

Original Research

KAP Assessment of Dentists Towards Metaverse and Blockchain in Enhancing Patient Care: A Cross-National Study

Akshay A. Katara^{1*}, Riya A. Parwani²

¹Department of Dentistry, Omni Family Health, Bakersfield, California, United States

²Department of Conservative Dentistry and Endodontics, M.A. Rangoonwala College of Dental Sciences & Research Centre, Pune, Maharashtra, India

Citation: Katara AA, Parwani RA. KAP Assessment of Dentists Towards Metaverse and Blockchain in Enhancing Patient Care: A Cross-National Study. Oral Sphere J. Dent. Health Sci. 2026;2(3):144-153.

For reprints contact:

publisher@fontfusionspublication.com

Received: February 22, 2026;

Revised: May 13, 2026;

Accepted: June 20, 2026;

Published: July 01, 2026

***Corresponding author:** Akshay A. Katara

Email: akshaykatara26@gmail.com

DOI: <https://doi.org/10.63150/osjdhs.2026.21>

©The Author(s). (2026)

Open Access.

Published by [Font Fusions Publication](http://FontFusionsPublication.com)

This article is licensed under the Creative Commons Attribution-NonCommercial 4.0 International License (<https://creativecommons.org/licenses/by-nc/4.0/>) allowing non-commercial sharing, adaptation, and distribution, provided you give appropriate credit to the original author(s), provide a link to the license, and indicate if changes were made.



ABSTRACT

Background: Emerging technologies such as the metaverse and blockchain have the potential to transform dental practice by enhancing patient engagement, improving clinical planning, and ensuring secure data management. However, their adoption depends on dentists' knowledge, attitudes, and practices (KAP), which remain insufficiently explored.

Methods: A cross-sectional mixed-method study was conducted among 385 licensed dentists from public and private sectors. Data were collected using a structured questionnaire assessing KAP domains and supplemented with semi-structured interviews for qualitative insights. Quantitative data were analyzed using descriptive and inferential statistics, while qualitative data were analyzed using thematic analysis.

Results: The findings revealed that a substantial proportion of dentists had low knowledge of the metaverse (45%) and blockchain (50%), although attitudes were generally positive (60% for metaverse and 45% for blockchain). Despite this, actual implementation was limited, with only 5% and 3% of respondents currently using metaverse and blockchain technologies, respectively. Key perceived benefits included enhanced patient engagement (60%), improved treatment planning (45%), and increased data security (55%). Major barriers identified were high implementation cost (50–60%), lack of technical expertise (40–45%), and concerns regarding practical application (30–40%).

Conclusion: Although dentists demonstrate positive attitudes toward metaverse and blockchain technologies, their adoption in clinical practice remains limited due to knowledge gaps and practical barriers. Targeted educational interventions, policy support, and technological infrastructure development are essential to facilitate integration and improve patient-centered dental care.

Keywords: Blockchain, Dentistry, Digital dentistry, Emerging technologies, Metaverse, Patient care.

BACKGROUND

The fast pace of technological development has had a profound effect on many industries, including dentistry [1]. The integration of new emerging technology, such as the metaverse and blockchain has started over the past decade to transform the practice of patient care, education and management for dentists. These technologies bring the unique opportunities to enhance the quality of care, streamline the practice processes, and offer innovative solutions to problems of the dental community. In particular, the metaverse and blockchain will create new interactions between dentists and patients, facilitate data storage and data management, and enhance dental practice. The full potential of these technologies will only be known by understanding the Knowledge, Attitudes and Practices (KAP) of dentists for the innovations [2].

The metaverse, which is defined as a shared virtual space that arises as a result of the merging of augmented physical reality and persistently virtual environments, has become one of the technologies that have revolutionized various industries [3]. Within the dental profession, one can find the enormous opportunities to change the approach to managing patients, as well as the possibilities to reinvent clinical practice. The field offers simulative training and practice environments of dental practices in a highly simulation manner. Dental practitioners can use virtual reality (VR) platforms to model intricate surgical procedures, practise techniques and perfect their skills without putting patients at risk [4].

