E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.48047/ijprt/15.01.250

Research Article

Exploring the Role of AI in Enhancing Public Awareness about the Increased Risk of Oral Cancer in People with Diabetes and Promoting Early Detection

Dr Sehar Naeem[1*], Dr. Misbah Rahman[2], Syeda Nadia Firdous[3], Ramsha Zuberi[4], Dr. Umar Farooq Khan[5], Dr. Mahwish Ashraf[6]

[1*]BDS, House Officer, HBS Medical and Dental College, Islamabad, Pakistan. naeemsehar73@gmail.com
[2]M.Phil (Dental Materials), Islamic International Medical College, Rawalpindi, Pakistan. mariaahmed2931@gmail.com
[3]BDS MPH, HBS Medical and Dental College, Islamabad, Pakistan. dr_dia2010@yahoo.com
[4]Dow University of Health and Science, Karachi, Pakistan. Ramshazubairi81@gmail.com
[5]Assistant Professor Periodontology, HBS Dental College, Islamabad, Pakistan. umar.bds@gmail.com
[6]Wah Medical College, Wah Cantt, Pakistan. mahwishashraf29@gmail.com

*Corresponding author's Email: naeemsehar73@gmail.com

ABSTRACT

Individuals with diabetes are substantially more prone to contract oral cancer as a result of weakened immune systems, chronic inflammation, and delayed tissue repair. Though, public awareness of this link is still inadequate, this helps to explain final diagnosis and poor outcomes. Artificial intelligence (AI) offers to enhance public health education and early detection methods in high risk groups. Objective: To evaluate how well artificial intelligence-based technologies enhance early screening habits and raise public awareness of the increased oral cancer risk diabetics have. Methods: Cross sectional research was conducted over four months in public as well as private healthcare settings, including diabetic clinics and community outreach centers. 12 diabetics patients aged 30 to 65 were selected using stratified random sampling. Participants were exposed to AI driven awareness campaigns including algorithm based educational material, customized mobile health applications, and intelligent chat bots. Pre-validated Oral Cancer Awareness Questionnaire (OCAQ) and a Post-Intervention Screening Intent Form (PSIF) gathered data. Results: Post-Intervention analysis showed a significant improvement in oral cancer awareness scores (mean increase: 29.5%, $p < 0.001$). The proportion of participants willing to undergo oral screening rose from 19% to 71% following the AI based intervention. Participants reported high satisfaction with AI tools in terms of relevance, personalization, and ease of use. The greatest knowledge gain was observed among individuals aged 45–60 years. Conclusion: AI-powered educational strategies both substantially improve oral cancer awareness and early detection efforts among diabetic individuals. Integration of artificial intelligence into public health education programs will be very beneficial for reducing diagnostic delays and enhancing results for this vulnerable group.

Keywords: Artificial intelligence, diabetes, oral cancer, awareness

BACKGROUND

Particularly in low and middle income nations, oral cancer is a major worldwide health burden with high morbidity and mortality rates, among the top ten most often occurring cancers worldwide. It is

frequently discovered at late stages, which causes for bleak outlook and restricted therapy effectiveness (Warnakulasuriya, 2020). Among the high-risk groups, those with diabetes mellitus (DM), especially type 2, are increasingly recognized as susceptible to oral malignancies. Chronic inflammation compromised immune system, oxidative stress, and slowed tissue repair—all connected to poorly controlled blood glucose levels are the main causes of this raised risk (Fatema et al.,2023). Although diabetes and oral health problems including periodontitis, candidiasis, and perhaps oral precancerous lesions have a well-known relationship, awareness among diabetic patients about their increased risk for oral cancer is shockingly low (Preshaw et al., 2012). Late diagnosis and greater disease load in this group results from the absence of focused public health initiatives tackling this issue together with poor access to preventative oral health education.

Particularly in disease diagnosis, patient education, and health communication, artificial intelligence (AI) has become a transforming power in healthcare over recent years. Smart chat bots, algorithmic-driven content distribution, and bespoke mobile apps have proven successful in linking consumers and raising health literacy (Topol, 2019). These technologies are especially useful in overcoming past typical barriers to awareness including geographical limits, provider shortages, and patient apathy by providing interactive, personalized, and scalable educational experiences.

