respondents. Regarding acceptance of AI tools, mean scores for perceived usefulness, ease of use, and behavioral intention to use were 4.1, 3.8, and 4.0, respectively, on a 5-point Likert scale. A substantial proportion of practitioners agreed or strongly agreed with these constructs, with 79.1% recognizing usefulness, 68.2% finding the tools easy to use, and 73.4% expressing an intention to use such tools in practice. Perceived benefits were strongly endorsed. Improved diagnostic accuracy was the most frequently cited benefit (85.7%), followed by faster image interpretation (80.6%) and reduction in diagnostic errors (77.2%). A total of 70.9% believed AI enhanced their clinical decision-making. These figures reflect positive clinical perceptions of AI's potential to augment diagnostic processes.

On the other hand, several barriers were highlighted. A lack of training emerged as the most common concern (74.8%), followed closely by data privacy issues (71.1%) and uncertainty in legal and regulatory domains (68.5%). Over half of the respondents (52.9%) also voiced concerns about potential job displacement due to automation. Statistical analysis revealed significant predictors of AI acceptance. Multiple linear regression showed that perceived usefulness ($\beta = 0.46$, $p < 0.001$), perceived ease of use ($\beta = 0.38$, $p < 0.001$), and prior

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exposure to AI tools (β = 0.27, p < 0.001) were the strongest predictors. Years of experience also contributed modestly (β = 0.12, p = 0.042), indicating a trend where more experienced clinicians showed greater openness to adopting AI, particularly when already familiar with the technology. Together, the findings suggest a generally favorable attitude toward AI-assisted diagnostic radiography among dental practitioners, tempered by legitimate concerns about implementation and support infrastructure. The detailed numerical results are supported by tables and illustrated in two charts below.

Table 1: Demographic Characteristics of Participants (n = 412)

Variable		Category
Gender	Male	228 (55.3%)
	Female	184 (44.7%)
Age (Mean ± SD)		34.2 ± 6.8 years
Years of Experience (Mean ± SD)		8.5 ± 4.2 years
Prior Exposure to AI Tools	Yes	132 (32%)
	No	280 (68%)

Table 2: Acceptance of AI Tools Based on TAM Constructs

Construct	Mean Score (±SD)	Agree or Strongly Agree (%)
Perceived Usefulness	4.1 ± 0.6	79.1%
Perceived Ease of Use	3.8 ± 0.7	68.2%
Behavioral Intention to Use	4.0 ± 0.5	73.4%

Table 3: Perceived Benefits of AI-Assisted Radiographic Tools

Benefit	Agree or Strongly Agree (%)
Improved Diagnostic Accuracy	85.7%
Faster Image Interpretation	80.6%
Reduction in Diagnostic Errors	77.2%
Enhanced Decision-Making	70.9%

Table 4: Perceived Barriers to AI Tool Adoption

Barrier	Agree or Strongly Agree (%)
Lack of Training	74.8%
Data Privacy Concerns	71.1%
Legal/Regulatory Uncertainty	68.5%
Fear of Job Replacement	52.9%

Table 5: Predictors of AI Acceptance (Multiple Linear Regression Analysis)

Predictor	Beta Coefficient	p-value
Perceived Usefulness	0.46	<0.001
Perceived Ease of Use	0.38	<0.001
Years of Experience	0.12	0.042
Prior Exposure to AI	0.27	<0.001

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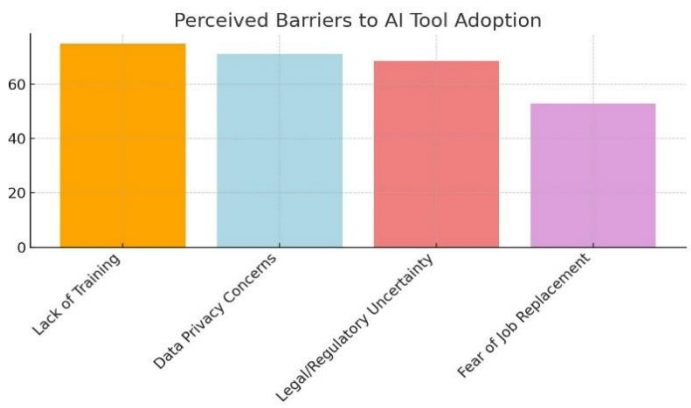