Also, the virtual environment provides patients with interactive possibilities, such as virtual consultations, during which they can talk about their issues with dental professionals in a controlled environment. This would increase the availability of care and reduce barriers to people living in isolated or underserved areas [5]. In addition, the metaverse will enable the development of digital twins, when the anatomical data of a patient is recreated in a virtual space. These digital representations may be used to make the dental practitioners plan procedures with greater accuracy and thus make the personalized treatment protocols based on the unique needs of a particular patient [6]. This means that the use of this technology in the dental practice requires immediate research on the knowledge, attitudes, and practices of dental practitioners, to outline the possible advantages and limitations of the technology. Although the metaverse is perceived as a highly useful tool by many practitioners, other practitioners are concerned about its feasibility or affordability or the way it would affect traditional care modalities. It is therefore important to have a subtle appreciation of the views of dentists so that

this technology can be successfully incorporated into the mainstream practice [7].

The cryptocurrency-based decentralized and safe ledger system, known as blockchain, has been applied in healthcare, including dentistry, due to its ability to guarantee data integrity and security. Blockchain can be used in dental practices to store patient records safely, in a way that all data is confidential, cannot be tampered with, and can be easily accessed by the relevant stakeholders. A blockchain may reduce fraud, error, and the possibility of data breaches since it offers a clear and unalterable record-keeping system that is a major issue in the healthcare sector. This safe data handling system is notably important in the field of dentistry, where the patient confidentiality is a paramount concern and the consequences of the data breach may be devastating [8]. Also, it is possible to simplify the process of administering dental insurance claims, payments, and contracts with the help of blockchain and improve the efficiency of operations. Dentists can deploy smart contracts to automate processes like billing, appointment booking, consent management, etc., to help decrease administrative overheads and enhance workflow [9]. Transparency can also be supported by the use of blockchain in dental supply chains to prevent the possibility of fake products getting into the market and making sure that only authentic materials are implemented in clinical procedures. Nonetheless, the use of blockchain technology in the dental field is not yet widespread because of the barriers of regulatory barriers, technical barriers, and insufficient in-depth knowledge of dental professionals. The explanation of the KAP of dentists with regard to the blockchain technology is therefore critical in determining the perceived acceptance as well as the steps necessary towards a wider consideration in dental practice [10]. The KAP research provides helpful information on the perceptions, knowledge, and actions of professionals towards new technologies [11]. A KAP research in the setting of the metaverse and blockchain can assess the level of dental professional knowledge regarding the technologies, their readiness to use them, and the degree to which they are being incorporated into the routine functioning [12]. Through these understanding the status of knowledge presently available, dentist's attitude toward expected benefits and risks and actual practices, the stakeholders can structure specific intervention and educational programmes that will help the targeted technologies to be successfully translated into dental care [13].

The use of metaverse and blockchain technologies in dentistry needs a technological infrastructure. Metaverse applications depend on immersive

technologies like virtual reality (VR) and augmented reality (AR) and associated hardware such as VR headsets, motion controllers and haptic devices to simulate clinical scenarios [14]. High-speed internet connections and cloud computing are necessary for real-time rendering and interaction with virtual spaces. Also, digital twins (virtual models of patients' oral structures from imaging data) development depends on integration with advanced imaging devices such as CBCT and intraoral scanners [15].

For blockchain to be applied to dentistry, the use of distributed ledger systems for secure, decentralized data storage is crucial. These systems need to include cryptographic protocols, secure nodes, and integrate with electronic health record (EHR) systems. Smart contracts may be used for administrative tasks including payment, insurance claims, and managing consent. But deployment is dependent on standards, regulations and interoperability with existing health IT systems [16].

The suggested study explores the KAP of dentists towards the metaverse and blockchain to assess the potential challenges in its adoption and offer some potential solutions, that can improve the adoption of these revolutionary technologies in the field of dentistry. The deep understanding of these factors will help to set up efficient and easy patient care in future. The strength of this study is its inclusion of researchers from diverse geographical backgrounds (USA and India). This international outlook captures the variation in health care systems, technology readiness and practices, and thus increases the global applicability of the results. It also showcases the impact of different regional obstacles in the deployment of new technologies in dentistry.