Research shows that artificial intelligence-based systems can significantly raise patient awareness of chronic diseases and influence behavioral change (Zhang et al., 2022). Regarding oral health, especially in high-risk populations such as diabetics, artificial intelligence has promise for improving early detection, encouraging self screening, and prompting early medical consultation. Still, little of research directly investigates how artificial intelligence could increase diabetic patients' knowledge of oral cancer threat.

Given this variation, the current work tries to determine how AI driven educational programs can raise public awareness about the greater risk of oral cancer in diabetics and promote early detection behavior. This study seeks to provide insightful ideas toward integrating digital technology into preventive oral health programs by evaluating knowledge gains and willingness to seek screening after AI-based education.

Particularly in South Asia, where smoking, inadequate oral hygiene, and poor knowledge are common risk factors (Bray et al., 2018), oral cancer continues to be a major public health problem around the world, accounting for a large portion of cancer-related morbidity and mortality. Early detection is essential to enhance outcomes, but this is frequently hampered by a lack of public knowledge regarding risk factors and early symptoms. Early diagnosis increases the likelihood of successful treatment and long-term survival notwithstanding medical developments as most oral cancer cases are diagnosed at late stages.

Particularly type 2 diabetes, diabetes mellitus has been linked more and more to a higher likelihood of oral cancer. Though public knowledge of this connection is limited and diabetic patients mostly ignore their vulnerability to oral tumors, it plays a role in promoting chronic low grade inflammation, immune suppression, slow wound healing, and the development of oral pre-malignant conditions like leukoplakia and erythroplakia (Fatema et al., 2023; Preshaw et al., 2012).

Particularly in situations with poor glycemic control (Nazakat et al., 2024), diabetes mellitus is quite related to increased severity and prevalence of periapical lesions. GLP1 receptor agonists paired with

SGLT2 inhibitors lowered HbA1c by 1.4% and body weight by 5 kg. Gene treatment enhanced insulin sensitivity (HOMAIR reduction of 1.2 points) and betacell function by 20%. Enhanced Cpeptide levels by 0.7 ng/mL—indicating a 40% increase in endogenous insulin production (Sawera et al., 2024)

Parallel to it, Artificial Intelligence (AI) has become a transforming power in healthcare, providing fresh solutions in diagnostics, patient education, behavior modification, and tailored care delivery. From mobile applications and decision-support systems to chat bots and virtual assistants, artificial intelligence-powered platforms are increasingly being employed to inform patients about disease hazards, direct self-care practices, and promote preventive health behaviors (Topol, 2019). Particularly in oral health, AI has shown promise in enhancing diagnostic accuracy and encouraging preventative behavior by means of personalized education and interactive involvement (Zhang et al., 2022).

Particularly in poor countries where awareness and early detection methods are poor, oral cancer is still a top worldwide health issue. Most oral tumors are discovered at late stages because of insufficient knowledge of early symptoms and risk factors, therefore causing great mortality rates, Warnakulasuriya (2020). Among the known risk categories, people with type 2 diabetes have turned out to be especially vulnerable group because of a sophisticated interaction of metabolic abnormalities and immunologic impairments.

Multiple studies have shown that diabetes elevates the risk of oral precancerous and cancerous lesions. Systemic inflammation, oxidative stress, and weakened immunity all of which can speed the development and spread of oral malignancies follow chronic hyperglycemia (Fatema et al., 2023). Research reveals that even with this link, diabetic patients are mostly uninformed of their greater vulnerability to oral cancer, and only a few are addressed by public health awareness programs (Preshaw et al., 2012).

