

Awareness and Perception of Dentists Regarding Role and Future of Artificial Intelligence in Dentistry

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ABSTRACT

Background: Every single field preferred artificial intelligence with great passion and thereby the discipline of dental science is no exemption.

Aims: To evaluate the awareness and perception of dentists regarding artificial intelligence among dentists working in Karachi

Methods: The current online cross-sectional survey conducted in Karachi during July 2021. The survey included house officers, post-graduate trainees, and general dental practitioner and specialist consultant dental surgeons of either gender. A questionnaire was adopted from an existing similar study and modifications were made according to our settings. The link of survey was created using Google Docs and disseminated through various open social media groups of dental practitioner in Karachi.

Results: Total 118 complete responses were received with almost equal responses from males (n=56, 47.5%) and females (n=52.5%). The mean age of study participants was 30.3±5.9 years. 83(70.3%) had awareness of the artificial intelligence driven tools in dentistry. 75.9%, 77.1%, 10.8%, 28.9%, 39.8%, 2.4% and 10.8% reported the use of digital intraoral radiographs, CAD-CAM, CBCT, digital dental records, clinical decision support system and none of the tool in their practice respectively. All of the participants had opinion that AI applications should be part of dental trainings.

Conclusion: The present survey showed that the majority had awareness of AI applications in dentistry and had positive perception regarding its future role but there was lacking in the utilization rate of AI tools in their practice. Therefore, it is recommended to attend AI trainings to bring and adapt the AI related changes in local settings.

Keywords: Artificial intelligence, dentistry, online survey, perception, awareness, Karachi

INTRODUCTION

Scope of every field is pushed by new emerging researches which gives the new directions. Powerful artificial intelligence (AI) is a breakthrough in the field of technology which is rapidly progressing and has captivated the minds of researchers across the globe (1). In simpler terms, AI is the acquiring intelligence via machines or computers to carry out jobs which usually require human intelligence (2). In recent times, multiple AI programs have been launched using "big data" gathered via internet (3). A branch of AI is machine learning which is used for analyzing the big data accurately and efficiently, using complex calculations and statistical algorithms (4). The exponential rise has been observed in popularity and use of AI in various sectors such as manufacturing and information-communications industries (3).

The development and applications of AI are presently entering in the medical world as well (5). In general, the healthcare sector is a natural consumer of AI applications. Food drug administration (FDA) is producing regulatory trails for encouraging medical developers, it is also predicted that AI use in healthcare industry will grow by tenfold in the subsequent few years (6). The AI utilization to support medical diagnostics have been continuously exploding since past few years (7). The successful use of AI has been documented in patient triaging (8), clinical decision making (9), quality control (10), image processing (11) and automated reporting (12). The endorsement of AI advancements in day-to-day care has been initiated.

Since AI applications are beneficial for imaging analysis such as images, radiographs, and histological sections, therefore in dental radiology, AI has been used for a variety of objectives. AI programs may aid in the outlining of cephalometric landmarks, in the detection of alveolar bone loss, caries, and periapical pathosis; the auto-segmentation of the inferior alveolar nerve, analyzing facial growth, and other comparable tasks (13). Studies have reported the AI use in the prompt screening of oral cancer and cervical lymph node metastasis, as well as in establishing the diagnosis and planning the management of several orofacial illnesses (13, 14).

Imaging holds an essential role in dentistry as it is the basis of dental journey particularly from screening to management. Multiple imagery particulars for the single anatomical region of the same patient are routinely followed with non-imagery materials such as clinical records and details of medications. Furthermore, data are mostly recorded at various time points. AI provides the best tools to manage and utilize these data efficiently and bring improvement in decision-making.

AI-based applications will restructure patient care, relieving the dental workforce from lengthy routine tasks, improving health at lesser costs for a wider population and ultimately assist prognostic, protective, and participatory dentistry. It is well known fact that developing countries are struggling with heavy disease burden, untrained healthcare workers as well as inadequate healthcare infrastructure. Hence it is of utmost importance to have the at least basic knowledge of AI in the exponential growing AI phase so it can be adopted in near future in our local settings to lower the healthcare burden and improve the patients' outcome. Therefore, we planned to conduct this study with the aim to evaluate the awareness and perception of dentists regarding artificial intelligence among dentists working in Karachi.

MATERIAL AND METHODS

The current online cross-sectional survey conducted in Karachi during July 2021 after taking ethical permission from IRB institutional review board. The survey included house officers, post-graduate trainees, general dental practitioner and specialist consultant dental surgeons of either gender. Respondents who were not giving consent to participate were excluded from the study. The consent was taken online from the participants which was the first component of the survey questionnaire. The total population of dental practitioners in Karachi is around 20,000. The sample size was calculated by using version 3.01 of Open-Epi, online available calculator. According to a study by Yuzbasioglu (1), 48.4% of participants had basic knowledge of AI technologies. Keeping this percentage as reference, confidence level at 95% and 9% precision, a sample size for our study was 118 dental practitioners.

