

# WHAT IS ARTIFICIAL INTELLIGENCE AND HOW MUCH ARE PRIVATE PRACTITIONERS AWARE OF IT?

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## ABSTRACT

The term “Artificial intelligence” (AI) refers to machines that can perform certain tasks like humans. Machine learning (ML) is an AI subdomain that “learns” intrinsic statistical patterns in large data to make predictions on previously unseen data. The current paper aims to give the reader a basic understanding of AI and its use to improve clinical practice and also to study the knowledge, and awareness of private practitioners about AI. Methodology: It was a cross-sectional survey-based study on full-time dental practitioners not involved in academics. Pre-validated questionnaires were used and collected data by visiting their clinics. Results: Out of 124 participants, the majority were males 104 (83.9 %), and only 20(16.1%) were females. Only 34 (27.4%) agreed they were aware of AI, while 68(54.8%) were not. Results showed 58% of the participants were not using AI in their clinics and only 8.1% were using more than 4 applications of AI in their clinics. The majority (75.8%) got awareness about AI through social media. Conclusion: Private practitioners are not well educated about the use of AI in dentistry.

**Keywords:** Artificial Intelligence, awareness, Machine learning, Dentistry, Deep learning, endodontic, questionnaire, knowledge, private dental practitioners

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## INTRODUCTION

Artificial intelligence (AI) has received a lot of attention in recent years, and it has evolved into one of the main drivers of not only modern life (via Siri, Alexa, using Google, etc.), but also medicine.

Artificial intelligence (AI) is a branch of science and engineering concerned with the computational understanding of what is commonly referred to as intelligence, as well as the creation of objects (machines) that exhibit such behavior (computer programs). Actually AI is a conceptual term denoting a series of basic technologies that enable digital systems or computers to perform functions involving human-like intelligence. It allows humans to combine human intelligence with computer technology to serve better.<sup>2</sup>

Machine learning is an artificial intelligence that enables computer systems to learn directly from examples, data, and experience.

## Background

Alan posed the question “Can a machine think?” in 1950, and proposed a test for machine intelligence - later known as the Turing Test - in which a machine would be considered intelligent if its responses to questions could help convince a human. In 1952, Arthur Samuel created an early learning machine that could learn to play chess by using annotated guides written by human experts and then played itself to learn and distinguish between good and bad moves. (3)

John McCarthy, a computer scientist, invented the term “artificial intelligence” in 1956. (4) . Hinton et al. developed deep learning and convolutional neural networks (CNNs), which were presented at the ImageNet Large-Scale Visual Recognition Challenge in 2012 (3).

The science which makes machines intelligent is artificial intelligence (AI) and Machine learning is a technology that empowers computers to execute specific tasks once it learns from examples. As a result, rather than following pre-programmed rules, these systems can learn from data and execute complicated operations. Significant advances in machine learning capabilities have occurred in recent years due to technological advancements, with increased data availability, and high computing capacity. With these advancements, systems that were unable to achieve precise results previously, now perform certain tasks better than

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humans. Systems for object recognition and voice are now more effective than human beings at some tasks.

In comparison to traditional programming methods, ML can learn from data, to perform different complicated tasks. The fields of computer science, statistics, and data science all merge into machine learning. It utilizes components from each of these disciplines to process data in a manner that can identify patterns and learn from them, forecast behaviour in the future, or make decisions. Instead of strict adherence to pre-programmed rules, ML can execute difficult tasks by learning from data.<sup>1,2</sup>

The advances in machine learning have improved its function and therefore increased its uses. ML system get trained on lots of examples in large available data and both its analytical abilities and processing power improved. There have also been algorithmic advances within the field that have given machine learning more power. As a result of these advancements, systems that performed noticeably at low levels previously can now perform better than humans at many tasks.

