ADVANCEMENT IN DENTISTRY

Abstract

This article explores the profound impact of digital technology on patient care, with a focus on dentistry and its global significance outlined by the WHO's Global Strategy on Digital Health. Highlighting technological advancements, including virtual reality, artificial intelligence, and CRISPR, the article discusses their contribution to alternative treatments and enhanced oral healthcare. Wearable biosensors, intelligent toothbrushes, and augmented reality are dissected as integral components of this transformative journey. The future of dentistry is envisioned through the lens of artificial intelligence, exploring personalized diagnostics, intelligent toothbrush monitoring, and immersive virtual reality experiences for students and patients. The concept of "phone dentistry" and tele-dentistry is introduced, providing convenient access to oral care, especially for remote populations. The integration of microchips, known as "intelligent teeth," is discussed for continuous monitoring, alongside the impact of computer-assisted design and 3D printing on dental solutions. The article envisions a future where digital health technologies revolutionize patient care and education globally, transcending geographical barriers.

Keywords: digital health, dental care, geographical barriers**.**

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I. INTRODUCTION

The integration of digital technology has become an indispensable element of our daily lives, fostering global connections among people like never before. Remarkable advancements, particularly within the realm of digital technology, are taking place at an unprecedented pace. However, the potential of digital health solutions to enhance the well-being of populations remains largely untapped.

The World Health Organization (WHO) recognizes the significant impact of digital technology and health innovation in expediting global health and promoting overall well-being. The 2020 Global Strategy on Digital Health, which received approval from the World Health Assembly, outlines a blueprint for incorporating the latest developments in digital health and utilizing them to improve health outcomes.

One of the strategic goals of the WHO is to ensure that digital health contributes to equitable and comprehensive access to high-quality health services. Digital health has the potential to enhance the effectiveness and long-term viability of health systems, enabling them to deliver affordable, impartial, and top-notch healthcare.

Achieving these objectives presents notable challenges, particularly for nations with limited economic resources. The Global Strategy on Digital Health seeks to aid countries in strengthening their health systems through the integration of digital health technologies, aligning with the overarching vision of universal health coverage. The strategy is intentionally flexible and accessible to all member states, including those with restricted access to digital technologies, products, and services.

II. IMPORTANCE OF TECHNOLOGICAL ADVANCEMENTS IN DENTISTRY

Despite the widespread acknowledgment of the significance of maintaining oral hygiene and its link to overall well-being, a substantial number of individuals still experience unease when contemplating a visit to the dentist. Nevertheless, the field of dentistry is presently undergoing a significant evolution through the introduction of cutting-edge technologies such as virtual reality, artificial intelligence (AI), and CRISPR. It is imperative to embrace these innovations and comprehend the respective advantages and disadvantages they entail. The potential for alternative treatments, streamlined procedures, heightened efficiency, and elevated quality of healthcare is on the horizon. In a manner akin to other domains of healthcare, dentistry has undergone a metamorphosis by incorporating computer-based technologies, novel preventative measures, and enhanced diagnostic techniques. The process of digitalization, alongside cloud computing and the integration of applications with smart phones and other devices, facilitates ongoing monitoring of oral health for patients. Additionally, wearable biosensor technology, exemplified by fitness trackers, smartwatches, and glucose monitors, has become an integral facet of our day-to-day existence.

III. THE FUTURE TECH OF DENTISTRY

Modern human life is gradually being permeated by the presence of technologies. The rapid expansion of health-related data and the advancement of health-care artificial intelligence (AI) have opened the door to incorporating intelligent algorithms into the health-

care system. These algorithms possess the capability to analyze health data, research discoveries, and treatment methodologies, thereby providing personalized diagnostic and therapeutic recommendations for individual patients. Presently, AI is progressing swiftly beyond its initial applications in text and image-based dental practices.

