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Use of Artificial Intelligence among Dental Clinicians and Oral and Maxillofacial Surgeons: A Cross-Sectional Survey

Aisha Faraz, Samia Siraj, Asna Khalid, Madiha Khan, Sobia Khan, Asma Siddiqui

ABSTRACT

Objective: To evaluate the utilization, knowledge, and attitudes of dental clinicians and oral/maxillofacial surgeons regarding AI in clinical practice.

Study Design and Setting: A Cross-Sectional Online Survey.

Methodology: The study was conducted over six months on 303 participants using a non-probability consecutive sampling technique. Participants were recruited via digital platforms. A structured, 21-item questionnaire, adapted from a validated tool, was distributed through online professional networks. Data were analyzed using SPSS v21, employing descriptive statistics and inferential tests (chi-square) to explore associations, with a significance threshold of $p < 0.05$.

Results: A total of 70% of participants were aged 18–25, with the majority still in training or having less than five years of experience. General Dentistry was the most represented specialty (60.1%), and 81.5% practiced in urban areas. AI usage was limited, with 42.6% reporting no use in daily practice; radiographic interpretation was the most common application (25.8%). A significant association was found between specialty and AI usage ($p = 0.023$) and between experience and AI knowledge ($p < 0.001$), while no significant link was observed with age or work area.

Conclusion:

the growing awareness and cautious optimism toward AI among Pakistani dental professionals, particularly among younger and early-career clinicians. While AI use remains limited, there is strong recognition of its potential to enhance diagnostics and efficiency. Differences in AI adoption across specialties and experience levels underscore the need for targeted education and infrastructure development to support broader integration.

Keywords: Algorithms, Computer, Operative, Surgical Procedures, Surgeons.

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INTRODUCTION

The area of dentistry, especially oral and maxillofacial surgery (OMFS), has come a long way in terms of diagnostic, surgical, and therapeutic options over the past few decades.[1] Significant technological advancements have facilitated more accurate diagnosis, improved treatment outcomes, and enhanced patient care. Among the most substantial innovations in recent history is artificial intelligence (AI), which is defined as the field of computer science concerned with simulating human intelligence processes by machines, particularly computer systems.[2] These processes include learning, reasoning, problem-solving, perception, and language understanding. AI, once a futuristic concept, has now emerged as a practical tool in the modern healthcare landscape, playing a pivotal role in clinical decision-making, workflow optimization, and precision medicine.[3]

AI technologies encompass various domains such as machine learning (ML), deep learning, natural language processing (NLP), and computer vision. These tools have demonstrated considerable potential in transforming healthcare by enabling data-driven, efficient, and highly personalized approaches to diagnosis and treatment planning. In dentistry, the

implementation of AI applications is on the rise.[4] AI is now being used for automated radiographic interpretation, early detection of dental caries and periodontal disease, orthodontic treatment planning through digital cephalometric analysis, designing dental prosthetics with CAD/CAM systems, and even monitoring patient compliance and progress via personalized alerts or virtual check-ins.[5] Such applications not only enhance clinical accuracy but also improve workflow efficiency and reduce the time and human effort required for routine tasks.[6]

Likewise, oral and maxillofacial surgeons have begun to incorporate AI-based tools into various stages of clinical and surgical care.[7] Applications include 3D imaging and reconstruction for complex facial bone injuries or congenital anomalies, virtual surgical planning for orthognathic procedures, automated risk stratification of surgical complications, and postoperative outcome prediction.[8] Robotic systems integrated with AI capabilities are also being explored to assist in performing delicate procedures with enhanced precision and control. These innovations have contributed to reduced surgical times, lower complication rates, and improved patient satisfaction, signifying a shift toward more intelligent, data-guided surgical care.

Although the utilization of AI in different medical specialties continues to grow, the acceptance and actualization among dental clinicians and oral surgeons are variable.[9] Some of the factors influencing the implementation of AI include awareness, access to AI-based tools, ease of use, ethics and liability, implementation cost, and experience or comfort level with digital technologies.[10] In addition, there continues to be a knowledge gap regarding the perception of AI, the level of utilization in routine practice, and barriers to utilization.

