

## Awareness of GMU Dental Students Regarding the Use of Artificial Intelligence in Dentistry

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**Aim:** The study aims to assess the awareness of AI in dentistry among GMU Dental students, identify factors contributing to this awareness, and evaluate students' knowledge regarding the benefits and challenges of AI in dental practice.

**Materials and Methods:** A cross-sectional study was conducted using an online questionnaire, that took place at the Gulf Medical University (GMU) Dental College. The subjects were 101 undergraduate dental students from GMU who met the inclusion criteria and agreed to participate. The primary outcome measures included the level of awareness and knowledge about AI in dentistry, as well as attitudes towards its implementation and potential impact on the field of dentistry.

**Results:** The survey revealed a high level of knowledge among students regarding AI in dental practice. Most participants expressed strong support for integrating AI into dental practice. Skepticism was primarily noted among students at earlier stages of their education, which was attributed to their limited knowledge and experience of AI technology. The greatest disagreement was observed regarding AI's potential to replace dentists and doctors in the future. Overall, the findings indicate a generally positive attitude towards AI among future dental professionals at GM.

**Conclusion:** The study highlights that GMU Dental students are largely aware of and support the use of AI in dentistry. However, the skepticism among early-stage dental students suggests a need for enhanced AI education in the early stages of dental training. These insights underscore the importance of preparing future dental professionals for the integration of AI technologies in their practice.

**Keywords:** Artificial Intelligence; student education; undergraduates; dentistry; questionnaire.

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## Introduction

The integration of Artificial Intelligence (AI) into healthcare has gained significant attention in recent years and promises to revolutionize various aspects of medical practice.<sup>1-4</sup> AI combines large datasets with advanced algorithms to create machines that can perform tasks autonomously, with increased accuracy and within shorter timeframes.<sup>5-9</sup> AI is designed to learn from multiple information sources to diagnose beyond human capabilities.<sup>10-12</sup> Real-time data from AI and other wearable devices can also improve analytics in dentistry, with applications ranging from diagnosis and treatment planning to patient management and record-keeping.<sup>13-18</sup>

Understanding the awareness of dental students towards AI is critical for assessment of the readiness and receptiveness of the next generation of dental professionals to embrace AI technologies.<sup>13-16, 19-24</sup> Despite the surge in AI applications within dentistry, recent studies indicate that many dental students remain unaware of its potential.<sup>1, 25</sup> Additionally, some students fear that AI could one day take over the duties of dentists.<sup>26</sup> Whilst the dental profession has welcomed several AI driven changes over the past decade, dental teaching curriculums still fail to incorporate material that can improve the ability of students to practice in an AI-driven environment. Incorporating AI into dental education can provide dental students with the skill to leverage AI technologies to improve patient care and treatment outcomes.<sup>27, 28</sup> In this study, we investigated the attitude and perspectives of dental students at the Gulf Medical University (GMU) regarding the use of AI in dentistry. Specifically, we assessed the awareness of students towards the incorporation of AI into dental practice, their perception and knowledge regarding its potential benefits and challenges. Our aim was to identify factors that contribute to the level of

awareness of AI within the next generation of dentists. These findings will improve the future dental professionals understanding of how to implement AI technologies in their field.

## Materials and Methods

### Design

The study was performed according to the reporting of observational studies using epidemiology (STROBE) guidelines.<sup>29, 30</sup> The target population was GMU Dental students enrolled within the BDS dental programs. Students were asked to complete a cross-sectional questionnaire to evaluate their awareness of the use of AI in dentistry. The questionnaire was provided on a google sheet.

### Participants

Verbal consent during online meeting was provided by all participants. Since no clinical data were gathered, written consent wasn't necessary. Consent was recorded via audio and notes, after thoroughly explaining the study's purpose, procedure, risks, and benefits. Participants voluntarily agreed to join after confirming their understanding. Consents were securely stored in accordance with ethical guidelines for research documentation and confidentiality was maintained, and data collected and analyzed anonymously. Inclusion criteria were female and male gender, all nationalities and all GMU dental student levels (BDS, intern, MDS, DDA). Exclusion criteria were non-dental students, those who did not provide consent, or those who failed to answer all questions within the questionnaire.

### Sample size calculation

A convenience sampling method was used (n=101). Participants included all dental students who agreed to take part in the study and met the inclusion criteria.