Artificial neural network (ANN) is also another form of AI. Unlike traditional machine learning, this approach considers input data and also output data while taking the variable weight which influences the input and output into account.<sup>5</sup> Deep learning (DL) is the most advanced form of machine learning. This method employs a neural network model that learns unsupervised and can predict outcomes with unstructured or unlabelled data.<sup>6-8</sup> An ANN's basic building block is a system of interconnected layers with active neurons, and the term "deep" refers to ANNs with a significant (deep) number of layers and neurons per layer.

Traditionally, programming methods were based on hard-coded rules for solving a problem. Machine learning systems, on the other hand, are given a mission with a huge amount of data to use as examples and learn to accomplish the given mission. In this way, the system learns the best way to produce the best-requested result. Machine learning helps AI applications learn a specific function by giving a particular set of data to learn from.<sup>8,9</sup>

Many people are already familiar with specific machine learning applications that they have encountered in their daily lives. Commercial recommender systems, image processing, and virtual personal assistants systems are commonplace, with limited awareness about the intelligence hidden beneath the surface. Other examples of machine learning in everyday life are, such as Google search, spam detection in emails, image recognition in social media, voice recognition, and responses to it, such as Cortana or Google Assistant in

mobile devices.<sup>5</sup>

AI and related innovations are becoming more common in business and are beginning to be used in the healthcare sector. These new technologies have the potential to transform many aspects of healthcare, including hospital administrative work, billing work, and the pharmacies work.<sup>6,8</sup>

Artificial intelligence is already being used in the medical field, especially in hospitals with limited human resources for online appointments, check-ins, digitization of patient records, to diagnose conditions and calls for patients for follow-up appointment reminders.<sup>8</sup> Recently, AI applications helped to speed up the diagnosis and also the monitoring of COVID-19, thus reducing the burden on healthcare providers.<sup>9</sup>

Artificial intelligence has changed conventional dentistry into digitalization. Its applications range from dental emergencies to the diagnosis of pain, radiographic interpretation, facial growth analysis for orthodontics, to the planning of efficient prosthetics for a particular patient.<sup>5,8</sup> AI has transformed the traditional hydraulic chair into electric and now into automatic chairs which are controlled by sensors.<sup>8</sup> The latest innovation is the dental chair operated by voice command, which eliminates the need for the dentist to exert physical effort. Some uses of AI in dentistry are presented in Table 1.

This paper had 2 aims, first to give the reader a basic understanding of Artificial Intelligence, and its uses to improve clinical practice and second aim was to study the knowledge, and awareness of our private practitioners about AI.

## METHODOLOGY

It was a cross-sectional study to investigate the knowledge of full-time private dental practitioners working in Islamabad and Rawalpindi about artificial intelligence. The present study was conducted only on full-time dental practitioners who are not involved in any academics. The dentists who were part-time practitioners or who were affiliated with teaching institutes were excluded from the study. As earlier estimation of private dental practitioners was unavailable, data collection was on a convenient basis.

The validated questionnaire was distributed physically and planned to collect after a week. As practitioners were very busy therefore multiple reminders were given every week. The data collection took 3 months for this study. Names, addresses, or Email addresses were not collected for the confidentiality of the participants. The questionnaire had 2 parts, the first part was about age, gender, and self-employed or employed. The second part had questions about the source of information for

artificial intelligence, knowledge, and awareness of its usage in dentistry. The aim of the study was explained in the questionnaire.

After data collection, it was recorded in SPSS version 23, and the frequencies of all variables were calculated. Scores for questions were different, few required simple Yes and No answers, while many were with the addition of somewhat to a simple yes and No options. The rest of the few were with different options to select from. To compare the means of the two groups t-test was applied to gender, age, and type of practice (self-employed or employed). The level of significance for the present study was  $\leq 0.05$  (p-value).

