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The Study and Design of Intelligent Agent in Dentistry: Where are We Lacking?

Saundarya Priyadarshini
Assistant Professor, Public Health Dentistry, School of Dental Sciences Sharda University, Greater Noida, Uttar Pradesh, India

Swati Sharma
Head of Department, Public Health Dentistry, School of Dental Sciences Sharda University, Greater Noida, Uttar Pradesh, India

Md. Arish
Intern, School of Dental Sciences Sharda University, Greater Noida, Uttar Pradesh, India

Ansuiya Warikoo
Intern, School of Dental Sciences Sharda University, Greater Noida, Uttar Pradesh, India

Rupali Kalsi
Ph.D. Scholar, Periodontology School of Dental Sciences Sharda University, Greater Noida, Uttar Pradesh, India

Rohie J.
MDS Oral and maxillofacial surgeon

Arpita Srivastava
Lecturer, Department of Oral Medicine and Radiology, Government college of dentistry Indore, MP, India

Rahul Shrivastava
MDS specialist Prosthodontist and Implantologist consultant, Queen Dental Centre, Doha Qatar

***Abstract*---**Introduction: Artificial Intelligence is a branch term for all the developing systems, furnished with human intelligence. Even though Artificial Intelligence can be useful in field of dentistry and can be of help in dental office but is not used extensively. A gap exists in the knowledge regarding application of Artificial Intelligence in

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***Corresponding author**: Priyadarshini, S.*
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Dental offices. Therefore, the present study was carried to determine the factors associated with knowledge and perception regarding use of Artificial Intelligence in dentistry among the dental professionals. Methodology: A cross sectional study was carried on 362 dental professionals of North India. A non-probability Snowball sampling was used. A The face validity and content validity was done for forming the questionnaire of the present study. The final questionnaire consisted of 13 variable, structured, close-ended questionnaire in English of which 7 were knowledge-based, 4 were based on attitude and 2 based on practice. SPSS version20 was used for statistical Analysis. Frequency, percentage was calculated. Chi-Square test was applied to determine factors associated with knowledge attitude and practice of Artificial Intelligence. A spearman's correlation and Multiple logistic regression was run to assess the corelation between knowledge and practice of AI by the dentist. Statistical significance was kept at p value<0.05.

***Keywords*---**artificial intelligence, cross-sectional study, dental professionals, dentistry, KAP study, questionnaire.

Introduction

Human cognition has is an intriguing dimension for researchers and developers. To understand and map out this structure, a broader term has been coined. Artificial Intelligence is a branch term for all the developing systems, furnished with human intelligence. Although, digital computerization has taken a roll since the 50s, AI is now found to be of judicious usage in diverse fields of medicine, dentistry etc. In this era where AI is literally at every corner of our lives, application of these computer-generated simulations in the field of dentistry has become a cyberspace.

In Oral Medicine and Radiology, it can be used to arrange appointments, notifying patients' complete medical and dental history, oral hygiene, diet and deleterious habits. [1] It has found its use in Oral Surgery where it aids in surgical resection thus decreasing the requirement for revision procedures. [1] Amongst Orthodontist, it has been useful in analysis photographs by intraoral scanners and cameras thus enhancing the diagnosis and treatment planning. In field of Prosthodontics, AI can be combined with designing software to helps in designing the best possible prosthesis [2]. It has been implemented into Dental Education System, creating a virtual reality that enables simulation of the practical procedures in three dimensions 2.

From clinical diagnosis of a particular lesion to their treatment planning, AI has proven to be a boon in dentistry. Artificial Intelligence has already begun to superimpose itself into human intelligence and its proliferation in dentistry has only proven to be of a much greater asset to mankind. Even though Artificial Intelligence can be useful in field of dentistry and can be of help in dental office but is not used extensively. A gap exists in the knowledge regarding application of Artificial Intelligence in Dental offices. Therefore, the present study was carried to

determine the factors associated with knowledge and perception regarding use of Artificial Intelligence in dentistry among the dental professionals.

Methodolgy

The present prospective, cross sectional, study was done on dental professionals of North India record the prevailing knowledge regarding Artificial Intelligence during 10th December 2021 to 23rdJanuary 2022. Sample size was calculated based on previous literature[6], keeping confidence interval at 95%, margin of error of 5% and proportion to 62% with power of the study at 80%, the total sample size came to 362.