### Study Questionnaire

The study was conducted from November 6th, 2023, to February 6th, 2024,

spanning a duration of three months. The questionnaire was adapted from Karan-Romero and colleagues<sup>25</sup> with modifications that proven by 2 expertise. The survey consisted of multiple-choice questions probing demographics, year of study and yes/no/don't know answers to a series of questions probing the use of AI in dental practice. The questionnaire process included pilot testing and iterative adjustments based on feedback. Data were analysed using descriptive and inferential statistical methods.

## Results

A total of 101 students completed the questionnaire. Of the cohort, 27.2% were males and 77.8% were females (Figure 1A). The average age of the study population was 21.36 years. Of the participants, 9.0% were Intern students, 26.7% were year 1 students, 12.87% were year 2 students, 16.8 were Year 3 students, 28.17% were Year 4 students and 4.95% were year 5 students (Figure 1B). This demographic diversity provided a varied perspective on the integration of AI into dental practice.

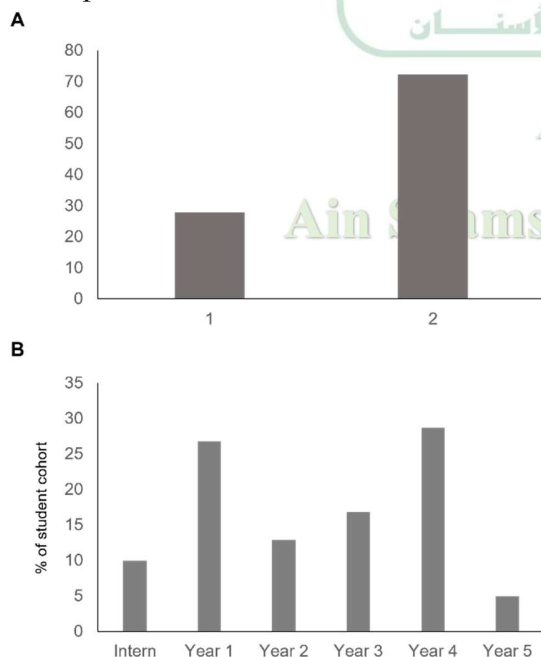


Figure 1. Demographics of the GMU Student Cohort.

## Attitudes perception towards AI in dentistry

Upon collective analysis of the data, most respondents felt knowledgeable regarding the concept of AI in dental practice, which was reflected in the low number of “do not know” scores across the questionnaire (mean of 11.4% responses  $\pm$  4.08 per-question). The largest number of non-responses were observed for questions probing the utility of AI for select disease applications (Questions 12-13). Most respondents (86%) agreed that AI will play a significant role in advancing dental practice going forward (Figure 2A). However, the cohort strongly felt that AI will not replace dentists or doctors in the future, as 64% disagreeing with this statement (Figure 2B). Despite the consensus that AI will help make the clinical outcomes of patients more predictable, up to 35% questioned its use as a definitive diagnostic tool (Figure 2C). A total of 77% however agreed in its value to predict the course of a disease and likelihood of recovery (Figure 2D). There was clear support for the accuracy of AI in the three-dimensional (3D) positioning and planning of implants (87% agreement, Figure 3A), its use as a treatment planning tool (89% Figure 3B), and its utility as a quality control tool to assess the success of treatments (82%, Figure 3C).

## Utility of AI in dental treatment

Analysis of the data indicated that most students believe AI will be crucial in addressing various technical challenges in dentistry and medicine. Importantly, 77% of the cohort agreed that AI should form part of future undergraduate dental education programmes (Figure 4A). A total of 83% agreed that it should form part of postgraduate dental education (Figure 4B). Within the cohort, 83% stated that the benefits of AI within dentistry treatment were exciting (Figure 4C). This highlighted clear

support for the inclusion of AI in dental practice.