Figure 1 Perceived Barriers to AI Tool Adoption

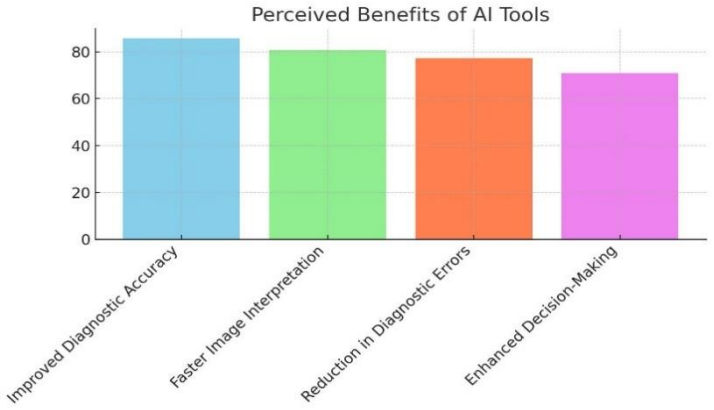


Figure 2 Perceived Benefits to AI Tools

DISCUSSION

The findings from this cross-sectional study offer meaningful insights into the level of acceptance, perceived benefits, and barriers to AI-assisted radiographic interpretation among general dental practitioners. The high mean scores for perceived usefulness and behavioral intention to use such tools indicate an overall favorable disposition toward AI integration in clinical workflows. These findings resonate with previous literature suggesting that when AI tools are perceived as enhancing diagnostic accuracy and efficiency, clinicians show strong inclinations toward adoption (13). Comparable trends have been noted in other healthcare settings where AI is perceived as an augmentative rather than a replacement tool, particularly in radiographic analysis (14). The current study's results reinforce this notion by showing that a majority of practitioners value the ability of AI to improve diagnostic accuracy and decision-making. Similarly, a study found that over 50% of dental professionals and students believe AI contributes positively to clinical diagnostics and efficiency (15). The regression analysis revealing that perceived usefulness and prior exposure to AI are strong predictors of acceptance aligns with the Technology Acceptance Model (TAM), where perceived utility strongly influences adoption behavior. This is consistent with findings of a study which emphasized the importance of perceived benefits and clinician familiarity in facilitating AI integration into diagnostic settings (16,17). Barriers such as lack of training, privacy concerns, and fear of job replacement were reported by a significant portion of participants, echoing broader concerns highlighted in multiple studies. A study noted that, while the theoretical understanding of AI was moderate to high among dental students and clinicians, practical knowledge and hands-on experience were deficient, limiting confident clinical application (18). Further studies illustrated the risk of over-reliance on AI, particularly among less experienced clinicians, underscoring the need for structured training and guidelines (19,20).

Despite these challenges, the positive perception of AI as a supportive tool remains a key strength of this study. By targeting general practitioners in real-world settings, the study provides context-specific data that could guide localized implementation strategies. The relatively large and diverse sample size adds to the strength of the findings, enhancing generalizability within the urban clinical context of Lahore. Nonetheless, certain limitations merit attention. The reliance on self-reported data introduces potential for response bias, and the cross-sectional design restricts causal inferences. Moreover, as the study was limited to a single urban setting, results may not reflect the perspectives of rural practitioners or those in under-resourced clinics where technological readiness may vary significantly. Future longitudinal studies assessing actual usage patterns and patient outcomes following AI integration would provide more comprehensive insights. Further research should also explore the effectiveness of targeted training programs and hands-on modules designed to improve clinician confidence in using AI tools. As emphasized in recent literature, training with AI modules significantly improves diagnostic accuracy among dental students (21). In conclusion, the study reinforces that, general dental practitioners are open to AI integration when they perceive it as clinically beneficial and accessible. Addressing practical concerns through education, ethical guidelines, and regulatory clarity is essential to harness the full potential of AI in improving diagnostic practices in dentistry.

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CONCLUSION

This study concluded that general dental practitioners in Lahore exhibit a positive attitude toward AI-assisted radiographic interpretation, recognizing its potential to enhance diagnostic accuracy and efficiency. However, barriers such as lack of training and legal uncertainties remain significant. The findings emphasize the need for structured educational initiatives and regulatory frameworks to facilitate responsible and effective integration of AI into routine dental diagnostics.

AUTHOR CONTRIBUTION

Author	Contribution
Sadaf Akram*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Naveed Iqbal	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Sohail Ahmed Memon	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Seema Shafiq	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Muhammad Tameem Akhtar	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Fatima Rehman	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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