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Progress in the Application of Digital Health Interventions in Oral Health Management

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Abstract: Objective: To systematically sort out the application forms and effects of digital health intervention technologies in oral health management, and provide references for the digital development of stomatology. Methods: By reviewing relevant domestic and foreign studies and clinical practices, this paper summarizes and analyzes the main application forms of digital health interventions, including digital health education, intelligent detection equipment, telemedicine platforms, oral health big data platforms, and school-hospital collaborative screening robots. *Results:* Studies have shown that digital health interventions can effectively improve the public's oral health knowledge level, optimize personal health behaviors, enhance clinical diagnosis efficiency, reduce overall medical costs, and promote the innovation and upgrading of oral health management models. *Conclusion:* Digital health intervention represents an inevitable trend in the future development of stomatology. In the future, it is still necessary to improve data security and privacy protection, technology adaptability and popularity, as well as relevant policies and norms, to give full play to its potential value.

Keywords: Digital health intervention; Oral health management; Application progress

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1. Introduction

Oral health is an important part of human health, directly affecting people's quality of life and overall sense of well-being. However, the incidence of oral diseases in China remains high, with common oral diseases such as periodontitis and dental caries exerting continuous pressure on public health. According to the Report on the Status of Oral Health in China released by the Chinese Stomatological Association in 2024, the prevalence of periodontitis among people aged 35–74 in China is as high as 68.7%, and about 72% of adults have poor dental plaque control. The traditional oral health management model mainly relies on regular clinical examinations and patients' subjective feelings, which often has limitations such as discontinuous data recording, lack of targeted interventions, and limited management efficiency. With the rapid development and cross-field integration of digital technologies, digital health intervention has provided new ideas and powerful technical tools for innovating oral health management, showing broad application prospects [1].

2. Overview of digital health interventions and oral health management

2.1. Digital health intervention

Digital health intervention mainly refers to the use of digital technology means such as big data, artificial intelligence, and the Internet of Things to continuously monitor, record, and evaluate an individual's oral health status, and provide personalized health management plans based on the evaluation results [2]. This process covers multiple links including oral health data collection, dynamic risk assessment, knowledge popularization and education, and rehabilitation follow-up guidance. Its core goal is to achieve early detection, early warning, and early intervention of oral diseases through modern and digital management methods, thereby enhancing the scientificity and forward-looking of oral health management. Applying digital health interventions to oral health management can leverage technological advantages to provide the public with more convenient, efficient, and personalized health services [3].

2.2. Importance of oral health management

As the starting point of the digestive system and the gateway to the respiratory tract, the oral cavity undertakes important physiological functions such as chewing, pronunciation, and facial maintenance. At the same time, numerous studies have confirmed that oral health is closely related to systemic diseases, for example, there is a two-way promoting relationship between periodontal disease and diabetes, cardiovascular diseases, respiratory infections, etc. Therefore, strengthening oral health management is not only necessary for maintaining the health of local organs but also an important part of preventing and controlling systemic diseases and improving the overall health level of individuals [4].

2.3. Limitations of traditional oral health management models

The traditional oral health management model, dominated by periodic outpatient examinations and patient self-reports, has limitations mainly reflected in the following aspects: first, the source of health data is single and discontinuous, making it difficult to form a complete personal health profile; second, health guidance tends to be generalized, making it difficult to meet the personalized needs of people of different ages and risk groups; finally, the management model is passive and inefficient, failing to adapt to people's demands for convenience and immediacy of health services in modern fast-paced life [5].

3. Application forms of digital health interventions in oral health management

3.1. Digital health education

Digital health education is an important form of digital health intervention. With the help of technologies such as artificial intelligence, virtual reality (VR), and augmented reality (AR), it transforms abstract and complex oral health knowledge into intuitive and vivid video content, thereby significantly enhancing the public's learning interest and understanding depth. For example, by building a digital oral health education center, 3D animation technology is used to simulate the formation process of dental caries or the development stages of periodontal disease, allowing the public to intuitively understand the principles of diseases. At the same time, VR/AR technology is used to create immersive interactive experiences, enabling users to "personally" experience the consequences of bad oral habits, effectively strengthening their health awareness. This educational method not only enriches popular science means but also reduces the cost of carrying out long-term health education [6].

3.2. Intelligent detection equipment

Intelligent detection equipment realizes real-time monitoring of daily oral health behaviors through integrated sensors and data transmission modules. For example, smart toothbrushes can record users' brushing time, coverage, intensity, and other data, generate visual reports through mobile phone apps, and provide personalized brushing improvement suggestions. In addition, some advanced oral detection equipment can quickly screen the temperature, pH value, and specific bacterial markers in the oral cavity, providing users with preliminary risk warnings and prompting them to seek professional diagnosis and treatment in a timely manner [7].