The link of survey was created using Google Docs and disseminated through various social media groups of dental practitioner in Karachi. A questionnaire was adopted from an already existing similar study and modifications were made according to our settings (1). The questionnaire comprised of following components; consent form, demographic information (including age, gender, designation, specialty and type of practicing institute) and AI related knowledge questions. Total AI knowledge related items were 11. The first questions was related to the opinion regarding at which level AI applications should be part of dental trainings which had four options undergraduate, post graduate, both and none. The second question was that if they had awareness regarding usage of AI tools in dentistry before participating this survey, the question had simple two responses 'yes' or 'no'. Participants who had no awareness were instructed not to fill the questionnaire further. Remaining questions including their familiarity with available AI tools, sources of AI information, use of artificial intelligence in their practice. Perception was determined for following questions; AI can replace dentists/physicians in the future, AI can be used as a "prognostic tool" to predict the course of a disease and determine whether there is a chance of recovery, AI use in 3-dimensional implant positioning and planning, as a "quality control tool" to assess the success of treatments, in radiographic diagnosis of pathologies in the jaw and AI will lead to major advances in dentistry and medicine. All the questions had binary responses either yes or no.

The link of the survey was closed when the required sample size was achieved and the data was imported to SPSS version 21 for statistical analysis. Categorical data was summarized as frequency and percentages whereas mean ± standard deviation was calculated to present continuous variables. Appropriate tables and graphical representation was used to present the data.

RESULTS

Total 150 responses were received out of which 118 complete responses yielded a survey completion rate of 78.7%. The mean age of study participants was 30.3±5.9 years. There was almost equal complete responses from males (n=56, 47.5%) and females (n=52.5%). Participants had designation of consultant (n=33, 28%), post-graduates (n=30, 25.4%), general dentist (n=27, 22.9%), house officers (n=23, 19.5%) and students (n=5, 4.2%). Majorities of the participants were working in out-patient department of a tertiary care hospital (n=55, 46.6%), nearly one-third were practicing in both government and private sector (n=43, 36.4%) and some were only working in their private clinics (n=20, 16.9%). Reported specialties of respondents included operative and endodontic (n=58, 49.2%), maxillofacial surgery (n=10, 8.5%), general dentistry (n=10, 8.5%), prosthodontist (n=7, 5.9%), orthodontists (n=6, 5.1%), oral pathology (n=2, 1.7%) and dental biophysics (n=1, 0.8%) whereas 24(20.3%) did not report their specialty.

83(70.3%) had awareness of the artificial intelligence driven tools in dentistry and out of them majority had perception that artificial intelligence can replace dentists/ physicians/ assistant in

the future (n=69, 83.1%), artificial intelligence can be used as a "prognostic" to predict the course of a disease (n=81, 97.6%), can be used as a "quality control tool" to assess the success of treatments (n=80, 96.4%) and can be used in the radiographic diagnosis of pathologies in the jaw (n=80, 96.4%) whereas all of the participants had perception that artificial intelligence can be used in 3-dimensional implant positioning and planning and will lead to major advances in dentistry and medicine.

The frequency of sources of knowledge is depicted in Figure 1. Respondents had awareness that following of the artificial intelligence tools are used in the field of dentistry; digital intraoral radiographs (n=70, 84.3%), electronic apex locator (n=71, 85.5%), CAD-CAM (n=56, 67.5%), CBCT (n=59, 71.1%), digital dental records (n=45, 54.2%) and clinical decision support system (n=9, 10.8%). Figure 2 displays the frequency of AI tools used by survey respondents in their practice. When participants were asked about at what level of education AI should be part of dental training, all of them were agreed that it should be part of training and 34(28.8%), 46(39%) and 38(32.2%) responded that at undergraduate level, post-graduate level and at both levels respectively.