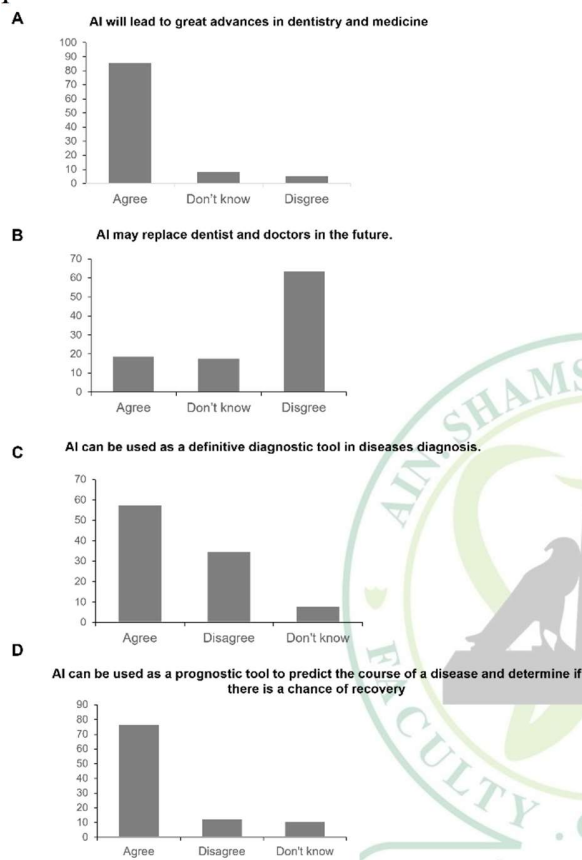


Figure 2. Perception of the use of AI in dental teaching.

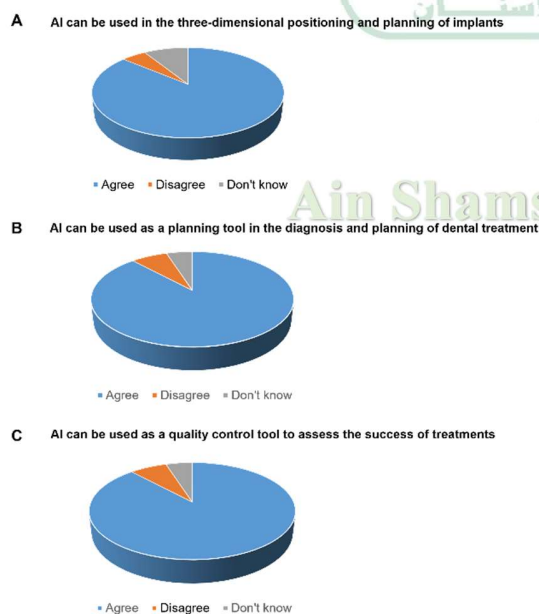
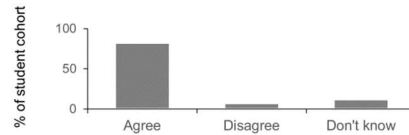
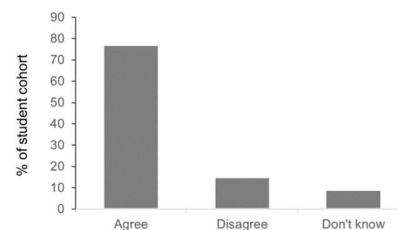


Figure 3. Knowledge of the applications of AI to dental education.

**A** AI applications should be part of undergraduate dental education



**B** AI applications should be part of postgraduate dental education



**C** The use of AI in dentistry and medicine is exciting

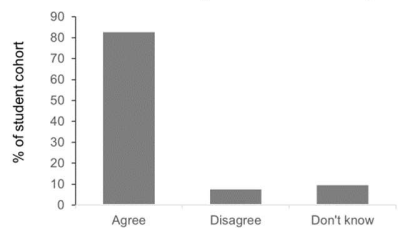


Figure 4. Students' perceptions towards the inclusion of AI in dental teaching.

### Perceptions towards the use of AI in Dental Practice

There was strong belief across the cohort that AI can benefit the radiographic diagnosis of dental caries (75%; Figure 5A). A total of 69% supported the notion that AI can be used for the diagnosis of soft tissue injuries in the oral cavity (Figure 5B), with stronger support for its utility in the radiographic diagnosis of jaw pathologies (76%; Figure 5C). There was also strong agreement that AI can be used for the radiographic diagnosis of periodontal disease (73%; Figure 5D). The utility of AI for use in

forensic odontology was also generally supported (68%; in agreement; Figure 5E).

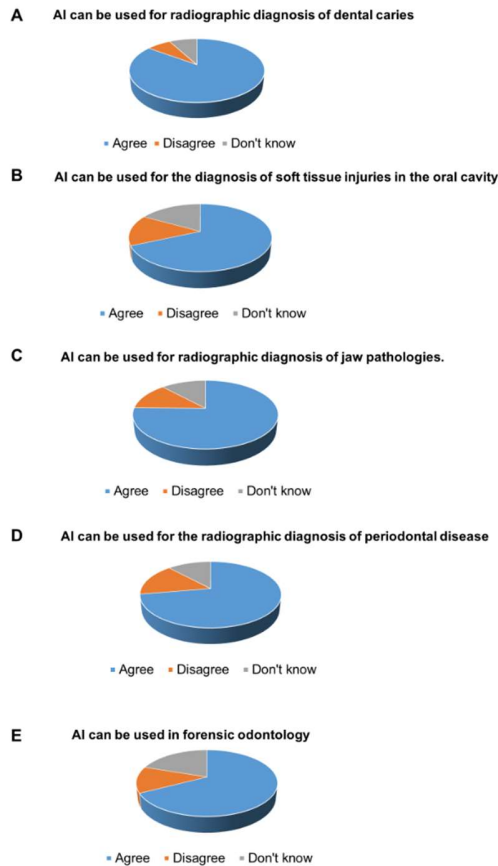


Figure 5. Students' perception of the benefits of AI for endodontic diagnosis.

