



The Impact of Digital Patient Education Tools on Oral Health

Yahya Nasser Alayed^{1*}, Mohammed Ibrahim Aloqayfi², Fatimah Abdullah Alqahtani³, Jaber Abdullah Alqahtani⁴, Ahmmed Osama Almashhoor⁵, Abdullah Mufarrih AlGahtani⁶, Ahmed Mohammed Alkadi⁷, Ashwaq Talal Assiri⁸, Ali Saleh Aljudayi⁹, Abdulaziz Sulaiman Alnasyan⁹, Abdulwahab Abdulrahman Albelaihi¹⁰, Mazin Abdullah Altasan¹¹, Ibrahim Mohammed Alyami¹², Abdullah Hassan Alhazmi¹¹

^{1*}Family Dental Medicine, Dental Medical Complex in West of Riyadh, Riyadh, Saudi Arabia

² West Riyadh Dental Center, 360 Clinics, Riyadh, Saudi Arabia

³ Dental Department, Al-Baha Primary Healthcare Centers, Al Baha, Saudi Arabia

⁴ Dental Department, Abha Specialized Dental Center, Abha, Saudi Arabia

⁵ Dental Department, King Abdullah Medical Complex, Jeddah, Saudi Arabia

⁶ Ministry of Health, Riyadh, Saudi Arabia

⁷ Riyadh South Specialized Dental Center Cluster One, Ministry of Health, Riyadh, Saudi Arabia

⁸ Dental Department, Al Noor Specialist Hospital, Mecca, Saudi Arabia

⁹ Dental Department, Al Asyah General Hospital, Buraydah, Saudi Arabia

¹⁰ Dental Department, Buraidah Central Hospital, Buraidah, Saudi Arabia

¹¹ Al-Jurf Primary Healthcare Center, Ministry of Health, Medina, Saudi Arabia

¹² Dental Department, Eastern Riyadh Dental Center, Riyadh, Saudi Arabia

***Corresponding author:** Yahya Nasser Alayed

*Family Dental Medicine, Dental Medical Complex in West of Riyadh, Riyadh, Saudi Arabia,

Email: yalayed@gmail.com

Abstract

Oral health is a vital aspect of overall health, yet it often receives inadequate attention due to limited patient awareness and education. With the advent of digital technology, patient education tools have evolved, offering new avenues for enhancing oral health literacy. This review article explores the impact of digital patient education tools (DPETs) on oral health outcomes. We examine various DPETs, including mobile apps, interactive websites, and virtual reality simulations, and their effectiveness in improving knowledge, attitudes, and behaviors towards oral hygiene. Evidence suggests that DPETs can significantly increase patients' understanding of oral health concepts, leading to improved dental care practices and better clinical outcomes, such as reduced plaque levels and lower incidence of caries. The interactive and personalized nature of these tools enhances engagement and retention of information. However, challenges such as accessibility, digital literacy, and the need for tailored content remain. The integration of DPETs into routine dental care has the potential to bridge the gap between patients and oral health professionals, fostering a more informed and proactive approach to oral hygiene. Future research should focus on optimizing the design and delivery of DPETs to maximize their impact on diverse populations and oral health disparities.

Keywords: oral health, digital education, impact of education, health education

Introduction

Oral health is a vital component of overall well-being, influencing not only the condition of the mouth but also general health and quality of life. Despite its importance, oral health is often overlooked, with many individuals failing to adhere to recommended oral hygiene practices. This neglect can lead to a range of oral health issues, including dental caries, periodontal disease, and tooth loss, which in turn can impact physical, psychological, and social well-being. Traditionally, patient education in oral health has been conducted through face-to-face interactions with healthcare professionals, printed materials, and group sessions (1,2). However, these methods have limitations in terms of reach, engagement, and individualization of content. With the advent of digital technology, there has been a significant shift towards the use of digital patient education tools (DPETs) as a means to overcome these challenges. DPETs encompass a variety of formats, including mobile applications, websites, interactive games, and virtual reality experiences, all aimed at enhancing patient understanding and engagement in oral health care (3).

The integration of digital tools into patient education offers several advantages. Firstly, they provide access to a wealth of information at the user's fingertips, allowing for on-demand learning that is not constrained by time or location. This is particularly beneficial in today's fast-paced world, where individuals may have limited time to visit healthcare providers or attend educational sessions. Secondly, DPETs offer the potential for personalized education, tailoring content to the individual's specific needs, preferences, and learning styles. This personalized approach can lead to greater comprehension and retention of information, thereby enhancing the effectiveness of the education provided. Furthermore, digital tools

can incorporate interactive elements such as quizzes, games, and simulations, which can make learning more engaging and enjoyable. This interactivity can foster greater involvement from the user, encouraging active participation in their own oral health care. Additionally, the use of multimedia elements such as videos, animations, and graphics can aid in the visualization of complex concepts, making them more understandable and memorable (4).