METHODOLOGY

The aim of our study was to explore the knowledge, attitude and practices (KAP) of dentists regarding the application of metaverse and blockchain technologies to improve patient care. The study design was cross-sectional, employing both quantitative and qualitative methods to gain insights into dentists' knowledge, attitudes, and practice. The quantitative part involved a survey that sought to evaluate dentists' knowledge, attitudes and practices regarding the use of these technologies in clinical practice.

The target population included qualified dentists working in both public and private dental facilities in USA and India. A stratified random sampling approach was employed to select the study sample, considering various demographic and professional factors. The strata were

geographical distribution (urban and rural), years of practice (less than 5 years, 5-10 years and above 10 years) and practice type (private clinic and public institution). This ensured representation of different groups, which could be compared.

We calculated the sample size according to Cochran's sample size formula for proportions. The parameters were set at a 95% confidence level ($Z = 1.96$), a proportion of 0.5 (to ensure the largest possible variability) and a 5% margin of error. This yielded a sample size of around 385. Given the variability in the total population size, adjustments could be made to the sample size using finite population correction if needed; but for large populations, the estimated sample size was deemed adequate.

Two main data collection instruments were used: questionnaire and interview. The questionnaire was divided into three parts. Section one collected demographic data, such as age, years of experience and practice type. The second section probed knowledge of the metaverse and blockchain using multiple choice and true/false questions. The third section assessed practices and attitudes using Likert-scale statements and open-ended questions to investigate usage patterns and barriers. A smaller sample of 20-30 dentists were invited for semi-structured interviews to gather qualitative data on dentists' experiences, reasons for use, advantages and barriers of using such technologies.

Data from the questionnaire were analysed using descriptive statistics such as means, frequencies and percentages, to provide an overview of KAP. Inferential statistical analyses, including Chi-square tests and t-tests, were used to determine significant differences between demographic variables, such as experience, practice type, and geographic location. Thematic analysis was applied to qualitative data from interviews to extract themes and patterns of dentists' views and experiences.

The study was conducted in accordance with ethical principles. Participants gave their informed consent before the data collection began. Anonymity and confidentiality of responses were maintained, and participants were made aware of their right to withdraw from the study at any point with no repercussions. Approval for the study was obtained from the institutional review board before the study began. This approach allowed us to assess dentists' knowledge, attitudes and practices in relation to incorporating metaverse and blockchain technologies into dentistry.

Table 1: Questionnaire of the study

Section	Question	Options
Demographic Information	1. Age:	Under 30, 31-40, 41-50, 51-60, Above 60
	2. Gender:	Male, Female, Other
	3. Years of Experience:	< 5 years, 5-10 years, > 10 years
	4. Type of Practice:	Private Clinic, Public Institution, Both
	5. Geographical Location:	Urban, Rural
Knowledge (Metaverse)	1. How familiar are you with the term "metaverse"?	Not familiar, heard of it but do not understand the concept, have a basic understanding, Have an in-depth understanding
	2. Do you think the metaverse can be used for virtual dental consultations?	Yes, No, not sure
	3. Which of the following dental practices can benefit from the metaverse? (Select all that apply)	Virtual consultations, Patient education and engagement, Virtual dental surgery simulations, Remote diagnosis and treatment planning
	4. Are you aware of any dental clinics using the metaverse for training or practice purposes?	Yes, No, Not sure
Knowledge (Blockchain)	5. How familiar are you with the concept of blockchain technology?	Not familiar, heard of it but do not understand the concept, have a basic understanding, Have an in-depth understanding
	6. Do you think blockchain can be used for storing dental patient records securely?	Yes, No, Not sure
	7. Which of the following applications of blockchain technology do you consider beneficial for dental practices? (Select all that apply)	Secure patient data management, improved dental insurance claim processing, Counterfeit prevention in dental materials, Improved financial transactions and billing systems
	8. Are you aware of any dental practices using blockchain for patient data management?	Yes, No, Not sure
Attitudes (Metaverse)	1. What is your overall attitude toward using the metaverse in dentistry?	Very positive, Positive, Neutral, Negative, Very negative
	2. What is your overall attitude toward using blockchain technology in dentistry?	Very positive, Positive, Neutral, Negative, Very negative
	3. Do you think integrating the metaverse and blockchain into dental practice is a necessity for the future of patient care?	Yes, No, Not sure
	4. What are your main concerns regarding the adoption of the metaverse and blockchain in dentistry? (Select all that apply)	Cost of implementation, Lack of technical expertise, Regulatory issues, Practicality in clinical settings, Patient acceptance and trust
	5. Do you believe that incorporating new technologies like the metaverse and blockchain can improve patient satisfaction and care?	Yes, No, Not sure

Table 1 Continued...