### Factors contributing to the level of awareness of AI

The largest negative response in the questionnaire was towards the ability of AI to replace dentists and doctors in the future (64% disagreement). Those who agreed that it could replace human intervention were primarily males in education years 1 and 4 (Figure 6A). Therefore, this perception was not directly related to the education experience of the cohort. Both genders equally supported the perceived benefits of AI in dental practice (Figure 6B). Of the collective “don’t know” responses observed, 56% were in year 1 of study, highlighting

how experience level and knowledge of AI benefits strongly influenced the responses (Figure 6C).

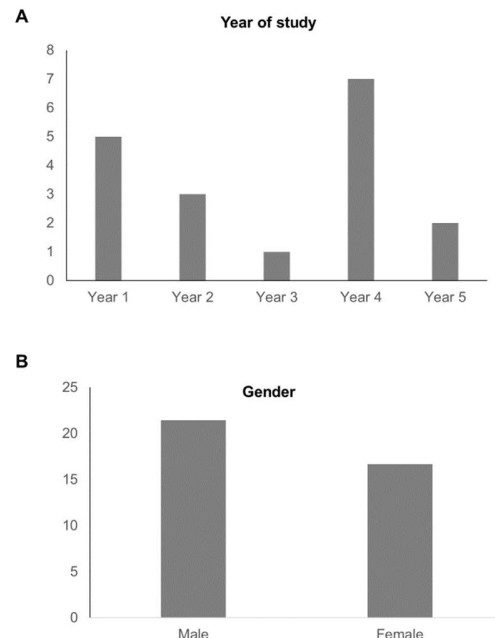


Figure 6. Demographics of students who believe that AI may replace dentists in the future.

### Discussion

This study investigated the attitude and perceptions of dental students regarding the use of AI in dental practice. A major interest in the study was the awareness of students on the incorporation of AI into medical applications and the knowledge of its benefits to dental practice. Our aim was to identify factors that contribute to the level of awareness of AI within the student cohort.

AI has emerged as a transformative diagnostic tool in dentistry.<sup>31</sup> A clear finding was that the students expressed confidence in the ability of AI to positively impact dental practice. Most respondents felt knowledgeable regarding the benefits of AI in dentistry, which was reflected by the low number of “do not know” scores. The different years of academic study within the cohort reflected the educational training experience of the dental students and



knowledge of the utility of AI for specific disease indications, highlighted by year 1 students producing the largest number of “don’t know” responses. This highlights a need for early implementation of AI into student teaching to ensure its benefits are fully embraced at the earliest possible stage of learning.

The functional applications of AI in dentistry include assisted treatment planning, computer-aided diagnosis and predictive data analytics.<sup>1</sup> Our data highlight how most participants recognised this potential. The GMU has been proactive regarding the integration of AI tools into student learning, which appears to have significantly and positively contributed to student engagement. Most of the respondents (86%) agreed that AI can enhance dental treatment, whilst 77% agreed in its value to predict the course of a disease and likelihood of recovery. Support was clear for the accuracy of AI in 3D positioning and planning of implants (87% agreement), its use as a treatment planning tool (89% agreement), and its utility as a quality control tool to assess the success of treatments (82%). These values were comparable to the attitudes and perceptions of students documented by Karen Romero and colleagues from a cohort of 200 students, with 86% agreeing that AI will lead to great advances in dentistry<sup>25</sup>. The use of AI in dentistry is not without debate. Sharing of sensitive data, privacy, ethical aspect and security remain concerns.<sup>10, 11, 15, 16, 22</sup> Uncertainty over responsibility for machine errors still require policymakers and medical professionals to seek legal clarification on its use for specific dental indications.<sup>25, 32-34</sup> This feeling was reflected within the GMU cohort who felt strongly that AI cannot replace human dentist knowledge (64%). A total of 35% also questioned its use as a definitive diagnostic tool. It is therefore clear that increased trust in AI technology is still

required, which can be achieved through further education.