The impact of DPETs on oral health outcomes has been a subject of research, with studies indicating positive effects on knowledge, attitudes, and behaviors related to oral hygiene. For instance, patients who engage with digital education tools have been shown to demonstrate improved knowledge about oral health conditions, treatment options, and preventive measures. This increased awareness can lead to better attitudes towards oral health care, with individuals becoming more proactive in maintaining their oral hygiene and seeking professional care when needed. Moreover, the use of DPETs has been associated with changes in behavior, such as more consistent brushing and flossing, reduced consumption of sugary foods and beverages, and increased adherence to dental appointments. These behavioral changes can translate into improved clinical outcomes, such as reduced plaque accumulation, lower incidence of dental caries, and improved gingival health. As such, DPETs have the potential to play a significant role in preventing oral diseases and promoting overall oral health. However, the effectiveness of DPETs is influenced by various factors, including the quality and relevance of the content, the usability of the tool, and the individual's level of digital literacy (5). It is essential for healthcare providers to recommend reputable and evidence-based DPETs to ensure that patients receive accurate and reliable information. Additionally, there is a need for ongoing research to assess the long-term impact of digital education tools on oral health outcomes and to identify best practices for their implementation.

Digital health education

In the modern era, the integration of digital technologies into the healthcare sector has revolutionized the way health education is delivered and accessed. Digital health education, encompassing a broad spectrum of tools and platforms, has emerged as a powerful means to disseminate knowledge, promote health literacy, and encourage proactive health behaviors among populations. This transformation is driven by the increasing ubiquity of digital devices, the expansion of internet connectivity, and the growing demand for accessible and personalized health information (6).

At the core of digital health education is the use of electronic resources to teach health-related topics. These resources include e-learning modules, web-based tutorials, mobile applications, virtual reality simulations, and social media platforms. The digital format allows for the presentation of complex health information in an engaging and interactive manner, catering to diverse learning preferences and styles. For example, interactive quizzes and games can reinforce learning, while videos and animations can illustrate concepts that are difficult to convey through text alone (7,8). One of the primary advantages of digital health education is its accessibility. With internet-enabled devices, individuals can access a wealth of health information anytime and anywhere, breaking down geographical and logistical barriers that traditionally limited access to health education. This is particularly beneficial in remote or underserved areas, where access to healthcare professionals and educational materials may be limited. Digital health education can also be tailored to meet the specific needs and preferences of different user groups, including varying age groups, cultural backgrounds, and language proficiencies. Moreover, digital health education facilitates self-paced learning, allowing individuals to absorb information at their own speed and revisit content as needed. This flexibility is crucial in accommodating the diverse learning paces and schedules of users. Additionally, digital platforms can provide real-time feedback and assessments, enabling learners to track their progress and identify areas for improvement (9).

The use of digital health education has been shown to have positive outcomes in various areas of healthcare. For example, in chronic disease management, digital education tools can empower patients to better understand their conditions, adhere to treatment plans, and make informed decisions about their health. In preventive care, digital resources can raise awareness about risk factors, promote healthy lifestyle choices, and encourage regular health screenings. Furthermore, digital health education plays a crucial role in public health initiatives. During health crises, such as the COVID-19 pandemic, digital platforms have been instrumental in disseminating accurate and timely information to the public, countering misinformation, and guiding health behaviors to mitigate the spread of the virus. Social media, in particular, has been a vital channel for health authorities to communicate with the public and provide updates on health guidelines and policies (10).

Despite the numerous benefits, there are challenges to be addressed in the implementation of digital health education. Digital literacy and access to technology remain significant barriers for certain populations, including older adults and those in low-income or rural areas. Ensuring the quality and accuracy of digital health content is also critical, as the vastness of the internet can lead to the spread of misinformation. Moreover, privacy and security concerns related to personal health data need to be carefully managed in digital health education platforms (11).

Impact of education on patients' oral health

Oral health is an integral component of overall well-being, with a direct impact on an individual's quality of life. Education plays a pivotal role in promoting oral health, empowering patients with the knowledge and skills necessary to maintain optimal oral hygiene, prevent dental diseases, and make informed decisions about their oral care. The impact of education on patients' oral health is profound, influencing attitudes, behaviors, and ultimately, clinical outcomes. At the heart of oral health education is the dissemination of information regarding the importance of oral hygiene practices, such as regular brushing, flossing, and the use of fluoridated products. Educating patients about the correct techniques and frequency of these practices is crucial, as it directly impacts the effectiveness of their daily oral care routine. Studies have consistently

shown that individuals who receive proper oral health education demonstrate improved plaque control, reduced gingivitis, and a lower incidence of caries, compared to those who lack such knowledge (12).