$n= z^2p*q/d^2$
$=(1.96)^2*62*38/(0.05)^2=362$

Where
z=level of confidence at 95% confidence interval
P=estimated proportion for infinite population
d= margin of error
q=1-p

A non-probability Snowball sampling was used. Those who were willing to participate in the study were included whereas people who refused to take part in the study or couldn't comprehend the questions of the study were excluded. A consent was taken from the participating population. The face validity of the present questionnaire was assessed by 10 people not participating in the study. A panel of 5 experts checked for Content validity. The content validity ratio was calculated using the formula given by Lawshe formula was used for calculation of Content validity which came to 0.91.Pilot stusy was done to Pre test and check the feasibility of the present study. Internal consistency of the questionnaire was measured using Cronbach's alpha which was found to be 0.97 The questionnaire was modified on the based on the results of the pilot study. The final questionnaire consisted of 13 variable, structured, close ended questionnaire in English of which 7 were knowledge based, 4 were based on attitude and 2 based on practice. The questionnaire was distributed to people through phone & e-mail. The online questionnaire was made in English. 2 reminders were sent to people on day 7 and day 15 after distributing the questionnaire. The response of the participants were kept anonymous and confidential to encourage honest responses. The questionnaire was so designed that it would not take more than 5 minutes in filling it. The data from the present study was entered & compiled using MS-Office Excel. SPSS version20 was used for statistical Analysis. Frequency, percentage was calculated. Chi Square test was applied. Multiple logistic regression was used to asess an association of knowledge and perception to age, gender, qualification and years of practice. Statistical significance was kept at p value<0.05.

Results

The present cross-sectional study was carried on 362 dental professionals. The qualitative data was tested to generate a hypothesis. Non parametric chi square

and Spearman's Correlation was used to analyse the association of response with age and year of practice and to analyse the relation between knowledge and practice. The study population comprised of 220 BDS pursuing students, 110 bds pass out students, 16 MDS pass out professionals.(table 2, graph 2) Out of 362 dental professionals 110 participants were males and 252 were females.(table 1, graph 1) 181 dental professionals had a practice of less than 1 year. The age range of the participating population was 20-34 years.

A large number of the participating population has an experience up to 5 years of practice and fell into general practice which is tabulated in table 3,figure 3. The response from table 4 reveals that 80.4% of the study population were aware about Artificial Intelligence whereas only 19.6% were unaware about the same. Majority of the participating population i.e. 63% (228) were aware that Artificial Intelligence can be used in diagnosis, 30.5% (110) were unaware about it while 6.5% (24) didn't know about it. 71% (259) knew about the role of Artificial Intelligence in Imaging. The knowledge regarding use of Artificial Knowledge in Oral Hygiene and practice was observed to be 54.3%. 52.2% of the participants were aware about the use of robotics in Oral Surgery. 73.9% (268) of the participating dental professionals believed that involving Artificial Intelligence can increase the clinical practice in dental office. 89.1% of the participating dental professionals were open and positive to learning about the use of Artificial Intelligence in Dentistry.

A non-parametric Chi square test was applied on the qualitative data set based on qualification with response and year of practice with response. An association was seen between years of practice and practice of Artificial Intelligence on daily basis. A Spearman's correlation was applied on qualitative data to establish a relation between response of knowledge and perception. A positive correlation was observed between the awareness about Artificial Intelligence and an increase clinical practice which was statistically significant. A positive significant correlation was found between the comfort of using Artificial Intelligence in daily practice and using Artificial Intelligence in the past. A positive correlation was observed between the comfort of using Artificial Intelligence in daily practice and past use of Artificial Intelligence.

A statistically positive correlation was observed between awareness about Artificial Intelligence and comfort of using Artificial Intelligence in daily practice indicating a linear relationship. In logistic regression In logistic regression a significant association was found with qualification and year of practice at a confidence interval of95%. (OR=0.8, CI=1.6-8.7), (OR= 0.63; CI=0.6=0.31) no association was found between age and gender with knowledge. In respect to perception as association was seen with education and gender at the confidence interval of 95% (OR=0.42, CI=0.6-0.3) ; (OR=0.43, CI=1.2-0.82) whereas no association was seen with age and year of practice. The data for the given factors is shown in table 6