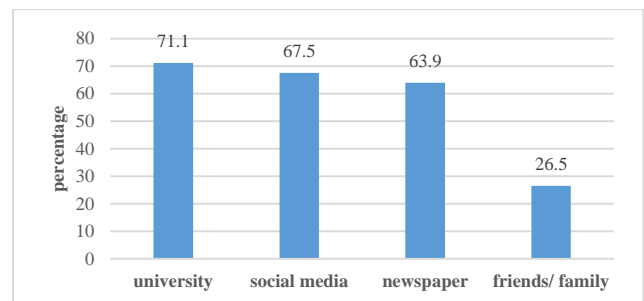


Figure 1: Frequency of sources of knowledge for AI information reported by survey respondents (n=83)

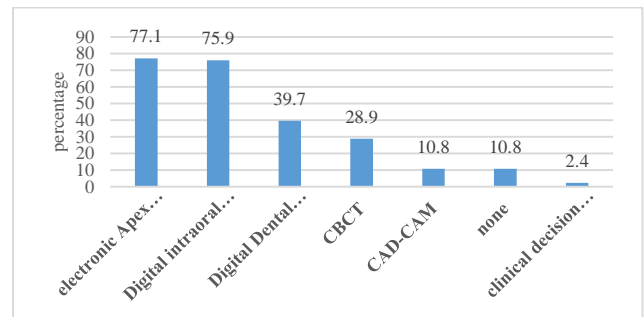


Figure 1: Frequency of use of AI tools in dental practice as reported by survey respondents (n=83)

Table 1: Responses distribution according designation of survey participants (n=83)

Survey items	Designation			
	Consultant/ Specialist n(%)	general dentist n(%)	post-graduates n(%)	House officers/student n(%)
Are you aware about Artificial Intelligence driven tools in Dentistry?	26(78.8)	18(66.7)	22(73.3)	17(60.7)
Which of the following artificial intelligence driven tools in dentistry are you familiar with?				
Digital intraoral radiograph	20(60.6)	16(59.3)	19(63.3)	15(53.6)
Electronic apex locator	20(60.6)	17(63)	20(66.7)	14(50)
CAD-CAM	20(60.6)	10(37)	13(43.3)	13(46.4)
CBCT	19(57.6)	11(40.7)	16(53.3)	13(46.4)
Digital dental records	16(48.5)	11(40.7)	9(30)	9(32.1)
Clinical decision support system	4(12.1)	1(3.7)	2(6.7)	2(7.1)
Friends/family	6(18.2)	9(33.3)	2(6.7)	5(17.9)
Newspaper	19(57.6)	13(48.1)	10(33.3)	11(39.3)
University	16(48.5)	10(37)	18(60)	15(53.6)

Social media	21(63.6)	14(51.9)	10(33.3)	11(39.3)
Do you use Artificial Intelligence driven tools in your practice				
Digital intraoral radiograph	20(60.6)	14(51.9)	18(60)	11(39.3)
Electronic apex locator	18(54.5)	15(55.6)	17(56.7)	14(50)
CAD-CAM	4(12.1)	1(3.7)	2(6.7)	2(7.1)
CBCT	14(42.4)	1(3.7)	6(20)	3(10.7)
Digital dental records	9(27.3)	8(29.6)	11(36.7)	5(17.9)
Clinical decision support system	2(6.1)	0(0)	0(0)	0(0)
None	2(6.1)	3(11.1)	2(6.7)	2(7.1)
Perceptions regarding artificial intelligence				
Artificial intelligence can replace dentists/ physicians/ assistant in the future	21(63.6)	17(63)	18(60)	13(46.4)
Artificial intelligence can be used as a "prognostic tool" to predict the course of a disease	8(24.2)	7(25.9)	5(16.7)	8(28.6)
Artificial intelligence can be used in 3-dimensional implant positioning and planning	18(54.5)	11(40.7)	11(36.7)	7(25)
Artificial intelligence can be used as a "prognostic tool" to predict the course of a disease and determine whether there is a chance of recovery?	25(75.8)	18(66.7)	21(70)	17(60.7)
Artificial intelligence can be used in 3-dimensional implant positioning and planning?	26(78.8)	18(66.7)	22(73.3)	17(60.7)
Artificial intelligence can be used as a "quality control tool" to assess the success of treatments	26(78.8)	16(59.3)	22(73.3)	16(57.1)
Artificial intelligence can be used in the radiographic diagnosis of pathologies in the jaw	26(78.8)	16(59.3)	22(73.3)	16(57.1)
Artificial intelligence will lead to major advances in dentistry and medicine?	26(78.8)	18(66.7)	22(73.3)	17(60.7)

DISCUSSION

AI applications in healthcare sector is progressing day by day at a rapid rate and worldwide gaining popularity in academics and clinical practice. AI provides the platform for increased learning and supports decisions system at larger scale that have the potential to transform the healthcare sector in more efficient way. Up till now AI has been applied in establishing diagnosis, prognosis, optimizing the treatment and predicting outcomes. AI applications are facilitating physicians in terms of providing latest medical knowledge from text books, journals and clinical practices to enhance patient care and outcomes. Real-time inferences and predictions using AI systems has importance in reducing the therapeutic and diagnostic errors that are unavoidable using the manual systems.