Moreover, education extends beyond personal hygiene practices to encompass a broader understanding of the factors that affect oral health. This includes awareness about the role of diet, particularly the consumption of sugary and acidic foods, in the development of dental caries. Nutritional education can guide patients in making healthier food choices, thereby reducing the risk of tooth decay and other oral diseases. Preventive education is another critical aspect, emphasizing the importance of regular dental check-ups and professional cleanings. By educating patients about the value of early detection and intervention, they are more likely to adhere to recommended schedules for dental visits. This proactive approach facilitates the timely management of potential issues, preventing the progression of minor problems into more serious conditions that require extensive and costly treatment (13).

The impact of education on patients' oral health is also evident in the management of chronic conditions such as periodontal disease. Educating patients about the link between oral health and systemic health, including the association between periodontal disease and cardiovascular diseases, diabetes, and respiratory infections, can motivate individuals to prioritize their oral care. Furthermore, tailored education for patients with specific conditions, such as diabetes, can address their unique oral health needs and challenges, leading to better overall management of their health. In the realm of pediatric oral health, education plays a pivotal role in shaping lifelong habits and attitudes. Educating parents and caregivers about the importance of early dental visits, the prevention of early childhood caries, and the proper care of primary teeth lays the foundation for a lifetime of healthy oral practices. School-based dental education programs have been effective in reaching large numbers of children, instilling knowledge and behaviors that contribute to better oral health outcomes (14). The mode of delivery of oral health education is also a critical factor in its impact. Traditional methods such as face-to-face counseling, brochures, and group education sessions have been supplemented by innovative approaches leveraging digital technologies. Online resources, mobile apps, and social media platforms offer interactive and engaging ways to deliver oral health education, reaching a wider audience and catering to different learning preferences. Despite the proven benefits of education on oral health, challenges remain in ensuring that all individuals have access to accurate and relevant information. Disparities in oral health education and care exist among different socioeconomic groups, with marginalized communities often facing barriers to accessing quality education and dental services. Addressing these disparities requires targeted efforts to provide culturally competent education and to improve the accessibility and affordability of oral health care (15).

Oral health education importance

Oral health is an essential aspect of overall well-being, affecting not only the health of the mouth but also general health and quality of life. Education plays a crucial role in promoting oral health, empowering individuals with the knowledge and skills necessary to maintain healthy teeth and gums, prevent oral diseases, and seek timely dental care. The importance of oral health education cannot be overstated, as it has far-reaching implications for public health, economic productivity, and social well-being (16).

One of the primary goals of oral health education is to raise awareness about the significance of good oral hygiene practices. This includes teaching individuals about the proper techniques for brushing and flossing, the importance of using fluoride toothpaste, and the benefits of regular dental check-ups. By instilling these habits from an early age, oral health education can help prevent the onset of common dental problems such as tooth decay, gum disease, and bad breath. In addition to promoting preventive care, oral health education also plays a vital role in disease prevention and management. By informing individuals about the signs and symptoms of oral diseases, education initiatives can encourage early detection and treatment, reducing the risk of complications and more severe health issues. For example, understanding the link between gum disease and systemic conditions like diabetes and heart disease can motivate individuals to prioritize their oral health as part of their overall health management (17).

Oral health education is also important for addressing health disparities and ensuring equitable access to care. Socioeconomic factors, cultural beliefs, and limited access to dental services can contribute to inequalities in oral health outcomes. Tailored educational programs that consider the specific needs and circumstances of different communities can help bridge these gaps, promoting oral health equity and reducing the burden of dental diseases on underserved populations. Furthermore, oral health education has economic implications. The costs associated with dental treatments, especially for advanced conditions, can be significant. Preventive education can reduce the need for expensive interventions, saving individuals and healthcare systems money. Additionally, poor oral health can impact productivity, with dental pain and related issues leading to absenteeism from work or school. By promoting good oral health practices, education can contribute to improved economic productivity and reduced healthcare expenditures (18).