In addition to logistical and financial barriers, there exists a notable knowledge gap regarding the perception of AI, its practical benefits, and its integration into daily clinical routines. Many clinicians may recognize the theoretical potential of AI but remain uncertain about its applicability to their specific clinical settings. Moreover, the majority of available literature tends to focus on AI's technological development rather than its actual use by healthcare providers. This creates a disconnect between innovation and practical utility. Prior research has shown that while the technological potential of AI in dentistry is vast, real-world implementation remains limited, especially in developing regions or institutions lacking adequate infrastructure

Prior research has shown that while there is much potential for AI in dentistry, implementation in the field is still in its infancy, especially in lower-resource settings.[11] Data on current AI uptake by dental clinicians and specialists is also sparse. A systematic assessment via structured questionnaires may serve as a beneficial tool to assess knowledge, attitudes, practices, and barriers regarding using AI in dental and maxillofacial clinical practice.

The current study aims to assess current trends in the use of AI in practice by dental clinicians and oral and maxillofacial surgeons, assessing their available knowledge and comfort with AI across technologies, while also identifying perceived advantages and disadvantages of using AI in clinical practice. This study will be a first step to raising digital literacy and providing a guide for the development of educational and infrastructural strategies involving AI in dentistry and surgical specialties. The current study aims to assess the commercial utilization, knowledge, and attitudes of dental clinicians and oral/maxillofacial surgeons regarding AI in clinical practice.

METHODOLOGY

This research was a cross-sectional, online survey study to measure the awareness, perception, and usage of artificial intelligence (AI) by dental clinicians and oral and maxillofacial surgeons in Pakistan. The study was conducted at the Department of Medical Education of Karachi Medical and Dental College, Karachi, and carried out over six months, from 1st October 2023 to 30th March 2024. Ethical approval was obtained from the Institutional Ethics Review Committee of Karachi Medical and Dental College, Karachi (Approval No: ERC 048/23; Dated 2nd September 2023).

We administered the online survey through various online platforms, including professional forums, invitation emails, and social media groups that included dentists and oral surgeons practicing throughout the country. The target sample size was between 300 and 350 participants, based on previous international studies. A study by Eschert et al. (2022) was able to analyze 303 valid responses in a similar study, analyzing the awareness of AI among dentists using the frameworks for Implementation.[12]

Due to the exploratory nature of our research, a formal power analysis was not performed. The inclusion criteria stated that participants had to be dental clinicians or oral and maxillofacial surgeons with a valid license for practice, at least 1 year of clinical practice, and voluntarily and willing to take part in our study. Professionals involved solely in academic or non-clinical roles were excluded. We used a non-probability consecutive sampling method to recruit participants using online platforms.

Data was collected through a structured 21-item questionnaire adapted from a validated tool developed by Eschert et al.[12] The questionnaire was hosted on Google Forms and included both closed-ended and Likert-scale items. It was divided into four major sections: demographic details (including age, clinical specialty, and years of experience), frequency and context of AI usage (such as radiographic analysis, aligner planning, and diagnostics), perceptions about the advantages and challenges of AI (covering diagnostic accuracy, efficiency, cost-effectiveness, and data privacy),

and anticipated impacts of AI on clinical roles and the dental workforce. The survey also explored respondents' tolerance for AI-associated errors and their opinions on future training needs.

Upon completion of the data collection phase, responses were compiled and analyzed using SPSS version 21. Descriptive statistics, including means, standard deviations, frequencies, and percentages, were used to summarize the characteristics and response patterns of the study population. Inferential statistical tests, such as the chi-square test and Friedman test, were applied to examine group-wise differences and associations between demographic variables and AI-related perceptions. A p-value of less than 0.05 was considered statistically significant.

Ethical approval for the study was obtained from the relevant institutional review board before data collection. Participant confidentiality and anonymity were ensured throughout the process. Informed consent was embedded within the introductory section of the online form, and only those who provided consent were allowed to proceed with the questionnaire.