The transformation of dentistry through digitalization is embarking on a fresh trajectory, with dentists utilizing software to gain valuable insights for clinical decision-making. Patient-centric care is also becoming increasingly cantered around mobile platforms, where AI-driven devices play a pivotal role in enabling patients to conveniently monitor their well-being and exchange data with dental professionals. Beyond the analysis of health data, AI-driven algorithms hold the potential to significantly enhance the management of dental conditions. In 2019, researchers introduced a machine learning technique that accurately quantifies immune cells neighbouring oral cancer cells, thereby offering enhanced insights into cancer spread, resistance mechanisms, and the prediction of survival rates. Similarly, neural networks are being leveraged to enhance the detection of dental decay and periodontal disease from radiographic images. These methods are poised to potentially become routine practices in the foreseeable future. The potential applications of AI in the realm of health care are virtually boundless.

IV. INTELLIGENT TOOTHBRUSH

Advanced smart toothbrushes come equipped with an array of sophisticated features, including cameras, sensors, and more, which work harmoniously to monitor the brushing activity and simulate a comprehensive dental check-up during routine brushing sessions. This innovative functionality empowers dentists to assess an individual's teeth utilizing the camera-generated data in real-time while brushing. Furthermore, the integrated pressure sensors play a crucial role in evaluating the accuracy of the brushing technique.

All the gathered data can be seamlessly transmitted to the dentist in real-time, leading to a substantial enhancement in the preventive care process. The intelligent toothbrush is also adept at capturing intraoral images, which are subsequently relayed to a server for analysis. AI algorithms diligently scrutinize these images, scouring for any indications of cracks, cavities, or other irregularities that warrant the attention of a dental specialist. In instances where the preliminary assessments raise concerns, both the patient and the clinician receive notifications through mobile applications, prompting the patient to schedule an appointment at the dental clinic.

V. AUGMENTED REALITY (AR)

Enhanced reality technology introduces supplementary virtual information into the physical environment, creating a blend of possibilities across various domains. Medical education and training have readily embraced this technology, particularly within oral and maxillofacial surgery in dentistry. Prominent applications arise in dental implant placement and orthognathic surgery, with ongoing technological progress unveiling fresh avenues in restorative dentistry, orthodontics, and endodontics.

Incorporating Enhanced Reality alongside a mannequin facilitates a hands-on learning experience for students. They can perform procedures while receiving immediate feedback,

as their movements are meticulously tracked. This empowers students to swiftly identify areas for improvement, fostering skill enhancement in the process. Furthermore, AR holds potential in the realm of dental reconstructive and aesthetic procedures. It provides patients with a preview of their appearance post-treatment. Utilizing AR apps, a phone or tablet camera overlays virtual images of an improved set of teeth, enabling patients and dentists to personalize features like height and spacing based on individual preferences even prior to entering the surgery room.

VI. VIRTUAL REALITY (VR)

Distinguishing itself from Augmented Reality (AR), Virtual Reality (VR) is a technology that engulfs the user within a simulated environment by isolating them from the external world through a dedicated headset. This specialized headset allows aspiring dental surgeons and students to be virtually transported to an operating room (OR) while seated on their sofa. Similarly, patients undergoing dental procedures can immerse themselves in calming landscapes, enhancing their experience and alleviating discomfort associated with the dental chair.

Presently, only a limited number of students have the opportunity to closely observe surgeries, posing challenges to mastering the intricacies of the profession. However, with the integration of virtual reality cameras, surgeons can broadcast procedures globally, enabling medical students to witness surgeries in real-time through their VR goggles. The dental field has rapidly embraced this technology, which also aids dentists in cultivating empathy through simulations that place them in their patients' perspectives or in challenging scenarios.

From the patient's standpoint, VR holds potential as an effective distraction tool in dentistry, potentially mitigating the anxiety often linked with dental appointments. Patients can don goggles that project serene natural scenes, potentially leading to more positive recollections of their treatment experiences afterward.

Augmented reality (AR) and virtual reality (VR) have gained substantial traction across the entire spectrum of dentistry and dental education, establishing themselves as invaluable digital resources. In this context, virtual articulators serve as a pivotal tool, enabling a thorough assessment of occlusion by utilizing dental models capable of replicating all conceivable movements of the lower jaw, whether stationary or dynamic. When integrated with supplementary software, virtual articulators contribute to the enrichment of both education and practice. They expedite the process of generating precise personalized diagnoses, leading to swifter and more accurate evaluations. Additionally, virtual articulators facilitate meaningful discussions surrounding dental treatment plans with patients right from their initial consultation. This amalgamation of technology significantly advances the educational, diagnostic, and patient-engagement facets of the dental field.