## RESULTS

Out of 124 participants, the majority were males 104 (83.9 %) and only 20 (16 %) were females and the difference is statistically significant ( $P < 0.00$ ). None of the participants were below age 35 and half of the participants were more than 56 years old, followed by 45% in the age group of 36-45. The difference in the number of participants in four age groups is statistically significant ( $P < 0.0$ ). More of these participants were self-employed 84 (67.7%) as compared to employee 40 (32.3%) at other clinics and the difference is statistically significant ( $P < 0.00$ ). (Table 2)

Table no 3, shows the responses of the participants about awareness of the use of artificial intelligence in their daily lives, only 34 (27.4%) agreed they are aware of it while 68 (54.8%) were not aware of it. Some participants 22 (17.7%) showed somewhat knowledge of AI usage in their daily lives but were not sure about it. Only 12 (9.7%), 6 (4.8 %), and 6 (4.8%) knew about artificial intelligence, Machine learning, and deep learning respectively. Most of the participants 82 (66%) were not aware of machine learning at all while they knew somewhat about both terms. (AI 54, 43.5%, and DL 54 43.5%).

Results showed 72 (58%) of the participants were not using AI in their clinics and only 10 (8.1%) were using more than 4 applications of AI in their clinics. Awareness about AI among these participants was more through social media 94 (75.8%) and only 10 (8.1%) got its information through colleagues or professional talks. The majority 42 (33.9%) of the participants reported they don't see many opportunities to learn about AI and 14 (11.3%) felt they were under-informed and under-educated about AI. On a question about familiarity with the differences b/w ML & DL, only 58 (46.8%) knew only one term and 14 (11.3%) were not familiar with both terms. Results also showed that only 12 (9.7 %) of participants thought AI will impact their careers within 5-9 years, while 50 (40.3%) thought AI will take 16-20 years to show an impact on their careers. (Table

3).

All of the participants were aware of AI use in different fields of dentistry. Out of the total of 124 participants majority, 86 (69.4%) agreed that they knew the use of artificial intelligence in prosthodontics, followed by 74 (59.7%) of its use in OMFS. Only 16 (12.5%) were aware of AI use in operative dentistry and the majority 108 (87%) were unaware of its use in Operative dentistry. (Table 4)

## DISCUSSION

The results of the present study have shown a general lack of knowledge about artificial intelligence among private dental practitioners. The participants were also unaware of its applications in various fields of dentistry. Normally the dental practitioners affiliated with teaching institutes are considered to be more aware of the latest technologies/discoveries or innovations because they have to read the latest research for academics, therefore only full-time private practitioners who had no affiliation with teaching for the last 2 years were included in the present study. They were asked about self-employment because employed workers can't invest in new gadgets at other's clinics easily while the self-employed can invest if they desire to do so.

Current study found only 9.7% of the participants had knowledge about AI and 17.7 % had somewhat knowledge. The 11.7 % of participants felt under-informed and 33.9 % claimed a lack of opportunities to learn artificial intelligence. These results are similar to a report that 11.3 % of the participants are under-informed and 33.9 % felt no opportunities to learn about it.<sup>10</sup>

The present study showed that private practitioners got more awareness of AI through social media 94 (75.8%) and only 10 (8.1%) got its information through colleagues or professional talks. Similar findings were reported by an investigator where the majority of their participants (40.9%) got more awareness through social media than other sources.<sup>11</sup>

More than half of the private dental practitioners in the current study had no knowledge about machine learning and deep learning, while only 8 (6.5%) knew the difference between these two terminologies. These results are similar to a study by Castagno who reported half of the respondents in his study had no knowledge about machine learning and deep learning and only 13% knew the difference between them.<sup>7</sup> In another study, (37.1%) of respondents knew about AI.<sup>12</sup> A study on Turkish students showed 48.40% had knowledge about artificial intelligence.<sup>11</sup>

The difference between machine learning and deep learning was known by only 6.5%, 46.8% knew one term