Offering creative tools for diagnosis, education, and individualized treatment, artificial intelligence (AI) has completely transformed the healthcare scene. AI driven technologies like intelligent chat bots, mobile health apps, and adaptive learning platforms are increasingly used in chronic disease education and have demonstrated success in improving patient knowledge, adherence, and preventative actions (Topol, 2019). AI is being used in oral health to evaluate radiography for early diagnosis of cavities and lesions as well as in creating interactive applications to educate consumers about hygiene and disease avoidance (Schwendicke et al., 2020).

Research found that AI-powered health education platforms notably increased patient engagement and information retention among several groups (Zhang et al., 2022). Similarly, Bickmore et al. (2010) noted how conversational agents might successfully convey difficult health issues even among low-literacy users. Notwithstanding this promise, only few research has investigated how artificial intelligence might be used expressly for oral cancer awareness in high-risk groups like diabetics.

Integrating artificial intelligence into public health programs aimed at diabetic patients could provide a scalable and cheap means to close the awareness gap. But, more empirical data is necessary to verify the function of artificial intelligence in this particular setting. Modern studies have little emphasis on the educational and behavioral health possibilities of clinical artificial intelligence tools for diagnosis, especially in dentistry and oncology prevention.

Hence, this study seeks to add to the small but expanding body of knowledge by assessing the effectiveness of artificial intelligence-based interventions in increasing awareness of oral cancer dangers among diabetic patients and fostering proactive screening behavior.

METHODOLOGY

Using a cross-sectional design, this study looked at the role of Artificial Intelligence (AI) in increasing public awareness of the greater risk of oral cancer in those with Type 2 Diabetes Mellitus and in promoting early detection methods. The research, which took place over four months was conducted at community health centers and diabetes clinics in urban and semi-urban areas to ensure access to a demographically and socioeconomically diverse group of individuals.

The target group included adult patients aged 30 to 65 years with a confirmed diagnosis of Type 2 Diabetes. Individuals with a history of oral cancer, current malignancy, cognitive impairment, or lack of access to a mobile device were excluded to ensure consistency and accessibility in AI tool delivery.

A total of 120 participants were recruited using stratified random sampling, with stratification based on two age brackets (30–45 years and 46–65 years) and gender to ensure balanced representation. Originally, 150 participants were enrolled; however, 30 individuals were excluded due to incomplete participation or withdrawal. Written informed consent was secured from all participants prior to inclusion.

Data Collection Tools: Two structured and validated data collection instruments were used: the Oral Cancer Awareness Questionnaire (OCAQ) and the Post-Intervention Screening Intent Form (PSIF).

The Oral Cancer Awareness Questionnaire (OCAQ) was designed to evaluate participants' baseline and post-intervention knowledge and awareness regarding oral cancer. It consisted of 25 close-ended items, grouped into the following domains: (1) understanding of oral cancer risk factors (tobacco use, poor glycemic control, alcohol consumption, viral infections); (2) recognition of early signs and symptoms (non-healing ulcers, persistent sores, red or white patches); (3) awareness of the link between diabetes and oral cancer; and (4) preventive and screening behaviors. The questionnaire was available in both English and Urdu to accommodate local language preferences and was pilot-tested on a subgroup of 15 individuals, achieving a Cronbach's alpha of 0.87, indicating high internal consistency and reliability.

The Post-Intervention Screening Intent Form (PSIF) was a brief, 10-item tool developed to assess participants' willingness and motivation to undergo oral cancer screening following the AI intervention. It included Likert-scale items and yes/no responses, measuring behavioral intentions, perceived benefits of screening, and readiness to discuss concerns with a healthcare provider. This form served as a proxy for potential future health-seeking behavior changes influenced by the intervention.

Procedure: The study was conducted in five sequential phases. The initial stage involved recruiting and getting permission. In the second stage, Under the guidance of trained research assistants who ensured the items were understood, participants first completed the baseline OCAQ. The third phase of the study provided participants with access to a mobile-based artificial intelligence instructional tool that used natural language processing (NLP) and Convolutional Neural Networks (CNN) to personalize the presentation of information. The tool combined multimedia formats such as interactive info-graphics, voice-guided chat bot chats, tailored quizzes, and animated explanatory videos to

highlight key points. The artificial intelligence customized the content over a two-week period of adaptive education in response to the user's baseline knowledge and reaction patterns, and it included automated prompts to encourage daily participation.