Table 1
Demographic representation based on gender of the participants

Gender	Frequency	Percentage

Male	110	30.4%
Female	252	69.6%

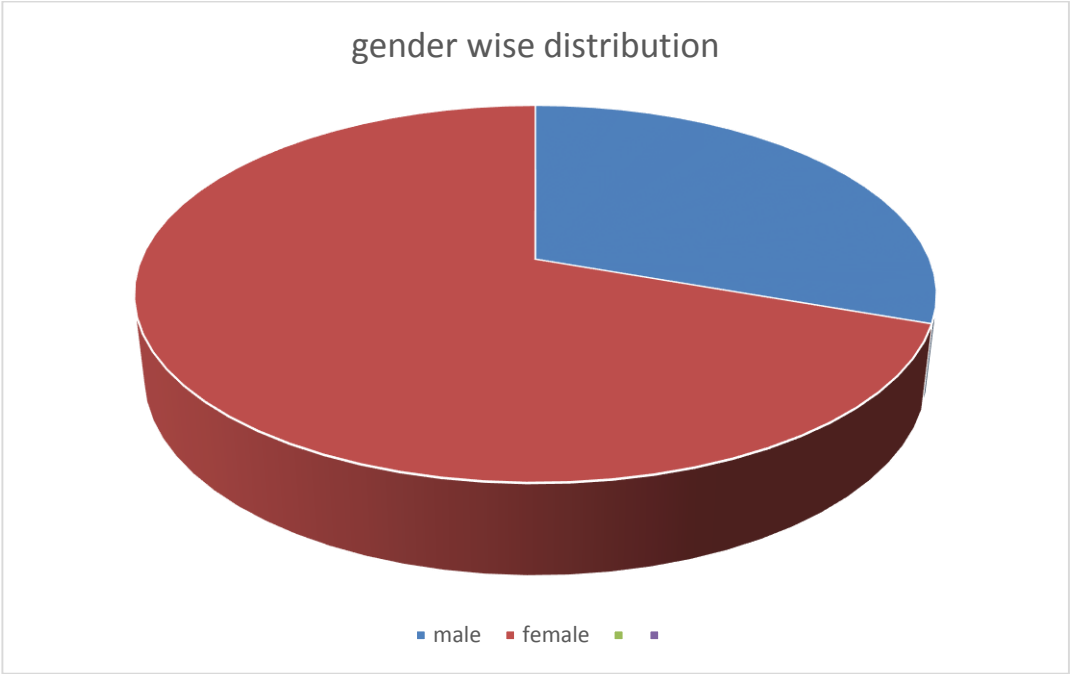

Figure1. Demographic representation based on gender of the participants

Table 2
Demographic data representing the qualification

Qualification	Frequency	Percentage
BDS Pursuing	220	60.9%
BDS	110	30.4%
MDS pursuing	16	4.3%
MDS	16	4.3%