TABLE 1: PROCEDURES SUCCESSFULLY DONE WITH AI IN DENTISTRY

Dental field	Procedure where AI used successfully
Operative Dentistry & Endodontics	<ul style="list-style-type: none"> <li>-Caries detection(13)</li> <li>Esthetic restorations with a computer color-matching system</li> <li>- Using a CBR system to simulate the longevity of dental restorations(8)</li> <li>- Prediction of color changes after the bleaching procedure.(5)</li> <li>- Use of an ANN system to locate canals</li> <li>-CAD/ CAM-based systems for Inlays, Onlays.(5)</li> <li>-To detect lesions at the periapical region,(14)</li> <li>-Evaluate the root canal anatomy, - minor Apical foramen location(15)</li> <li>-Predict the viability of stem cells in pulp,</li> <li>-Working Length Measurements,</li> <li>-To predict the success of retreatment procedures.(15)</li> </ul>
Orthodontics	<ul style="list-style-type: none"> <li>-For cephalometric diagnosis (8)</li> <li>-For prediction of extraction needs in orthodontics (8)</li> <li>-Factors influencing the clinical management of impacted maxillary canines.(8)</li> <li>-To predict the morphology of the mandible in skeletal classes I, II, and III.</li> <li>- Determination of growth and development periods.(8)</li> <li>-“virtual models are useful in assessing dental &amp; craniofacial abnormalities”.(8)</li> <li>- Aligners can be printed for individualized treatment using 3D scans.</li> </ul>
OMFS	<ul style="list-style-type: none"> <li>-Diagnosis of cancer in the head &amp; neck(16)</li> <li>- Oral cancer risk assessment.</li> <li>- Prognosis of Oral cancer. (16)</li> <li>- MRI for progression of TMD</li> </ul>
Periodontology	Detection of severe periodontitis(16)(14)
Oral medicine/oral pathology	<ul style="list-style-type: none"> <li>- Prediction of recurrent aphthous ulceration.(8)</li> <li>-“Supervised machine learning-based classification of oral malodor using the microbiota in saliva samples”.(8)</li> </ul>
Prosthodontics	<ul style="list-style-type: none"> <li>-Helps in including facial measurements, aesthetics, anthropological calculations &amp; desire of the patient</li> <li>-Precise fitting of prostheses, crowns, and bridges with AI systems(8)</li> </ul>

TABLE 2: DEMOGRAPHIC INFORMATION OF THE PRIVATE PRACTITIONERS

S. No	Variables	Variables	Subjects (%)	Total (%)	P value
1	Gender	Males	104 (83.9)	124 (100)	.000
		Females	20 (16.1)		
2	Age	25-35	Nil	124 (100)	.000
		36-45	52 (45.2)		
		46-55	6 (4.8)		
		>56	62 (50)		
3	working	Self-employed	84 (67.7)	124 (100)	.000
		Employed	40 (32.3)		

TABLE 3: AWARENESS, KNOWLEDGE, AND PERCEPTION OF THE PRIVATE PRACTITIONERS OF AI

S. No	Question	Variables	Subjects (%)	Total (%)
1	AI applications are widely used in daily life. Are you aware of these?	Yes	34 (27.4)	124 (100)
		NO	68 (54.8)	
		Somewhat	22 (17.7)	
2	Do you know about AI?	Yes	12 (9.7)	124 (100)
		NO	58 (46.8)	
		Somewhat	54 (43.5)	
3	Do you know about ML?	Yes	6 (4.8)	124 (100)
		NO	82 (66)	
		Somewhat	36 (29)	
4	Do you know about DL?	Yes	6 (4.8)	124 (100)
		NO	64 (51.6)	
		Somewhat	54 (43.5)	
5	How many applications of AI have you come across in your work	None	72 (58.1)	124 (100)
		one	20 (19.4)	
		2-4	18 (14.5)	
		>4	10 (8.1)	
6	From where have you heard about AI?	media/social media	94 (75.8)	124 (100)
		professional talks/colleagues	10 (8.1)	
		friends/family	20 (16.1)	
7	Knowledge of AI	I feel under-informed and under-educated	14 (11.3)	124 (100)
		it will be able to significantly help with dental lab	40 (32.3)	
		have not learned much about AI	28 (22.6)	
		Don't see opportunities to learn about it.	42 (33.9)	
8	Are you familiar with the differences b/w ML & DL?	Not at all.	14 (11.3)	124 (100)
		I only know one term	58 (46.8)	
		can't differentiate the two	44 (35.5)	
9	Do you expect AI to have an impact on your career soon?	can differentiate the two	8 (6.5)	124 (100)
		in 5-9 years	12 (9.7)	
		in 10-15 years	32 (25.8)	
		in 16-20 years	50 (40.3)	
		in 21-25 years	30 (24.2)	