The results of our study are comparable to other surveys of dental students and their knowledge and beliefs regarding the utility of AI in dentistry. Kalaimani and colleagues surveyed 595 dental surgeons and 405 dental students who believed that dental curriculums should be updated to incorporate AI ( $\geq 60\%$  agreement) but highlighted a lack of knowledge regarding the use of deep learning models and websites used for AI in dental practice. Similar to this study, only 26.9% agreed that AI can replace the role of dentists.<sup>26</sup>

Singh and colleagues investigated the attitude, perception and barriers of the use of AI in dentistry. In the study, only 51.3% of respondents showed knowledge regarding the use of AI in dental practice, whilst 59.6% believed that AI can be used as a diagnostic tool. The general consensus that AI should be included as part of dental training was lower than this study (55.7%).<sup>27</sup> Differences in sample size, the use of closed-ended questions and differences in years of undergraduate or postgraduate study may have contributed to this difference.

Marali and co-workers investigated the perception of dental students towards AI using a cross-sectional questionnaire delivered to 460 dental students and professionals. Like this study, knowledge regarding AI was high (94%) with 88% agreeing in its utility for treatment plans, forensic dentistry (74.13%), and as a prognostic (80.65%). Comparable to our findings, most students (92%) felt that AI should be incorporated into dental practice and dental teaching curriculums.<sup>28</sup>

Some limitations of this study should be noted. Of the cohort, 27.2% were males and 77.8% were females. A more balanced gender representative would have permitted more accurate comparisons on the perception of AI in dentistry. Whilst the present study

highlights the positive attitudes regarding the use of AI in dental practice, it was performed on a limited number of students at a single education centre. Further studies in many teaching institutes will allow more robust conclusions applicable to other populations to be drawn. This can also be aided by a consistent level of education and training on the use of AI in the dentistry curriculum combined with regular training across institutions to improve the applicability of our findings.

In summary, we present a comprehensive dataset that captured a wide array of perceptions on AI tools. It is clear from our findings that the GMU's commitment to understanding and advancing the role of AI in shaping modern dentistry paradigms has positively impacted our student cohort. Further training at undergraduate and postgraduate levels can help overcome future challenges towards the use of AI in dentistry. These findings will contribute to an improved understanding of how future dental professionals view AI technologies in their field.

## Conclusion

The study reveals that GMU Dental students have a high awareness and positive attitude towards AI in dentistry. However, skepticism among novice students underscores the need for enhanced AI education early in their training. This is crucial for preparing future dental professionals to effectively integrate AI technologies, ultimately advancing the field and improving patient care.

## Funding

This research did not receive any funding.

## Data availability

All data collected and analyzed in this study have been made publicly available at the resource indicated below, as per the data availability requirements. Elemam, Ranya,

2024, "Survey Response Dataset for Awareness of GMU Dental Students Regarding the Use of Artificial Intelligence in Dentistry", <https://doi.org/10.7910/DVN/0X23T9>

## Declarations:

### Ethics approval and consent to participate:

This study adhered to all ethical guidelines for research involving human subjects and was reviewed and approved by the institutional review board of the GMU (Ref. no. IRB-COD-FAC-30-OCT-2023). All participants provided a verbal informed consent. Confidentiality and anonymity of all data were maintained. Data were only accessible to IRB members and research investigators.

### Competing interests

The authors declare that they have no competing interests.

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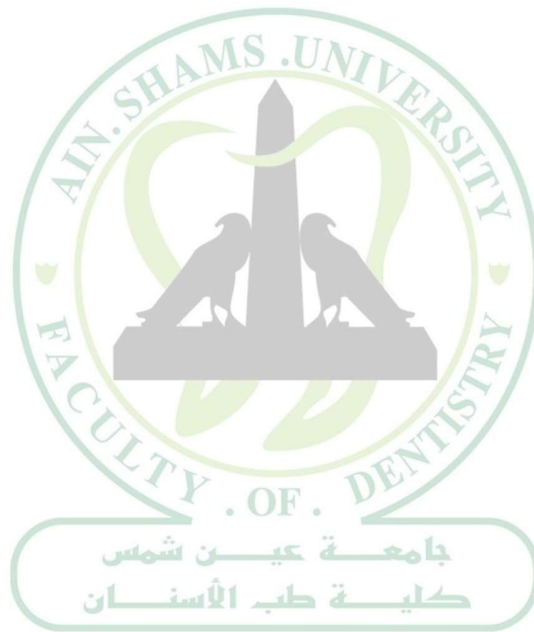
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