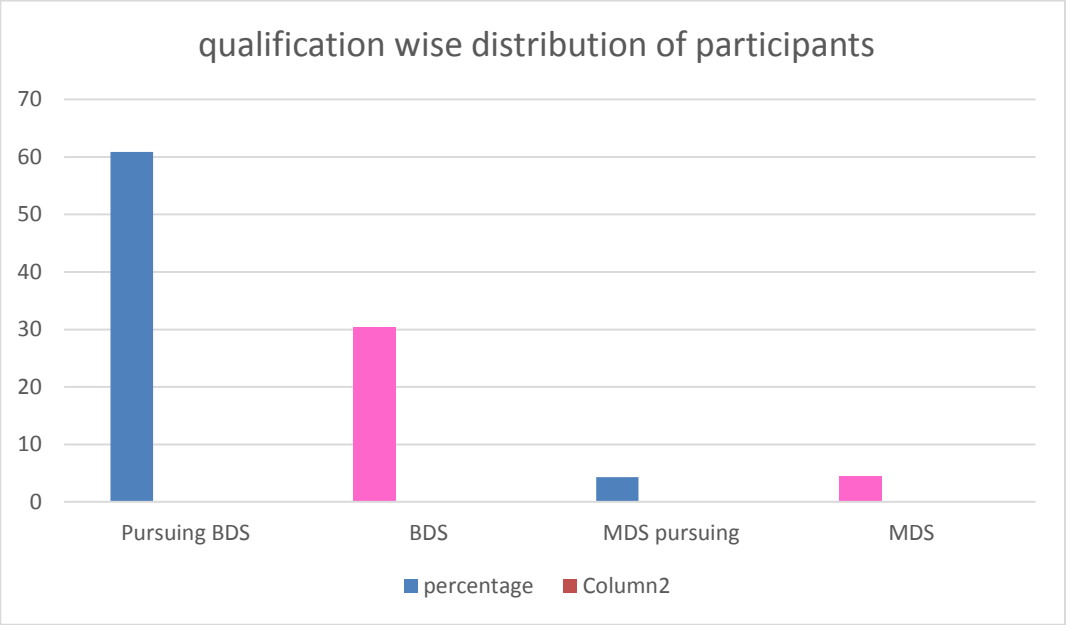

Figure 2. Demographic data representing the qualification of study participants

Table 3
Demographic data representing the years of practice

Year of practice	Frequency	Percentage
0-5years	181	50%
5-10 years	55	15.2%
10-15 years	8	2.2%
15-20 years	39	10.9%
Above 20 years	39	10.9%

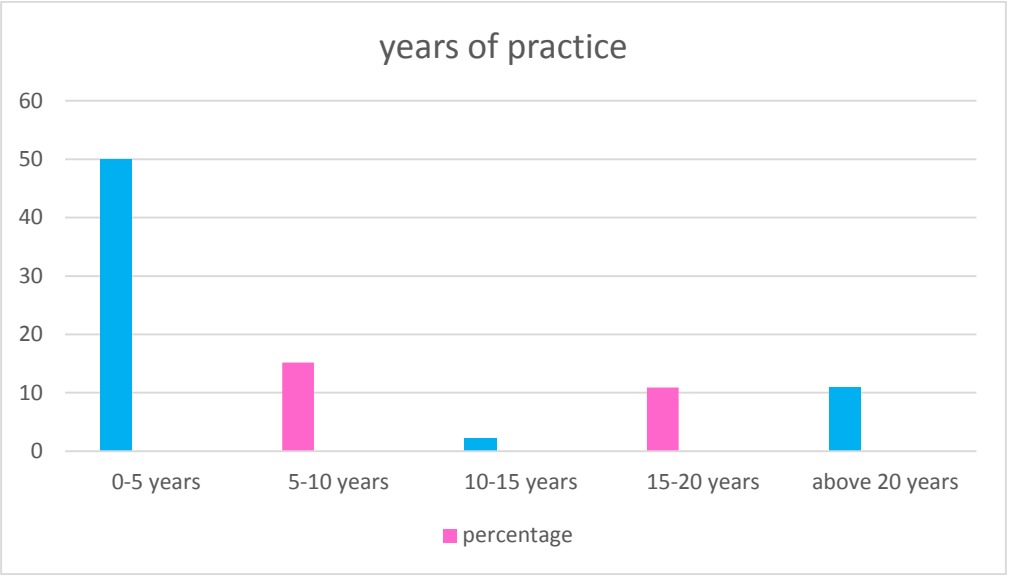

Figure 3. Demographic data representing the years of qualification

Table 4
Tabulation of the response of the study population

Question	Yes	No	Don't Know
Are you aware about the use of Artificial Intelligence in diagnosis?	228 63%	110 30.5%	24 6.5%
Are you aware about the use of Artificial Intelligence in imaging?	259 71.7%	79 21.7%	24 6.6%
Are you aware about the use of Artificial Intelligence in treatment planning	228 63%	87 23.9%	47 13.1%
Are you aware about the use of Artificial Intelligence in restoration?	157 43.5%	126 34.8%	47 21.7%
Are you aware about the use Artificial Intelligence in Oral hygiene and Preventive dentistry?	197 54.3%	79 21.7%	87 23.7%
Can Artificial Intelligence be used in fabrication of complete denture?	197 54.3%	24 6.6%	141 39.1%
Are you aware about the use of surgical robot in field of OMFS?	189 52.2%	102 28.3%	71 21.7%
Can Artificial Intelligence provide more accurate treatment for Orthodontics	197 54.3%	39 10.9%	126 34.8%
Do you think Artificial Intelligence can increase clinical practice?	268 73.9%	31 8.7%	62 17.14%
Are you comfortable using Artificial Intelligence in daily practice?	236 65.2%	31 8.7%	94 26.1%