Practices (Metaverse)	1. Have you ever used the metaverse or any virtual reality (VR) platforms for dental practice or training?	Yes, regularly, Yes, occasionally, No, but plan to in the future, No, and do not plan to
	2. Have you ever used blockchain technology for any part of your dental practice (e.g., patient record management, financial transactions)?	Yes, regularly, Yes, occasionally, No, but plan to in the future, No, and do not plan to
	3. Are you currently using or planning to use the metaverse for patient education or engagement?	Yes, already using, Yes, planning to use, No, not planning to use
	4. Are you currently using or planning to use blockchain for managing patient records or data security?	Yes, already using, Yes, planning to use, No, not planning to use
	5. Do you plan to participate in any training or workshops on the metaverse or blockchain in the next year?	Yes, No, Not sure
Open-Ended Questions	1. In your opinion, how can the metaverse improve patient care in your practice?	[Open-ended response]
	2. What are the potential challenges of adopting blockchain in dentistry, and how can they be overcome?	[Open-ended response]
	3. What would motivate you to start using the metaverse or blockchain technologies in your dental practice?	[Open-ended response]

RESULTS

The current research aimed at analyzing the knowledge, attitudes, and practices of dentists in terms of how they adopt the use of metaverse and blockchain technologies to develop the patient care. A group of 385 respondents were interviewed. 185 were from United States of America and 200 from India. These results prove that there is a diversified degree of knowledge, awareness, and adoption of these technologies in clinical dentistry. The questionnaire data provides the following results which are expressed in terms of knowledge, attitudes and practices.

The outcomes showed that most dentists had little knowledge with regard to metaverse and blockchain technologies. Particularly, 173 respondents (45%) had low level of knowledge on the metaverse, and 192 respondents (50) had low level of knowledge on blockchain. A small percentage of the respondents, 58 (15%), indicated a high level of knowledge about these technologies with the rest being put under medium

knowledge. This is consistent with the results obtained in Table 2 that shows the distribution of the knowledge degree related to the metaverse and blockchain technologies. Table 2 also shows the percentage of knowledge scores of the respondents: in the case of the metaverse, 173 dentists (45 percent) had low knowledge, 154 dentists (40 percent) had medium knowledge, and 58 dentists (15 percent) had high knowledge. In the case of blockchain technology, the proportion of participants with low knowledge is 192 (50%), medium knowledge is 135 (35%), and the proportion of participants with high knowledge is 58 (15%). The above results suggest that there is a generic requirement of increased educational programs and creation of awareness concerning these technologies.

Table 2: Evaluation of the level of dentists knowledge in relation to the metaverse and blockchain technology

Knowledge Level	Metaverse (%)	Blockchain (%)
Low	173 (45%)	192 (50%)
Medium	154 (40%)	135 (35%)
High	58 (15%)	58 (15%)

The research showed that there is an overall positive attitude to the future uses of the metaverse and blockchain in the field of dentistry, but with concerns about its practical use. According to Table 2, 231 individuals (60%), said that they had a positive attitude towards the metaverse, compared to 173 individuals (45%) who had a positive attitude towards blockchain technology. In its turn, a significant percentage (115 people, 30% in case of the metaverse and 135 people, 35% in case of blockchain) held a neutral position, and the smaller share expressed negative attitudes (38 people, 10% in case of the metaverse and 77 people, 20% in case of blockchain).

In Table 3, dentists who supported the positive attitude towards the metaverse and blockchain expressed the faith in the possibilities of the technologies, such as improvement of patient care, optimization of the planning of the procedures, and strengthening of data security. Yet, the fact that there are both neutral and negative responses serves as the testimony to a widespread caution or skepticism of dental professionals in the context of the practical use of these innovations, which also coincides with the issues related to cost, availability, and the necessary amount of technical knowledge.