3.3. Telemedicine platforms

Telemedicine platforms break the time and space limitations of oral medical services using communication technology. Patients can upload oral photos, describe symptoms, and share past medical records through mobile applications or computer-based platforms, communicate online with doctors, and obtain preliminary diagnostic opinions and medical guidance. For example, the children's oral health management platform developed by Qingdao Stomatological Hospital integrates remote consultation functions, facilitating communication between parents and doctors, especially suitable for follow-up consultations and chronic disease management, effectively saving patients' time and economic costs [8].

3.4. Oral health big data platforms

Oral health big data platforms are committed to aggregating massive data from multiple sources such as clinical diagnosis and treatment, intelligent equipment, and public health surveys. By using big data analysis and machine learning algorithms, the platform can deeply tap data value, reveal disease prevalence rules, evaluate intervention effects, and predict individual disease risks, thereby providing strong data support for formulating precise public health strategies and personalized clinical treatment plans [9].

3.5. School-hospital collaborative screening robots

The introduction of screening robots equipped with artificial intelligence visual recognition technology into campuses is an innovative application of digital health interventions in group screening. Robots can automatically collect and analyze students' oral images, quickly identify common problems such as dental caries, dental plaque, and gingivitis, and generate screening reports. This method helps realize large-scale, standardized early screening among children and adolescents, achieving early detection and early intervention. At the same time, it liberates professional medical staff and improves public health efficiency [10].

4. Application effects of digital health interventions in oral health management

4.1. Improve the effect of oral health knowledge promotion

Digital health education methods, with their vividness and interactivity, have significantly improved the attractiveness and dissemination efficiency of health information. By visualizing and interesting complex knowledge, they effectively overcome the tediousness of traditional text-based promotion, enhance the understanding and memory of the public of different ages and educational backgrounds, and thus comprehensively improve the effect of oral health knowledge popularization [11–13].

4.2. Optimize oral health behaviors

The real-time feedback and personalized guidance provided by intelligent detection equipment create a continuous behavioral intervention mechanism. When users can intuitively see that their brushing effect is poor or certain oral indicators are abnormal, they are more motivated to adjust their behaviors. This immediate, visual positive or negative feedback helps urge users to develop good oral hygiene habits, realizing the transformation from "knowledge" to "action".

4.3. Enhance diagnosis efficiency

Telemedicine platforms optimize the allocation of medical resources, enabling expert resources to serve a wider population, reducing unnecessary offline outpatient visits, and improving service accessibility. At the same time, oral health big data platforms can assist doctors in diagnostic decision-making. By retrieving and analyzing patients' panoramic data, they shorten diagnosis time and improve the accuracy and consistency of diagnosis.

4.4. Reduce medical costs

Digital health interventions fundamentally reduce medical expenditures through "front-end prevention" and "early intervention". For example, the application of campus screening robots can detect and address simple oral problems as early as possible, preventing them from developing into complex severe diseases and saving high treatment costs in the later stage. For individuals and society, this proactive health management method can reduce the loss of work and study time caused by oral diseases, generating significant economic benefits [14].

4.5. Promote the innovation of oral health management models

Digital health interventions are driving the transformation of oral health management from "treatment-centered" to "health-centered". They make continuous, dynamic health monitoring possible, and the management method becomes more precise and personalized. For example, a municipal stomatological hospital has innovated a regional oral health management model by building a three-level oral disease prevention and control network and using digital tools to achieve data intercommunication and linkage between communities and hospitals [15].

5. Conclusion

In summary, digital health intervention technologies have brought revolutionary changes to oral health management, injecting new connotations of precision, personalization, and efficiency. However, their widespread application still faces a series of challenges: first, the security of health data and the protection of personal privacy are top priorities, requiring strong laws, regulations, and technical means as guarantees; second, attention must be paid to the universality of digital technologies, striving to address the "digital divide" faced by people of different ages and regions; finally, the charging standards, effect evaluation systems of digital medical products, and their connection with existing medical insurance payment policies still need to be further clarified and improved. Looking forward, efforts should be made to build a collaborative innovation ecosystem covering technology R&D, clinical verification, policy support, and market application, promoting the in-depth integration and standardized development of digital health interventions in the field of stomatology, and ultimately providing core driving force for achieving the grand goal of "national oral health".

Disclosure statement

The author declares no conflict of interest.

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