Table 5
Tabulation of the response of the study population

Question	Yes	No
Are you aware about Artificial Intelligence?	291 80.4%	71 19.6%
Are you open to learning about Artificial Intelligence?	323 89.1%	39 10.9%
Have you ever used Artificial Intelligence?	87 23.9%	275 76.1%

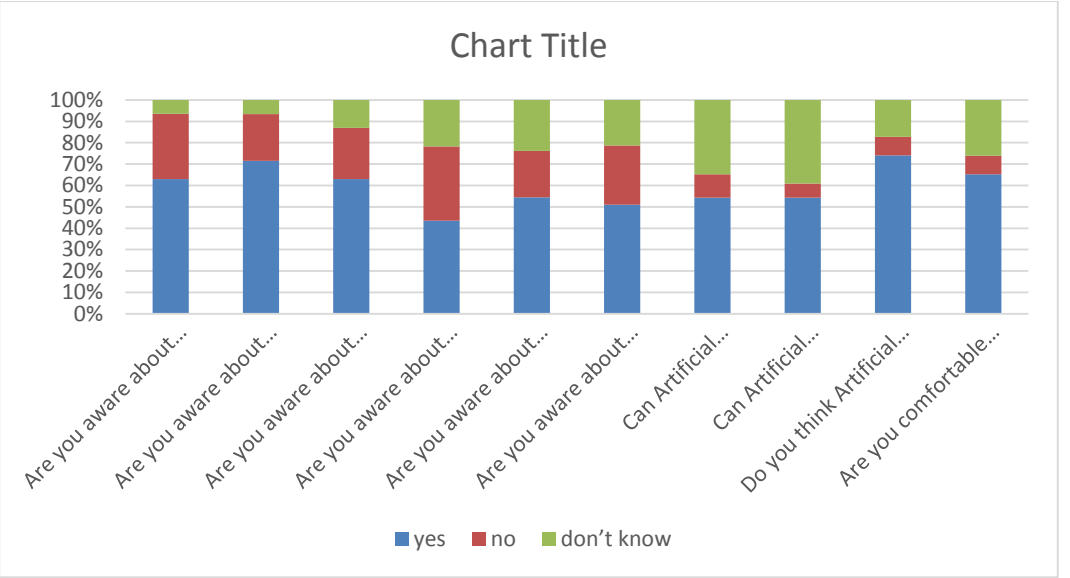

Figure 4. Graphical representation of the response of participants

Table 6
Showing association between response of candidates with qualification and years of practice

Question	Qualification	Year of practice
Are you aware about Artificial Intelligence?	0.785	0.296
Are you aware about the use of Artificial Intelligence in diagnosis?	0.833	0.757
Are you aware about the use of Artificial Intelligence in imaging?	0.937	0.807
Are you aware about the use of Artificial Intelligence in treatment planning	0.215	0.482
Are you aware about the use of Artificial Intelligence in restoration?	0.569	0.548
Are you aware about the use Artificial Intelligence in Oral hygiene and Preventive dentistry?	0.182	0.199
Can Artificial Intelligence be used in fabrication of complete denture?	0.501	0.283

Are you aware about the use of surgical robot in field of OMFS?	0.631	0.321
Can Artificial Intelligence provide more accurate treatment for Orthodontics	0.790	0.706
Do you think Artificial Intelligence can increase clinical practice?	0.219	0.206
Are you open to learning about Artificial Intelligence?	0.883	0.659
Are you comfortable using Artificial Intelligence in daily practice?	0.264	0.017*
Have you ever used Artificial Intelligence?	0.118	0.759

Chi square test applied; $p<0.05$

Table 7
Showing correlation between different questions

Question	r^2	p value
Are you aware about Artificial Intelligence? * Do you think Artificial Intelligence can increase clinical practice?	0.516	0.001*
Are you comfortable using Artificial Intelligence in daily practice? * Have you ever used Artificial Intelligence?	0.335	0.014
Do you think Artificial Intelligence can increase clinical practice? * Have you ever used Artificial Intelligence?	0.27	0.013
Are you comfortable using Artificial Intelligence in daily practice? * Have you ever used Artificial Intelligence?	0.36	0.023
Are you aware about Artificial Intelligence? Are you comfortable using Artificial Intelligence in daily practice?	0.397	0.232

Spearmen's test applied; $p<0.05$

Table 8
Multifactorial logistic regression analysis of perception and knowledge of dental professional about AI