The importance of oral health education extends beyond individual health to encompass broader public health goals. Oral diseases are among the most common noncommunicable diseases globally, with significant impacts on health systems and societies. Effective education strategies can contribute to the prevention and control of these diseases, supporting the achievement of global health targets such as those outlined in the World Health Organization's Global Oral Health Strategy. The delivery of oral health education has evolved with advancements in technology and communication. Digital platforms, social media, and mobile applications offer new opportunities to reach diverse audiences with interactive and engaging content. These tools can complement traditional education methods, providing accessible and personalized information that can cater to different learning styles and preferences (19,20).

Conclusion

In conclusion, the importance of oral health education cannot be overstated. It is a cornerstone of preventive dentistry, empowering individuals with the knowledge and skills necessary to maintain optimal oral hygiene and prevent dental diseases. By fostering awareness of the critical link between oral health and overall well-being, education encourages proactive behaviors that contribute to a lifetime of healthy smiles. Effective oral health education transcends merely imparting information; it involves engaging individuals in a way that motivates them to adopt and sustain positive oral hygiene practices. It addresses the diverse needs of different populations, taking into account age, cultural background, and socioeconomic status, to ensure that the education is relevant and accessible to all.

References

1. Petersen PE, Kwan S. Evaluation of community-based oral health promotion and oral disease prevention – WHO recommendations for improved evidence in public health practice. *Community Dent Health*. 2004 Dec;21(4 Suppl):319-29.
2. Nutbeam D. Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. *Health Promot Int*. 2000 Sep;15(3):259-67.
3. Sheiham A, Watt RG. The common risk factor approach: a rational basis for promoting oral health. *Community Dent Oral Epidemiol*. 2000 Dec;28(6):399-406.
4. Kay EJ, Locker D. Is dental health education effective? A systematic review of current evidence. *Community Dent Oral Epidemiol*. 1996 Aug;24(4):231-5.
5. Kwan SYL, Petersen PE, Pine CM, Borutta A. Health-promoting schools: an opportunity for oral health promotion. *Bull World Health Organ*. 2005 Sep;83(9):677-85.
6. Sgan-Cohen HD, Evans RW, Whelton H, Villena RS, MacDougall M, Williams DM, et al. IADR Global Oral Health Inequalities Research Agenda (IADR-GOHIRA®): a call to action. *J Dent Res*. 2013 Feb;92(2):209-11.
7. Watt RG. From victim blaming to upstream action: tackling the social determinants of oral health inequalities. *Community Dent Oral Epidemiol*. 2007 Feb;35(1):1-11.
8. Moysés SJ, Watt RG, Sheiham A. Associations between health-promoting schools' policies and indicators of oral health in Brazil. *Health Promot Int*. 2003 Sep;18(3):209-18.
9. Burt BA, Eklund SA. *Dentistry, Dental Practice, and the Community*. 6th ed. St. Louis: Elsevier Saunders; 2005.
10. Pine CM, Harris RV, Burnside G, Merrett MCW. An investigation of the effectiveness of school dental health education in the United Kingdom. *Br Dent J*. 2006 Feb;200(3):155-9; discussion 147.
11. Biesbrock AR, Bartizek RD, Walters PA, et al. Clinical evaluations of plaque removal efficacy: an advanced rotating-oscillating power toothbrush versus a sonic toothbrush. *J Clin Dent*. 2007;18(4):106-11.
12. Kay EJ, Locker D. Is dental health education effective? A systematic review of current evidence. *Community Dent Oral Epidemiol*. 1996 Aug;24(4):231-5.
13. Petersen PE, Bourgeois D, Ogawa H, et al. The global burden of oral diseases and risks to oral health. *Bull World Health Organ*. 2005 Sep;83(9):661-9.
14. Sprod AJ, Anderson R, Treasure ET. *Effective oral health promotion: literature review*. Cardiff: Health Promotion Wales; 1996.
15. Nutbeam D. Health promotion glossary. *Health Promot Int*. 1998 Mar;13(4):349-64.
16. Sheiham A. Oral health, general health and quality of life. *Bull World Health Organ*. 2005 Sep;83(9):644.
17. Pine CM, Adair PM, Nicoll AD, et al. International comparisons of health inequalities in childhood dental caries. *Community Dent Health*. 2004 Mar;21(1 Suppl):121-30.
18. Robinson PG, Deacon SA, Deery C, et al. Manual versus powered toothbrushing for oral health. *Cochrane Database Syst Rev*. 2005 Jul 20;(2):CD002281.
19. Watt RG, Marinho VC. Does oral health promotion improve oral hygiene and gingival health? *Periodontol 2000*. 2005 Jun;37:35-47.
20. Loe H. The Gingival Index, the Plaque Index and the Retention Index Systems. *J Periodontol*. 1967 Nov;38(6):Suppl:610-6.