VII. DIGITAL PATIENTS

This enables them to refine and enhance their communication skills within a controlled and secure setting prior to engaging with actual patients. Moreover, virtual patients offer a diverse array of scenarios and medical conditions, affording students the opportunity to familiarize themselves with a broad spectrum of cases that might not be encountered

during their practical clinical training. This exposure cultivates the development of essential attributes such as critical thinking and problem-solving abilities, as students become adept at diagnosing and devising treatment strategies for an array of patient profiles. In essence, the amalgamation of technology and virtual patients within dental education provides an invaluable resource, elevating the quality of training and preparation for the next generation of dental practitioners.

VIII. PHONE DENTISTRY

For individuals with specific needs or elderly residents in nursing homes, seeking healthcare services can pose challenges. Additionally, geographical distance compounds the issue, particularly for those living in rural areas who often lack access to dental care options. However, the landscape can transform significantly through the widespread adoption of tele dentistry.

Tele dentistry solutions introduce a convenient avenue for accessing oral and dental care, offering heightened affordability, advocating preventive measures, and granting patients the opportunity to consult with healthcare providers who might otherwise be out of reach. It establishes a comprehensive tele dentistry platform that empowers patients to capture images, transmit pertinent information to a dentist remotely, and engage in real-time consultations. Through this system, dentists can initiate video chats with patients and their caregivers, facilitating direct communication. This approach allows medical professionals to connect with patients, establish rapport, provide guidance, and arrange in-person clinic visits as needed.

Recent years have marked substantial technological advancements within the realm of dentistry. The integration of computers, telecommunication technology, digital diagnostic imaging services, devices, and analytical software has all progressed significantly. As a result, the field of dentistry has achieved noteworthy advancements in the domain of remote care. The incorporation of sophisticated information technology has not only elevated the standard of dental patient management but has also enabled the possibility of managing patients partially or entirely from great distances, even thousands of kilometers away from healthcare facilities or qualified dental professionals. The dental sector of telemedicine, commonly known as "tele dentistry," encompasses a comprehensive process that involves networking, the exchange of digital information, remote consultations, comprehensive workups, and in-depth analyses.

IX. INTELLIGENT TEETH

The integration of sophisticated microchips into artificial limbs or the insertion of a microchip obtained from a fragment of an existing tooth presents the opportunity for monitoring various parameters. These microchip implants have the potential to contribute to the development of "smart teeth," which possess the capability to assess factors such as saliva acidity, dietary intake, consumption of acidic beverages and meals, blood alcohol levels, and other pertinent information. The collected data could then undergo analysis through AI and big data techniques to uncover patterns and correlations. This process could potentially lead to an increase in personalized recommendations for preventive dental care tailored to each individual's unique needs.

X. COMPUTER-ASSISTED DESIGN AND 3D PRINTING

Over the last 25 years, the utilization of computer-aided design (CAD) and computer-aided manufacturing (CAM) has gained significant popularity within the field of dentistry. This technology has found application in both dental labs and dental offices, revolutionizing the creation of a range of dental solutions including inlays, onlays, veneers, crowns, fixed partial dentures, implant abutments, and even comprehensive full-mouth reconstructions. Notably, orthodontic treatments are also progressively incorporating CAD/CAM technology.

The evolution of CAD/CAM technology was driven by three primary objectives. Firstly, it aimed to ensure the durability of restorations, particularly for posterior teeth. Secondly, it sought to achieve a natural and aesthetically pleasing appearance for these restorations. Lastly, the technology aimed to simplify and expedite the process of tooth restoration, simultaneously enhancing precision. Notably, in certain instances, CAD/CAM technology facilitates same-day restorations for patients, contributing to an efficient and prompt dental care experience.