	Associated factor	OR	p value	CI at 95%
Knowledge	Education	0.8	0.041	1.6-0.87
	Gender	0.71	0.541	0.8-0.5
	Year of practice	0.63	0.032	0.6-0.31
	Age	0.31	0.712	0.2-0.83
Perception	Education	0.42	0.001	0.6-0.3
	Gender	0.43	0.034	1.2-0.82
	Year of practice	0.32	0.24	0.98-0.71
	Age	0.21	0.56	0.43-0.21

Discussion

21st century is an era of digitisation. What people in early 1950s used to ponder about, is happening now. Whether it be educational institutions, healthcare, e-

commerce etc. digitisation is what has circled the world around our fingertips. A humongous amount of efforts and advancements have been made to overlap digitisation and hospitalisation. The blueprint and implementation of AI technologies in various dimensions of dentistry, clinical diagnosis of various lesions and injuries and in the treatment modalities for the same, has made manual labour and clock count a lot more less. These mimickers of dental specialists have proven to be precise and accurate in the lengthy regimen. But apart from all this theory, how much we as dental specialists know about AI as much as it knows about us, is the main headline question.

According to the study conducted, Artificial Intelligence was known by 80.4 percent of the survey population, whereas only 19.6 % were unaware of it. The majority of the participants i.e. 63%, were aware of the use of Artificial Intelligence in diagnosis, while 30.5 percent were unaware, and 6.5% did not have any knowledge about the artificial intelligence. Artificial Intelligence in Imaging was known by 71% (259) of the respondents.

In A study conducted by Hoda Lofty Abouzeid et. al.[7] wherein out of 313 respondents, 54.6% were males. Amongst the respondents who showed up for the survey, Dental interns comprised of 18.2% and dentists under post graduation were around 23%. (7) Jaideep Sur et. al,[8] conducted a similar 171 (68%) out of the 250 respondents were already familiar with the AI framework and 181 dentists (72%) agreed that AI has medical uses, only 106 (42%) had a basic understanding of how to incorporate AI into their dental practise. Furthermore, 136 dentists (55%) agreed that AI can speed up the healthcare system. Although 15% of dentists were confident that AI can make better diagnoses than a human practitioner, the remaining 45% were unsure. (8). Another study conducted by Emir Yüzbaşıoğlu[9] among Turkish dental students concluded that About 48.40 percent out of 1130 students had just rudimentary awareness of AI, while 10.6 percent had no AI-related information sources. AI will change dentistry, according to 85.70 percent of respondents, but AI will not be able to replace dentists in the near future, according to 28.60%. Furthermore, 46.30% disagreed that AI could be used as an effective diagnostic tool whereas 30% agreed to it. (9). Another survey based study conducted by Sanjeev Khanagar et. al. [10] among the dental students in Riyadh, Saudi Arabia concluded that out of 423 dental students 50.1 percent had no basic understanding of how AI works. Furthermore, the vast majority 55.8 percent were unaware of the use of AI in dentistry . 40.9% had knowledge about AI due to the use of social media. (10). In a study conducted by Manu Batra et al [11] about 55.8% of undergraduate students and 77.4% of postgraduate students said they are familiar with AI's applications and knowledge. Around 36.7% of undergraduate students and 20.8 % of postgraduate students replied positively when questioned how AI may be used in dentistry practise. It revealed that undergraduate students had a better understanding of how AI can be used in dentistry practise. (11). A similar study conducted by Mohammed Asmatahasin et.al. [12] out of a total of 270 students the majority of students (89.63 percent) were familiar with the phrase artificial intelligence, with 77.04% believing that AI will lead to significant breakthroughs in dentistry and 89.63% agreeing that AI applications should be included in undergraduate and postgraduate dental education. (12)

Limitation

The limitation of the current study is there are not many literatures available regarding the subject. A social desirability bias can occur in response. Since both the investigator and respondents are dental professionals.

Recommendation

Further studies should be carried with large number of participants to know the opinion regarding Artificial Intelligence. Practical knowledge in respect to the use of Artificial Intelligence in dentistry should be through CDE programs and workshops.

Conclusion

The present study showed a satisfactory knowledge among dental professionals regarding the use of Artificial Intelligence in dentistry but lack of practical use of it. Health care should be combined with developing technology for welfare and easy delivery of health care practice.

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