Table 3: Attitudes toward the metaverse and blockchain

Attitude Type	Metaverse (%)	Blockchain (%)
Positive	231 (60%)	173 (45%)
Neutral	115 (30%)	135 (35%)
Negative	38 (10%)	77 (20%)

Table 3 illustrates the distribution of dentists' attitudes toward adopting the metaverse and blockchain in dental practice.

Concerning the present and future utilisation, the research revealed a small percentage of dental professionals had incorporated the metaverse and blockchain in their practice. Table 3 demonstrates that 19 respondents, or 5 per cent, used the metaverse regularly but 96 respondents, or 25 per cent, said that they would use it in the future. With regards to blockchain technology, only 12 respondents (3%) said that they

currently use them; 77 respondents (20%) responded that they intended to use them in the future. The other 270 respondents (70%) and 297 respondents (77%) revealed that they had no immediate plans of having these technologies implemented. The findings reported in Table 3 suggest that, even though people appear to be interested in using the metaverse and blockchain in the dental practice, the true implementation is limited. Moreover, quite a large percentage of professionals seem to be on an early stage of awareness or show concerns about the practicability and use of these technologies.

Table 4: Current and intended practices involving the metaverse and blockchain

Practice Type	Metaverse (%)	Blockchain (%)
Already Using	19 (5%)	12 (3%)
Intend to Use	96 (25%)	77 (20%)
Do Not Intend to Use	270 (70%)	297 (77%)

Table 4 shows the percentage of dentists who reported using or intending to use the metaverse and blockchain technologies in their practice.

Dental professionals were asked about the potential benefits of the introduction of metaverse and blockchain technologies, and several central advantages could be presented. As it was reported in Table 4, the first advantage was the increased level of patient engagement (231 responses, 60 percent), which was followed by the improved planning of the procedure (173 responses, 45 percent). On the other hand, the enhancement of data security was the primary attribute associated with blockchain (211 responses, 55 percent), followed by the improvement of the patient care (116 responses, 30 percent) and reduction of counterfeits in dental supply chains (58 responses, 15 percent). As shown in Table 4, despite the benefits of both technologies being acknowledged, there is a stronger belief that blockchain will help improve the security of data and the efficiency of the implemented procedures, whereas the metaverse is more likely to be linked with the interaction with patients and their engagement.

Table 5: Perceived benefits of the metaverse and blockchain

Benefit Type	Metaverse (%)	Blockchain (%)
Enhanced Patient Engagement	231 (60%)	116 (30%)
Improved Procedure Planning	173 (45%)	135 (35%)
Better Data Security	58 (15%)	211 (55%)
Cost Efficiency	38 (10%)	58 (15%)

Table 5 illustrates the perceived benefits of the metaverse and blockchain, as reported by dentists.

Although the benefits of the concept are perceived to be beneficial, a number of obstacles to the adoption of the metaverse and blockchain were identified. Table 5 shows the significant barriers to adoption, with high implementation costs (192, indicating 50 per cent of the metaverse and 231, indicating 60 per cent of blockchain) having the most common barriers. The absence of technical skills (154, which signifies 40 percent in the case of the metaverse and 173, which signifies 45 percent in the case of the blockchain) was also a major issue as well as the feasibility of using the technologies in clinical practice (115, which signifies 30 percent in the case of the metaverse and 154, which signifies 40 percent in the case of the blockchain). A lower fraction of dentists (58, or 20 per cent in the case of the metaverse, and 77, or 25 per cent in the case of blockchain) expressed regulatory issues. These results, as presented in Table 6 indicate that although there is a relatively good interest in these technologies, the high expenses and technical issues are major barriers to their large-scale implementation in dental practices.

Table 6: Barriers to the adoption of the metaverse and blockchain

Barrier Type	Metaverse (%)	Blockchain (%)
High Implementation Cost	192 (50%)	231 (60%)
Lack of Technical Expertise	154 (40%)	173 (45%)
Concerns About Practical Application	115 (30%)	154 (40%)
Regulatory Challenges	58 (20%)	77 (25%)

Table 6 summarizes the main barriers faced by dentists in adopting the metaverse and blockchain technologies.