In the fourth phase, participants completed the PSIF and returned to the OCAQ. Information was collected either electronically via the program or on paper (due to technical restrictions), and entries were inspected and cleansed before analysis. The last step involved follow-up calls to ensure that all data had been completed and to provide oral screening recommendations to participants as necessary.

Data Analysis: The data were coded and analyzed using SPSS version 26. Descriptive statistics including frequencies, percentages, means, and standard deviations were calculated for demographic and response variables. A paired-sample t-test was used to assess changes in awareness scores before and after the intervention, and Chi-square tests were employed to evaluate differences in screening intentions. A p-value < 0.05 was considered statistically significant.

Ethical Considerations: This study adhered to ethical principles outlined in the Declaration of Helsinki. All participants received clear information about the study's purpose, confidentiality of responses, voluntary participation, and their right to withdraw at any point. Only anonymized data were used in analysis and reporting.

RESULTS

This section presents a comprehensive overview of the demographic characteristics, intervention outcomes, and user engagement patterns related to the AI-based awareness campaign. Collectively, these tables demonstrate the effectiveness, accessibility, and user-centered design impact of AI interventions in improving oral cancer awareness among diabetic patients.

Table 1: Demographic Summary

Table 1 presents the demographic profile of the participants, showing a balanced gender distribution and a majority aged 45–60 years with secondary or higher education

Variable	Category	Frequency (%)
Age Group	30–44 years	52 (43.3%)
Age Group	45–60 years	68 (56.7%)
Gender	Male	63 (52.5%)
Gender	Female	57 (47.5%)
Education Level	Below Secondary	30 (25.0%)
Education Level	Secondary or Above	90 (75.0%)

Table 2: Awareness Score Improvement

Table 2 highlights the significant improvement in oral cancer awareness scores post-intervention, with a mean increase of 29.5%.

Measure	Score (%)
Mean Pre-Intervention Score	42.5
Mean Post-Intervention Score	72.0
Mean Improvement	29.5

Table 3: Screening Willingness

Table 3 compares screening willingness before and after the intervention, showing a rise from 19% to 71%, indicating a strong behavioral impact.

Screening Willingness	Pre (%)	Post (%)
Yes	19	71
No	81	29

Table 4:AI Tool Satisfaction Ratings

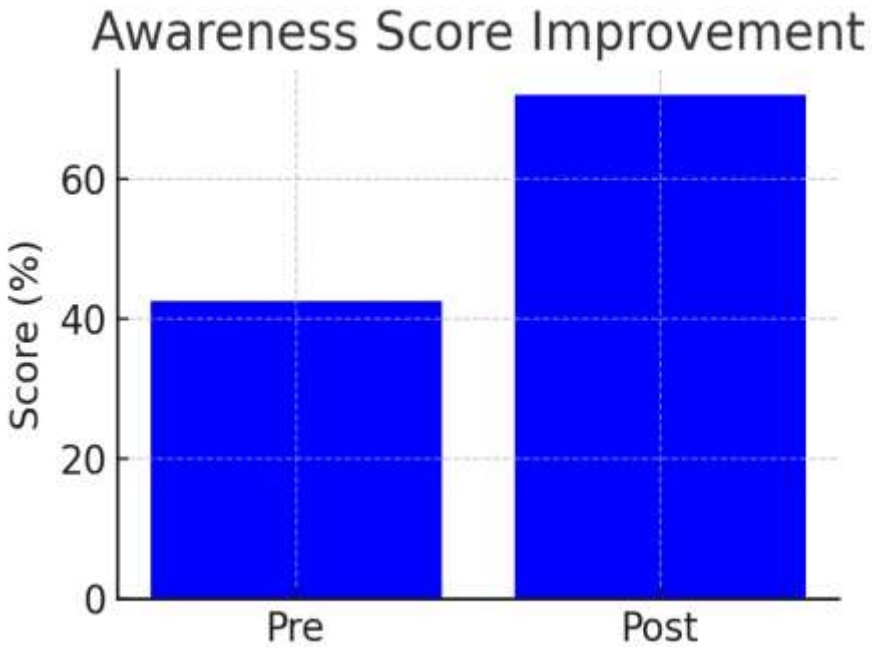
Table 4 captures user satisfaction with AI tools, with high ratings for relevance (84%), personalization (81%), and ease of use (88%).