RESULTS

The majority of participants belonged to the 18–25 age group, comprising 70.0% of the total, while 24.1% were aged between 26 and 45 years, and only 5.9% were in the 46–60 age group. Most respondents were practicing in the field of General Dentistry, making up 60.1%, followed by Oral and Maxillofacial Surgery at 10.9%, Orthodontics at 8.3%, and Endodontics at 5.9%. Smaller proportions were involved in Periodontology (4.6%) and Pedodontics (4.0%), while 6.3% reported practicing in other areas. Regarding years of practice, 57.1% were still in training, 15.8% had less than 5 years of experience, and 17.5% had been practicing for 5–10 years. A minority reported 20–30 years (8.3%) or more than 30 years (1.3%) of practice. The work environment was predominantly urban, with 81.5% of respondents working in urban areas and only 18.5% practicing in rural settings. (Table 1). A significant portion of participants, 42.6%, reported never using AI in their daily work, while 29.7% used it weekly and 27.7% monthly. In terms of AI application, radiographic interpretation was the most commonly reported use at 25.8%, followed by treatment planning (14.6%), clinical decision support systems (13.9%), and predictive analytics (9.6%). Less common uses included virtual patient simulations (7.3%), automated documentation (6.6%), voice-assisted transcription (5.3%), image enhancement (4.3%), and appointment or inventory management (3.3%). Notably, 42.6% gave no response regarding AI application areas. (Table 2)

When rating their own AI knowledge, 46.5% considered it average, 21.5% rated it above average, and 14.1% claimed excellent knowledge. Meanwhile, 13.5% rated their knowledge below average, and 4.3% as very poor. Regarding AI's impact on the profession, 56.8% believed it would improve the field to a great extent, 33.0% thought it would somewhat improve it, and 9.9% felt the impact would be very little. Nearly half (48.5%) anticipated a decrease in the clinical workforce due to AI, while 37.6% expected an increase, and 12.5% foresaw no impact. (Table 2)

When asked whether the profession is equipped for AI integration, 41.6% responded "no," 37.3% said "yes," and 20.5% were unsure. In terms of acceptable AI error for screening by non-specialists, 36.3% deemed performance equivalent to the average clinician as acceptable, followed by 27.7% accepting equivalence to the worst-performing clinician. Fewer respondents accepted superior performance to the average (13.9%) or the best clinician (6.9%). For diagnosis support by specialists, 32.7% accepted AI error equivalent to the average clinician, 25.4% to the worst, 16.5% superior to the average, and 10.9% superior to the best. Finally, 68.3% of participants were open to adopting a radiograph-AI workflow, while 13.5% opposed it and 18.2% were unsure. (Table 2)

Most participants perceived that AI could significantly enhance access to disease screening, with 83.2% indicating this as a major benefit. Better diagnostics was the next most frequently reported benefit at 68.0%, followed by a reduction in time-consuming, monotonous tasks, noted by 57.4% of respondents. Other perceived advantages included more consistent diagnostics (39.3%), more individualized and evidence-based treatment (38.3%), cost efficiency in healthcare delivery (22.4%), and more targeted referrals (15.2%). (Table 3)

The bar graph illustrates the responses of 301 participants regarding which dental specialties they believe will benefit the most from the implementation of Artificial Intelligence (AI), allowing multiple selections per respondent. The specialty most frequently cited was Orthodontics (75.1%) respondents identifying it as a key beneficiary of AI technologies. This was closely followed by Endodontics, selected by 72.4% of participants, and Oral and Maxillofacial Surgery, noted by 65.4% of participants. These results suggest that participants recognize the potential of AI in enhancing diagnostic accuracy, treatment planning, and surgical precision within these disciplines.

Other specialties that were prominently mentioned include Conservative Dentistry (63.5%), Prosthodontics (62.5%), and Periodontics (49.8%), reflecting a consensus that AI could play a transformative role across most branches of dentistry. Pedodontics was selected by 47.8% of respondents, possibly reflecting growing interest in AI for pediatric care and early diagnosis. A smaller segment, 13.3% of participants selected the "Other" category, suggesting perceived AI benefits in less conventional or emerging subfields, or providing unique use cases that didn't fit standard classifications. (Figure 1)

A majority of respondents expressed a favorable opinion toward the integration of AI in their profession. Specifically, 43.7% strongly agreed and 39.7% agreed that AI would improve their profession, while only 3.0% disagreed and 1.7% strongly disagreed. A neutral stance was taken by 12% of participants. (Figure 2)

Similarly, in terms of AI's potential to reduce iatrogenic errors, 40.4% agreed and 32.3% strongly agreed with the statement. A smaller portion remained neutral at 20.5%, while disagreement was limited to 4.3% and 2.3% who disagreed and strongly disagreed, respectively. (Figure 3)

The inferential analysis revealed that there was a statistically significant association between the participants' specialty and their frequency of AI usage, with a p-value of 0.023, indicating that different specialties vary in how frequently they use AI in clinical practice. Additionally, years of experience showed a highly significant association with AI knowledge, with a p-value of less than 0.001, suggesting that clinical experience influences self-rated AI knowledge. However, no significant relationships were found between age group, years of experience, or work area and the frequency of AI use, nor between age group and AI knowledge, as all corresponding p-values were above the 0.05 threshold. (Table 4)

DISCUSSION

Artificial Intelligence has emerged as a transformative tool in healthcare, with dentistry increasingly exploring its potential applications. From radiographic interpretation to treatment simulation, AI holds promise for revolutionizing dental workflows. Understanding how dental professionals perceive and utilize AI is essential to ensuring its effective integration into clinical practice.