At the concluding stage, the research examined the differences in the knowledge levels under the divisions of professional experience. Table 6 shows that the group of practitioners with more than a decade of clinical experience demonstrated a significantly better level of knowledge of blockchain technology, with 20 per cent of this group representing a high level of knowledge (equivalent to 58 dentists), compared to the sample with a relatively shorter history. Concerning the metaverse, the distribution of expertise was more even with respect to the levels of experience sense with 15 percent of all respondents (58 dentists, too) showing the same level of knowledge across all the groups.

Table 7: Knowledge of the metaverse and blockchain by years of experience

Years of Experience	Metaverse (%)	Blockchain (%)
< 5 Years	135 (35%)	173 (45%)
5-10 Years	154 (40%)	135 (35%)
> 10 Years	58 (15%)	58 (15%)

Table 7 shows that knowledge of the metaverse and blockchain was less among dentists that had less professional experience compared to those who had more experience.

DISCUSSION

This paper assessed the knowledge, attitudes and practices (KAP) of 385 dentists with regard to integrating metaverse and blockchain technologies into clinical practice. The results reported that the participants demonstrated a poor level of knowledge, moderate positive attitudes, and poor current adoption of the technologies at the same time noting the possible benefits of them and serious barriers such as cost and necessary technical skills. The implications of these results are immense to the design of future education programs and the creation of technology implementation strategies in the area of dentistry.

In this research, there was a significant percentage of respondents with little to moderate knowledge of the metaverse (173/385, 45= low; 154/385, 40= medium) and blockchain (192/385, 50= low; 135/385, 35= medium). These rates of awareness are in line with previous studies that have conducted research on the implementation of extended-reality technologies in the field of dentistry. Masood et al. (2023) [14] found significant lack of awareness of dental practitioners on the topics of virtual reality and augmented reality, with specialists showing a slight increase over general practitioners, therefore pointing to broader gaps in technological literacy within the field of dentistry. In a similar study, Brar et al. (2023) [15] investigated the awareness of metaverse in 476 dental students and practitioners, and they have shown that, despite positive views on immersive technologies, the amount of knowledge was rather limited. The authors came to a conclusion that the digital competence of dental professionals urgently needs to be improved with the help of structured educational programmes. All these findings support the assumption that the dental community is still at its infancy stage regarding digital transformation.

In spite of the lack of knowledge, this research discovered moderately favorable attitudes towards the metaverse and blockchain in dentistry, though the issues with its practical application were also raised. Attitude of dentists towards the metaverse showing that 231 (60%) expressed a positive attitude and 173 (45) expressed a favourable approach toward the blockchain technology. Nevertheless, a significant share of the population 115 (30% in the case of the metaverse and 135 (35% in the case of blockchain) was neutral and a smaller share of the population held a negative view, i.e., 38 (10% in the case of the metaverse and 77 (20% in the case of blockchain).

Dentists who expressed positive attitude towards the metaverse and blockchain explained that they identified the potential advantages of the technologies in the context of improved patient care, better planning of the procedure, and data security. However, the apathy and pessimism of the reactions underlines that lots of dentists are wary or unconfident about the practicality of these advancements a position that is consistent with the concerns of cost, availability and technical skills.

These findings are confirmed by research performed in wider healthcare environments. Yuntao Wang et al. (2023) [16] did not pay particular attention to the field of dentistry but considered the healthcare metaverse and said that the current state of the metaverse technologies is still unknown, despite their potential. This supports the findings of the current study, where there are positive attitudes and fears related to implementation.

In line with reported knowledge gaps, the actual implementation rates were significantly low with 19 of 385 (5%) metaverse technology users and 12 of 385 (3%) blockchain technology users presenting the actual usage. Similarly, Mokhamed et al. (2023) [9] found similar results in the field of dentistry and showed that enthusiasm was better than real integration. These results highlight a common thread data throughout the literature, such that adoption habits follow awareness and positive attitudes, leading to a gap in practice. The identified trend indicates an average technology-adoption curve, with awareness and positive attitudes followed by practical integration, thus pointing to the need of continuous training programs and further investment of augmented infrastructural facilities.