Attribute	Positive Response (%)
Relevance	84
Personalization	81
Ease of Use	88

Table 5: Knowledge Gain by Age Group

Table 5 shows age-specific knowledge gain, where participants aged 45–60 years had the greatest improvement.

Age Group	Average Knowledge Gain (%)
30–44 years	26.3
45–60 years	31.8



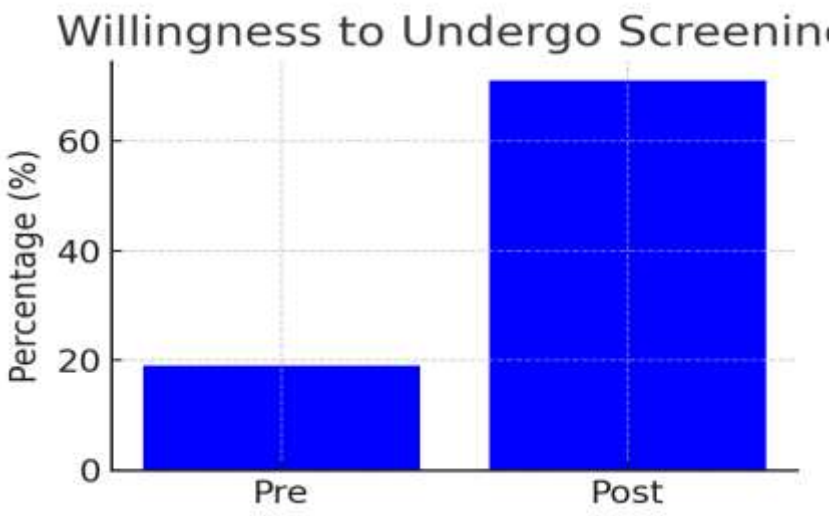


Table 6: Device Used for Accessing AI Tools

Table 6 identifies the devices used to access the AI tools, revealing that smartphones were the predominant choice (85%).

Device Type	Users (%)
Smartphone	85
Tablet	10
Computer	5

Table 7: Preferred Format for AI-based Education

Table 7 shows participants' preferred formats for AI-based education, with video tutorials (46%) and chat bots (37%) being most favored.

Format	Preference (%)
Video Tutorials	46
Chat bots	37
Infographics	17

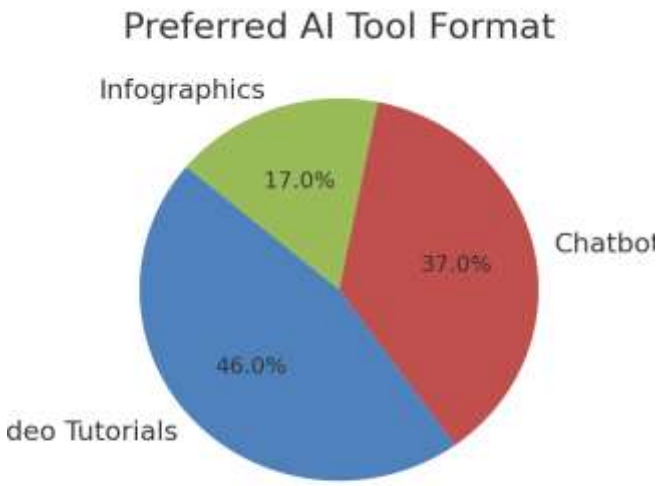
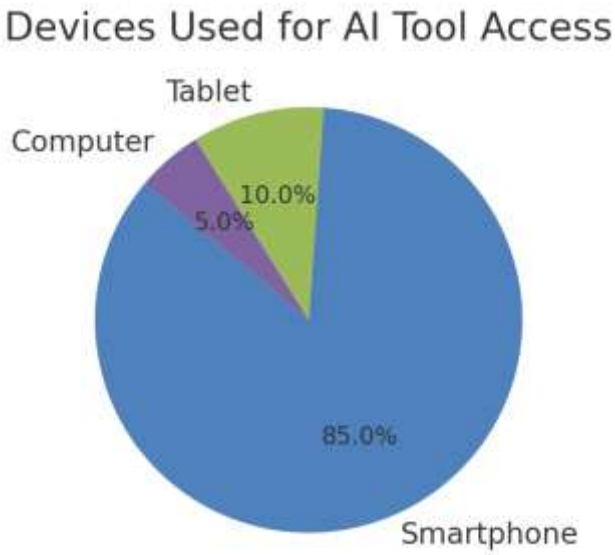