A vast majority of respondents (70.0%) fell between 18 and 25 years of age, suggesting they are either still undergoing training or have less than five years of clinical experience. This finding is consistent with previous studies by Hegde et al. (2025) and Bisdas et al. (2021) which both had a young sample where the younger demographic may be trending upwards in perception surveys related to AI in dentistry.[13, 14] This is likely driven by a developing interest in digital innovation within newer generations of dental professionals. Younger clinicians will typically have more exposure to technology, professional change, and a willingness to incorporate new tools, like AI, into their work. Given their exposure to and familiarity with digital platforms and higher levels of educational exposure to technology, younger professionals probably feel more curious and optimistic about what AI can offer in their clinical practice.

The majority of participants were general practitioners (60.1%), which is consistent with previous survey by Shan et al., 2021 that found general dentists frequently employed diagnostic tools – a setting where AI is justly most commonly implemented.[15] However, limited participation of specialties such as Periodontics and Pedodontics may denote a smaller number of practitioners represented because of their specialties or lesser reliance on AI-inspired tools during general practice. Almost all (81.5%) respondents were urban practitioners; numerous national and international surveys have identified a higher concentration of healthcare practitioners in urban environments. Ortega-Fernández et al. (2020) identified urban attraction to AI solutions as resulting from superior infrastructure and access to technology and continuing education.[16]

Table 1: Demographic Characteristics of Participants (n = 303)

Variable	Category	Frequency (n)	Percentage (%)
Age Group	18-25	212	70.0%
	26-45	73	24.1%
	46-60	18	5.9%
Area of Clinical Practice	Endodontics	18	5.9%
	General Dentistry	182	60.1%
	Oral and Maxillofacial Surgery	33	10.9%
	Orthodontics	25	8.3%
	Pedodontics	12	4.0%
	Periodontology	14	4.6%
	Other	19	6.3%
Years of Practice	In Training	173	57.1%
	< 5 years	48	15.8%
	5-10 years	53	17.5%
	20-30 years	25	8.3%
	>30 years	4	1.3%
Work Environment	Rural	56	18.5%
	Urban	247	81.5%

Table 2: Usage and Perception of AI in Clinical Practice

Question	Frequency (n)	Percentage (%)
Frequency of AI Use in Daily Work		
Weekly	90	29.7%
Monthly	84	27.7%
Never	129	42.6%
Areas of AI Application		
Radiographic interpretation (e.g., caries detection, pathology identification)	78	25.8%
Treatment planning (e.g., implant, orthodontics, prosthetics)	44	14.6%
Clinical decision support systems (e.g., diagnostic aids)	42	13.9%
Predictive analytics (e.g., treatment outcomes, disease progression)	29	9.6%
Virtual patient simulations or education tools	22	7.3%
Automated patient charting or documentation	20	6.6%
Voice-assisted note-taking or transcription	16	5.3%
AI-powered image enhancement or segmentation	13	4.3%
Inventory or appointment management	10	3.3%
Other (short answers not fitting predefined categories)	14	4.6%
No response	129	42.6%
Self-rated AI Knowledge		
Very Poor	13	4.3%
Below Average	41	13.5%
Average	141	46.5%
Above Average	65	21.5%
Excellent	43	14.1%
AI's Impact on the Profession		
Very little	30	9.9%
Somewhat	100	33.0%
To a great extent	172	56.8%
AI's Impact on Clinical Workforce		
No impact	38	12.5%
Decrease	147	48.5%
Increase	114	37.6%
Profession Equipped for AI		
No	126	41.6%
Yes	113	37.3%
Unsure	62	20.5%
Acceptable Error in AI for Screening (by non-specialists)		
Equivalent to the average-performing clinician	110	36.3%
Equivalent to the best-performing clinician	46	15.2%
Equivalent to the worst-performing clinician	84	27.7%
Superior to the average-performing clinician	42	13.9%
Superior to the best-performing clinician	21	6.9%
Acceptable Error in AI for Diagnosis Support (by specialists)		
Equivalent to the average-performing clinician	99	32.7%
Equivalent to the best-performing clinician	44	14.5%
Equivalent to the worst-performing clinician	77	25.4%
Superior to the average-performing clinician	50	16.5%
Superior to the best-performing clinician	33	10.9%
Radiograph-AI Workflow Acceptance		
No	41	13.5%
Yes	207	68.3%
Unsure	55	18.2%