In our case, dentists indicated that there were substantial advantages linked to the metaverse and blockchain, especially when it comes to patient engagement and data security. However, they also found some significant obstacles, i.e. cost of implementation and shortage of technical skills. These obstacles are echoed by what is found in the extant literature. Allana R et al (2023) [17] published

a review of the use of blockchain in dental practice and listed the challenges in the implementation of technology, resistance of the stakeholders, and the complexity of technologies as the main barriers, thus confirming the fears mentioned by our respondents [18]. Similarly, Sharma et al. (2023) [10] emphasized that blockchain potential to increase the level of data security and interoperability has to be balanced with the limitations in form of regulation compliance and educational restrictions; this fact is shared with the obstacles reported in the present KAP results.

Kurian et al. (2023) [18] explored how immersive technologies have the potential to revolutionize the clinical training, care of patients, and professional growth and, therefore, supports the transformational promise of the research expressed by the attitude findings of this study.

On a larger scale of healthcare, the adoption of metaverse and blockchain technologies in the field of integrative medicine was studied by Daneshfard et al. (2023) [19], who reported the same level of enthusiasm and the ability to secure collaborative platforms and promote patient education, which are also themes that can be identified within the discussed benefits of the participants in the current study in the field of dentistry.

Overall, the comparative studies highlight that even with the extensive potential that the emergence of new technologies, such as the metaverse and blockchain, have in dentistry, the translation of the positive perception into the clinical environment needs extensive educational strategies, training and pilot implementation programs. The analyses of the work conducted so far, from the plethora of areas within artificial intelligence to the implementation of virtual/augmented reality, the evidence shows that knowledge is the key to effective implementation in clinical practice.

LIMITATIONS

The current study highlighted major barriers including the cost of implementation, lack of technical knowledge and regulatory concerns; however, solutions to these barriers can be tackled on several fronts. The high cost of implementation can be offset by government incentives and institutional funding, as well as public-private collaborations with technology firms who can fund infrastructure development. Scalable cloud computing solutions might also help overcome the need for significant upfront costs.

The technological competency gap also points to the need for educational strategies. Inclusion of digital dentistry components in the undergraduate curriculum,

continuing dental education (CDE) courses, and workshops can enhance the technological skills of dentists. Partnerships between dental universities and technology providers can also help knowledge dissemination.

Government hurdles can be overcome by establishing guidelines for the safe and ethical development of blockchain and metaverse platforms in health care. Governments and professional groups need to collaborate to develop policies that safeguard patient privacy, interoperability, and regulatory compliance in this area.

Future studies should use more sophisticated statistical methods, such as multivariate regression, to determine predictors of technology use. Factors like years of practice, practice setting and region can have a substantial impact on knowledge and technology adoption.

CONCLUSION

The research reveals a disconnect between positive perceptions and implementation of metaverse and blockchain technologies in dentistry. Although there is awareness among dental professionals of the potential benefits of these technologies in improving patient interaction, planning, and data security, they remain underused due to economic, technical and regulatory constraints. Overcoming these barriers through educational programs, institutional backing, and policy frameworks is a key step towards integration. Moreover, the study highlights the need for international cooperation and future research on longitudinal research and implementation plans. Closing this gap will play a pivotal role in driving digital transformation and enhancing patient-centred care.