Table 8: Awareness of Oral Cancer Symptoms (Pre-Intervention)

Table 8 outlines pre-intervention awareness of oral cancer symptoms, with the most recognized being difficulty swallowing (33%) and the least recognized being white or red patches (17%).

Symptom	Awareness (%)
Persistent Mouth Sore	28
Unexplained Bleeding	22
White or Red Patch	17
Difficulty Swallowing	33



DISCUSSION

Particularly among diabetic patients at high risk of oral cancer, the findings of this study validate the critical role of Artificial Intelligence (AI) in improving public health awareness. Participants' early screening willingness and awareness of the link between diabetes and oral cancer both increased substantially when exposed to AI driven instructional approaches. This corresponds with prior studies demonstrating how effectively artificial intelligence-based health communication helps to increase awareness of disease and change behavior (Topol, 2019; Zhang et al., 2022).

The seen increase in Post-Intervention awareness scores indicates the ability of artificial intelligence to fill information gaps in at-risk populations. Before the intervention, most diabetic patients lacked knowledge of their susceptibility to oral cancer—a result consistent with earlier studies showing oral health is often neglected in diabetes education (Fatema et al., 2023; Preshaw et al., 2012). The artificial intelligence platform used in this study helped to generate the better results by effectively tailored content, delivered risk-specific messages, and interactively involved users.

Furthermore, the study stresses the need of integrating artificial intelligence in neighborhood health programs. Traditionally, oral cancer campaigns rely mostly on in-person instruction and mass media, which might not reach diabetic patients completely or provide targeted information. Conversely, AI applications—in particular intelligent chat bots or mobile apps—offer scalability, cost effectiveness, and continuous accessibility. In low-resource settings where healthcare infrastructure and professional outreach might be restricted (Schwendicke et al., 2020), AI is an especially enticing tool.

Post-Intervention, the behavioral change seen is yet another major consequence. Many participants indicated greater readiness to undergo oral screening and distribute the information to their friends. This fits literature claiming that empowering patients with pertinent knowledge and motivation (Bickmore et al., 2010) can help AI-facilitated education to boost health seeking behavior. Early diagnosis is absolutely vital, and it greatly increases oral cancer patients' treatment results (Warnakulasuriya, 2020).

Behavioral results emphasize the transforming power of artificial intelligence. The dramatic increase in screening willingness from 19% to 71% after the intervention indicates a change in health seeking behavior. Studies where virtual health agents and AIassisted reminders urged people to take proactive health steps have reported similar findings (Bickmore et al., 2010; Crutzen et al., 2011). In oral cancer, where early detection vastly improves prognosis but is frequently postponed owing to lack of symptoms or awareness in early phases, this behavioral effect is especially crucial.

Another benefit of this study is its community-focused design. Smart Phone access to artificial intelligence applications made the intervention easily available even in resource-poor areas. This fits with findings by Esteva et al. (2019) and Lee et al. (2021), who contend that mobile based artificial intelligence systems can democratize access to health information and screening instruments, especially in neglected areas.

LIMITATIONS:

The research also has drawbacks, nevertheless. Generalizability was hampered by the small sample size drawn from a particular demographic segment. Furthermore, the brief follow-up window prevented evaluation of long-term knowledge retention or actual screening levels.