Every single field preferred artificial intelligence with great passion and thereby the discipline of dental science is no exemption. Presently, many AI tools are now utilized in several phases of orthodontics from diagnosis to treatment planning and follow-up surveillance. Thus, the present study aimed to evaluate the perception and awareness regarding artificial intelligence among dentists practicing and/or under training in Karachi. To the best of our knowledge, the present study is the first kind of report from Pakistan assessing the AI knowledge among dentists. The present study demonstrated that nearly seven-tenth of the respondents had awareness of AI applications in dentistry (70.3%). The results are completely opposing from the other Pakistani study conducted in Peshawar that reported 61.7% of medical students had no previous knowledge of AI (15). Another survey report from Pakistan reported that most of the surgeons had no familiarity with basic concepts of AI and 51.4% of the participants said that they had no concept of surgical data sciences (16). The awareness rate among dentists is considerably high in our study than medical students and surgeons in Pakistan as evident from previous researchers (15, 16). A similar finding was published from India that reported 68% of dental practitioner had familiarity with the concepts of AI (17).

The most widely used technique among survey respondents was electronic apex locator (77.1%). A study conducted in India also reported that the most commonly used technique was apex locator (18). In this survey, 75.9% reported that they were using digital radiographs in their settings. In contrast to the current survey, 69% participants were using digital radiographs in their clinics as reported in recently published survey from Karachi (19). In this survey more than half were familiar with CAD-CAM use in dentistry (67.5%) but this is quite alarming that only 10.8% were actually using it in their centers. CAD-CAM is reported to be frequently used technique in Indian study (18). In a survey

conducted in Karachi, 62.3% reported that they advised CAD-CAM once their practice (19). 71% of the participants in this survey were aware of the use of CBCT in dentistry practice whereas only nearly quarter (28%) were using it in their practice. In contrast to this, a study from Lithuania reported that 89.1% had knowledge of CBCT use and one-third of them were referring their patients for CBCT (20). It is quite distressing in the era of this advanced technology and a decade of AI nearly half of the survey respondents were aware with the technique of digital dental records (54.2%) and about 40% were using it. A study from India also reported a similar finding in a cross-sectional survey from Delhi that only 46% of dental practitioners reported that they were using digital methods for record keeping (21). Even a studies published from United States and Mississippi reported that electronic dental record adoption rate in their study was 52% and 46% respectively (22, 23).

Mostly dental practitioners (83.1%) in the survey gave the viewpoint that AI has the potential to replace dentists/physicians/assistants in the future. In other Pakistani survey that was conducted on surgeons stated that quarter of them believed that their nature of job will changed due to AI evolution in future and 4.1% said they will be replaced by AI whereas 13.2% said there will be no impact in their working (16). Mupparapu et al elucidated that dental surgeons would definitely have benefit from AI tools and its further related advancements but the intention of AI was never to replace humans (24).

Almost all of the participants (97.6%) had knowledge regarding the use of AI as prognostic tool for prediction of disease course. In this regard, a lower awareness rate of 67.3% than our population was reported from a similar Turkish survey (1). All of the participants were aware that the AI role for in 3-dimensional implant positioning and planning and the major changes that AI will lead in all of the domains of medicine. Nearly all of the participants had perception that AI can be used as quality control tool and in the radiographic diagnosis of pathologies in the jaw (96.4%). A survey from India reported that when participants were asked the most useful purpose of AI in dentistry, respondents said radiograph scans (51%), making diagnosis and treatment decisions (41%) and direct treatment (8%) and further in this survey 94% participants had perception that AI has vital role in reducing medical errors and delivering the high quality data in real time (17).

All of the participants had opinion that AI should be the part of curriculum but only 32.2% said that AI training should be given in both undergraduate and post-graduate level. In other Pakistani study, it was reported that 35.1% surgeons were enthusiastic to apply AI tools in their surgical practice, 56.2% expressed that they want to increase their knowledge further before using it whereas

8.6% straightforwardly refused to use it (16). On the other hand, a Turkish survey reported that 8.9% disagreed that AI should be part of undergraduate training and 16.6% had no idea about this (1). A survey conducted in India reported that 7% of their participants also refused to learn AI related tools (25).

The current survey suffers with some serious limitations such as lower sample size, survey was not conducted across the country, sub-group inferential analysis was not performed due to smaller sample size, and the questionnaire could use a scoring system. Since we aimed to conduct a survey as simpler as possible therefore we did not include further technical questions related to AI. Therefore, a future study is suggested to target a larger group overcoming all of the shortcomings of the present survey.

CONCLUSION

The present survey showed that the majority had awareness of AI applications in dentistry and had positive perception regarding its future role but there was lacking in the utilization rate of AI tools in their practice. Therefore, it is recommended to attend AI trainings to bring and adapt the AI related changes in local settings.

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