TABLE 4: AWARENESS OF THE PRIVATE PRACTITIONERS ABOUT AI USE IN VARIOUS DENTAL FIELDS

S.No	Question	Yes (%)	No (%)	Total (%)
	Have you heard about the use of AI in OMFS?	74 (59.7)	50 (40.3)	124 (100)
	Have you heard about the use of AI in Operative Dentistry?	16 (12.5)	108 (87)	124 (100)
	Have you heard about the use of AI in Orthodontics?	54 (43.5)	60 (56.5)	124 (100)
	Have you heard about the use of AI in periodontics?	18 (14.5)	106 (85.5)	124 (100)
	Have you heard about the use of AI in prosthodontics?	86 (69.4)	38 (30.6)	124 (100)
	Have you heard about the use of AI in Oral Radiology?	86 (22.6)	38 (30.6)	124 (100)
	Have you heard about the use of AI in Endodontics?	28 (69.4)	96 (77.4)	124 (100)
	Have you heard about the use of AI in Oral Medicine?	18 (14.5)	106 (85.5)	124 (100)

and 11% did not know the difference between ML and DL. On the other hand, Castagno reported 87% knew nothing about ML and DL, and 50% knew at least one of these. This shows that participants in the present study were more aware of AI than at the time when Castagno studied the knowledge and awareness among his participants.<sup>7</sup> The difference may be due to the time period Simon studied 3 years back while the present study was newer when AI is the hotter topic on social media and academics, therefore more and more people are aware of it now than before.

In the question of the use of AI applications in clinical work, 58% of the participants were not using AI in their clinics and only 8.1% were using more than 4 applications of AI in their clinics. These results are similar to a study by Castagno where 64% never used AI applications in their clinical work and 5% used only one.<sup>7</sup> Eschert found 28.7% of participants in his study were not using AI applications in their clinical practices and found most dentists frequently used aligner therapy that includes AI-guided treatment planning or intra-oral scanning (12). This shows less knowledge about AI applications in their clinical work and another reason maybe participants were not able to afford the initial huge cost of the equipment. It needs further studies to rule out the reason for not using AI applications in practice. Contrary to these studies Hossain reported (98.5%) used at least one AI application while 1.5% have no experience with any AI application. He also reported only 7.7% of professionals were using three, and 68% were using two AI technologies in their clinical practices.<sup>10</sup>

Private practitioners of the current study felt that AI will not impact their careers soon and only 9.7% thought it may affect careers within 5-9 years while 40% thought it will take 16-20 years to show an impact on their careers. Eschert found the majority (43%) of the participants expected AI to impact their profession within 05 years,<sup>12</sup> while another study on students found students thought AI will not impact their career

therefore they were least afraid of AI.<sup>2,11,12</sup>

All of the participants in the present study were aware of AI use in different fields of dentistry. The majority, 69.4% agreed that they knew the use of artificial intelligence in prosthodontics, followed by 59.7% of its use in OMFS. Only 12.5% were aware of AI use in operative dentistry.

In present study only 54.8% were unaware of AI in dentistry as compared to 55.8% of the participants reported by Khanagar.<sup>11</sup>

## CONCLUSION

Artificial intelligence is dentistry's future. It has the potential to transform oral health care by enhancing diagnosis and decision-making performances. A future for AI in the healthcare system cannot be ruled out given that numerous AI systems for various dental disciplines are being developed and have shown promising preliminary findings. AI systems have the potential to be an extremely useful tool for dental practitioners.

Our private practitioners are not well aware of these applications and they should be trained and educated about AI through workshops or seminars so that they can take advantage of these applications by incorporating them into their clinical practices.

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| <b>1 Saeeda Abdullah:</b> | Conceptualization, literature search, wrote article, editing |
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