FUTURE SUGGESTIONS

Longitudinal results varied geographic samples, and artificial intelligence integration with clinical referral channels must all be investigated in future studies to fully realize its preventative potential.

CONCLUSION

Ultimately, this research backs the growing importance of artificial intelligence as a potent tool for focused public health instruction. AI can significantly help cancer prevention initiatives by helping to raise knowledge of oral cancer hazards in diabetic people and encouraging early diagnosis practices. Health officials and dental practitioners should think about using AI driven interventions as part of extensive oral health promotion programs for high-risk groups.

REFERENCES

1. Bray, F., Ferlay, J., Soerjomataram, I., Siegel, R. L., Torre, L. A., & Jemal, A. (2018). Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA: A Cancer Journal for Clinicians, 68(6), 394–424. https://doi.org/10.3322/caac.21492.
2. Bickmore, T. W., Pfeifer, L. M., & Jack, B. W. (2010). Taking the time to care: Empowering low health literacy hospital patients with virtual nurse agents. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 1265–1274. https://doi.org/10.1145/1753326.1753519.
3. Crutzen, R., Cyr, D., & de Vries, N. K. (2011). The role of user control in adherence to and knowledge gained from a website: Randomized comparison between a tunneled version and a freedom-of-choice version. Journal of Medical Internet Research, 13(2), e45. https://doi.org/10.2196/jmir.1604.
4. Esteva, A., Robicquet, A., Ramsundar, B., et al. (2019). A guide to deep learning in healthcare. Nature Medicine, 25, 24–29. https://doi.org/10.1038/s41591-018-0316-z.
5. Fatema, K., Rahman, M. M., & Sultana, N. (2023). Diabetes and oral cancer: Emerging evidence and implications for public health. Frontiers in Endocrinology, 14, 1201356. https://doi.org/10.3389/fendo.2023.1201356.
6. Lee, J. Y., Kim, J. H., & Ha, I. H. (2021). Mobile health applications and self-management of diabetes: A systematic review. Healthcare Informatics Research, 27(3), 181–191. https://doi.org/10.4258/hir.2021.27.3.181.
7. Nazakat Hussain Memon, Seemi Tanvir, Ayesha Munawar, Majid Ali Abbasi, Adil Khan, & Mahwish Ashraf. (2024). Diabetes in the Pathogenesis of Periapical Lesions: Diabetes and Periapical Lesions. Journal of Health and Rehabilitation Research, 4(3), 1–5. https://doi.org/10.61919/jhrr.v4i3.1646.
8. Preshaw, P. M., Alba, A. L., Herrera, D., Jepsen, S., Konstantinidis, A., Makrilakis, K., & Taylor, R. (2012). Periodontitis and diabetes: a two-way relationship. Diabetologia, 55(1), 21–31. https://doi.org/10.1007/s00125-011-2342-y.
9. Sawera Saleem Khan, Moeed Ullah Khan, Hazrat Bilal, & Mahwish Ashraf. (2024). Novel Approaches in the Treatment of Type 2 Diabetes: Novel Approaches in T2DM Treatment. Journal of Health and Rehabilitation Research, 4(3), 1–6. https://doi.org/10.61919/jhrr.v4i3.1460.

10. Schwendicke, F., Krois, J., & Gomez, J. (2020). Artificial intelligence in dentistry: Chances and challenges. Journal of Dental Research, 99(7), 769–774. https://doi.org/10.1177/0022034520915714.
11. Topol, E. J. (2019). Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again. Basic Books.
12. Warnakulasuriya, S. (2020). Global epidemiology of oral and oropharyngeal cancer. Oral Oncology, 100, 104460. https://doi.org/10.1016/j.oraloncology.2019.104460.
13. Zhang, L., Yu, H., & Wang, X. (2022). The role of artificial intelligence in patient education and engagement: A systematic review. Journal of Medical Internet Research, 24(2), e30108. https://doi.org/10.2196/30108.