REFERENCES

1. Gracco A et al. *Int J Environ Res Public Health*. 2023 Apr 3;20(7):5364. [PMID: 37047978]
2. Ivanišević A et al. *Clin Pract*. 2024 Dec 5;14(6):2623-2636. [PMID: 39727795]
3. Faizan Siddiqui M et al. *J Med Educ Curric Dev*. 2025 May 29;12:23821205251342315. [PMID: 40452894]
4. Singh V et al. *J Pharm Bioallied Sci*. 2024 Dec;16 (Suppl 4):S3740-S3742. [PMID: 39926724]
5. Goodridge D et al. *Chron Respir Dis*. 2016 May;13(2):192-203. [PMID: 26902542]
6. Saini RS et al. *Digit Health*. 2024 May 7;10:20552076241253550. [PMID: 38726220]
7. Kashwani R et al. *Int Dent J Stud Res*. 2024;12(3):157-160. [DOI: 10.18231/j.idjsr.2024.030]
8. Jafri R et al. *Blockchain Applications for Healthcare Informatics*. 2022 Jun 17;71-92. [DOI: 10.1016/B978-0-323-90615-9.00022-0]
9. Mokhamed T et al. *Sensors (Basel)*. 2023 Mar 20;23(6):3277. [PMID: 36991986]
10. Sharma V et al. *Cureus*. 2023 May 30;15(5):e39710. [PMID: 37398809]
11. Kharkar M et al. *Perspect Clin Res*. 2012 Jul;3(3):90-4. [PMID: 23125959]
12. Zhu F et al. *Healthcare (Basel)*. 2025 Jan 24;13(3):234. doi: 10.3390/healthcare13030234. [PMID: 39942423]
13. Kashwani R et al. *Int Dent J Stud Res*. 2023;11(3):94-98. [DOI: 10.18231/j.idjsr.2023.021]
14. Masood Z et al. *J Pak Med Assoc*. 2024 Apr;74(4 Suppl 4):S10-S16. [PMID: 38712404]
15. Brar ADK et al. *Bioinformation*. 2025 Feb 28;21(2):262-267. [PMID: 40322712]
16. Yuntao Wang et al. *Surveys Tuts*. 25, 1 (Firstquarter 2023), 319-352. [DOI: 10.1109/COMST.2022.3202047]
17. Allana R et al. *Cureus*. 2023 May 17;15(5):e39166. [PMID: 37332444]
18. Kurian N et al. *Br Dent J*. 2022;232(3):191. [PMID: 35154392]
19. Daneshfard B et al. *Explore (NY)*. 2025;21(5):103212. [PMID: 40638985]

Ethical Approval: Institutional Review Board approval was obtained from M.A. Rangoonwala College of Dental Sciences & Research Centre, Pune, Maharashtra, India. (Ethical Number: ECR/521/Inst/MH/2026/RR-20).

Declaration of Patient Consent: Patient consent was not required as there are no patients in this study.

Financial Support and Sponsorship: Nil

Conflicts of Interest: The authors declare that they have no conflicts of interest.

Use of Artificial Intelligence (AI) - Assisted Technology for Manuscript Preparation: The authors confirm that no artificial intelligence (AI)- assisted technology was used to assist in the writing or editing of the manuscript, and no images were manipulated using AI tools.

AUTHOR CONTRIBUTIONS

Akshay A. Katara: Conceptualization, study design, methodology, data collection, data analysis, interpretation of results, manuscript drafting, and critical revision of the manuscript.

Riya A. Parwani: Literature review, questionnaire development, supervision, data interpretation, manuscript editing, and final approval of the manuscript.

ABBREVIATIONS USED IN THE STUDY

- a) AR: Augmented Reality
- b) CBCT: Cone Beam Computed Tomography
- c) CDE: Continuing Dental Education
- d) HER: Electronic Health Record
- e) KAP: Knowledge, Attitude, and Practice
- f) VR: Virtual Reality

DECLARATION ON PUBLICATION ETHICS

The authors declare that they adhere to the COPE guidelines on publishing ethics, as described elsewhere at <https://publicationethics.org/>. The authors also undertake that they are not associated with any other third party (governmental or non-governmental agencies) linking with any form of unethical issues related to this publication. The authors also declare that they are not withholding any information that is misleading to the publisher regarding this article.

DECLARATION ON OFFICIAL E-MAIL

The corresponding author declares that a lifetime official e-mail from their institution is not available for all authors.

COMMENTS FROM READERS

Articles published in the ORAL SPHERE JOURNAL OF DENTAL AND HEALTH SCIENCES are open for relevant post-publication comments and criticisms, which will be

published immediately, linking to the original article without open access charges. Comments should be concise, coherent, and critical in fewer than 1000 words.

DISCLAIMER

The Oral Sphere Journal of Dental and Health Sciences provides a platform for the scholarly communication of data and information to create knowledge in the dental and medical domains after adequate peer/editorial reviews and editing, with entertaining revisions where required. The views and opinions expressed are those of the author(s) and do not reflect the views or opinions of Oral Sphere Journal of Dental and Health Sciences (and/or) its publisher, Font Fusions Publication Pvt. Ltd. Font Fusions Publication remains neutral and allows authors to specify their address and affiliation details, including territory where required.