Table 3: Perceived Benefits of AI (Multiple Responses Allowed)

Benefit	Frequency	Percentage (%)
Better access to disease screening	252	83.2%
Better diagnostics	206	68.0%
Less time-consuming, monotonous tasks	174	57.4%
More consistent diagnostics	119	39.3%
More individualized and evidence-based treatment	116	38.3%
More cost-efficient healthcare	68	22.4%
More targeted referrals	46	15.2%

Figure 1: A bar chart showing the Specialties That Will Benefit Most from AI (Multiple Responses Allowed

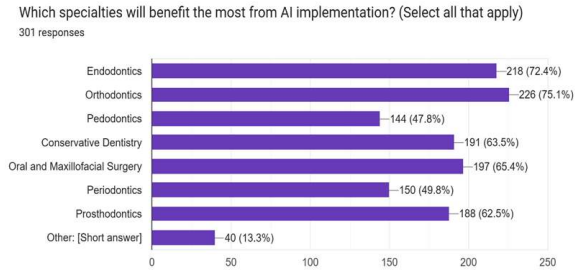

Figure 2: A Pie Chart Showing the Frequency of Participants Agreeing to the Statement That AI Is Improving Their Profession.

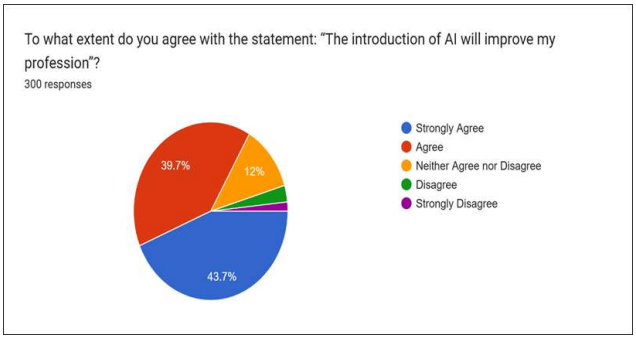

Figure 3: A Pie Chart Showing the Frequency of Participants Agreeing to the Statement That AI is Reducing Iatrogenic Error in Their Profession.

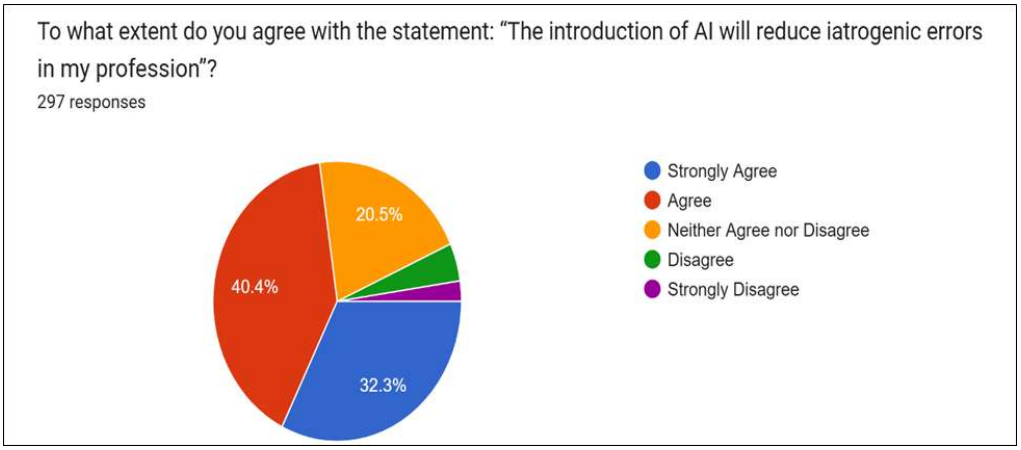

Table 4: Inferential Analysis of Demographic Factors and Perceptions toward AI Use

Variables Compared	Test Statistic (x^2 / x^2r)	df	p-value
Age Group × Frequency of AI Use	6.051[a]	6	0.418
Years of Experience × AI Usage Frequency	14.193[a]	8	0.077
Work Area × AI Usage Frequency	4.911[a]	6	0.555
Specialty × AI Usage Frequency	23.556[a]	12	0.023*
Age Group x Knowledge of AI	9.108[a]	8	0.333
Years of Experience x Knowledge of AI	554.113[a]	432	0.0001*

The survey also showed that 42.6% of respondents have never utilized AI in their clinical practice, which aligns with prior findings by Singh et al. (2023) and Ivaniševiæ et al., (2024) around insufficient exposure and training as a barrier to use.[17, 18] In accordance to our findings, a study by Adam et al., 2021 reported radiographic interpretation the most popular use of AI.[19] By contrast, AI uses in terms of voice-assisted transcription and inventory management showed limited use, potentially due to limited possible use, unknown implications, or lack of integration with practice management systems. Participants held pragmatic expectations of AI, indicating they anticipated performance at least at the level of the average clinician, rather than perfect performance. This represents an educational and/or experience shift from perceptions of AI as a substitute and a better understanding of AI as a useful tool. 68.3% struggled to say they would not use AI that would support radiograph interpretation, which is the same situational use and reflects their increasing comfort with AI. A large majority (83.2%) perceived that AI would expand the reach of disease screening, aligning with that of Kar et al. (2020),[20] and 68.0% affirmed it would be beneficial for diagnosis. Even more interesting is that 57.4% of those who deemed an encouraging use for AI was that it would reduce redundancies in clerical and administrative work. This is again consistent with to use of AI for improvement of workflow efficiency measures, and is aligned with Matulis JC et al. (2021), who noted the advent of AI in creating expedient, patient-centered schedules.[21]

Orthodontics (75.1%), Endodontics (72.4%), and Oral and Maxillofacial (65.4%) were viewed as the most impacted fields by AI, as these areas rely on diagnostic images and digital workflows, making them more likely to adopt it. These attitudes are consistent with the work of Najeeb et al. (2025) regarding AI's use in cephalometric, surgical planning, and design of restorations, conservative dentistry and prosthodontics were viewed positively,[22] while Periodontics, and Pedodontics received the lowest perceived impact, though emerging studies are showing that these areas are exploring AI for predictions of behavior and early disease identification. [23, 24]

This study demonstrated that the specialty intended to be practiced significantly impacted respondents' frequency of perceived use of AI, which supports previous work by Alexander et al. (2020) suggesting that AI will be adopted more readily in imaging-dependent fields. [25] The difference in perceived influence of AI in specialties is consistent with prior research that documented youth and urban practice as correlates to the adoption of AI.[26] However, unlike prior research, there was not a significant relationship in this study between AI usage and age, location, or experience, which could suggest that access to training and access to the technology may be proportional across demographics within the population surveyed.

CONCLUSION

The findings underscore a growing interest and cautious optimism toward AI in dentistry, particularly among early-career professionals. While awareness and openness are relatively high, actual usage remains limited, pointing to the need for structured education, targeted training, and investment in infrastructure. As AI continues to evolve, fostering specialty-specific engagement and addressing concerns about preparedness and workforce impact will be critical to its successful and ethical integration into dental practice.

LIMITATIONS

There are multiple limitations associated with this study. By using a non-probability sampling approach and distributing the survey instrument online, the sample may have been subject to selection bias, as respondents who showed a higher interest in AI may have been more likely to participate. Additionally, the sample was comprised primarily of younger, early-career professionals, which may not adequately represent the perspectives of more senior practitioners. Self-reported data are also subject to recall bias and social desirability bias. Lastly, due to the cross-sectional design, it is not possible to account for trends in responses over time. Overall, future studies should collect more diverse samples and use objective assessments of AI use and competency.

Authors Contribution:
Aisha Faraz: Conception, design, data acquisition, analysis, drafting, and critical revision.
Samia Siraj: Data acquisition, analysis, drafting, and final approval.
Asna Khalid: Data acquisition, critical revision, and final approval.
Madiha Khan: Drafting and final approval.
Sobia Khan: Drafting and final approval.
Asma Siddiqui: Data analysis, interpretation, and final approval.

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