Review Article

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Exploring the Current Applications and Future Implications of Artificial Intelligence in Public Health Dentistry: A Narrative Review

Dentistry Section

TANUSHRI MAHENDRA DALVI[1], RAJESHRI KOTWADEKAR[2], SHRIVARDHAN R KALGHATGI[3], PRIYANKA PAUL MADHU[4], PRIYANKA METHILDEOTARE[5]

ABSTRACT

Artificial Intelligence (AI) is transforming healthcare at a rapid rate by enhancing disease prevention, diagnosis, treatment planning and management of health systems. AI technologies such as machine learning, deep learning, and natural language processing have been able to show an enormously huge scale capacity for improvement in oral health outcomes at the population level, particularly among disadvantaged groups. AI based applications in preventive dentistry can identify high risk individuals for dental caries, periodontal infections and oral cancer to allow targeted dental care. Deep learning algorithms can also be applied in imaging diagnostics and dental care can be personalised using patient's history, habits and genetics. AI applications can also be utilised in epidemiologic surveillance for analysis of health-related information in forecasting disease patterns and drafting evidence based public health policies. AI can enhance dental education and training of new dental professionals through simulation-based education and intelligent tutoring systems. Administrative efficiency can also be achieved using AI based management software for patient scheduling, billing, and resource management which can reduce the workload of the clinician and enhance the functioning of health system. Inspite of the widespread applications of AI in dental public health, ethical issues related to data security, unequal access to technology and regulatory policies need to be addressed. Transparency in AI usage, accountability and equitable incorporation of AI in health systems are required. With a focus on diagnostic tools, epidemiological monitoring, individualised care, and health system management, this review article attempts to investigate the various uses of AI in public health dentistry. In the present review article, future prospects for AI in the public health dentistry field are explored, as well as its possible advantages and difficulties.

Keywords: Diagnostic imaging, Epidemiological surveillance, Oral health, Predictive modelling, Tele-dentistry

INTRODUCTION

The AI refers to imitation of human intelligence in machines designed to perform functions that usually require human cognitive abilities. AI is blossoming and expanding rapidly in all sectors like healthcare and medicine, education, finance, manufacturing, retail, supply chain, logistics and utilities [1]. It can learn from human expertise and undertake works typically requiring human intelligence. In recent years, AI has made sufficient contributions to various health traps, including public health dental treatment, where it has the opportunity to change the way of dental care at the population level. AI can assist in treatment planning and predicting treatment outcomes. Machine learning algorithms can analyse data from previous treatments to suggest the most effective treatment plans [2]. AI-powered chatbots and virtual assistants can educate patients about oral health, provide personalised advice, and raise awareness about the importance of regular dental check-ups [3]. AI can also assist to address the shortages in the workforce and there by assisting to attain WHO sustainable developmental goals. AI has been adopted in all dental disciplines, i.e., operative dentistry, periodontics, orthodontics, oral and maxillofacial surgery, and prosthodontics [2]. Globally, with increasing strain of oral diseases, especially in signed communities, AI can offer innovative prevention solutions, diagnosis and improvement in management. The AI model can also effectively recognise and classify patients with various oro-facial into different risk categories, both individually and on the group basis [4]. This review examines AI applications in public health dentistry, focusing on its impact on the prevention of diseases, clinical accuracy, epidemiological monitoring and health system management.

Applications of AI in Public Health Dentistry

The incorporation of AI in transforming Public Health Dentistry by improving health care delivery systems, and improving disease prevention. With the help of machine learning, predictive analytics and imaging techniques, AI facilitates early detection of oral conditions, enhances epidemiological surveillance and assists in personalised treatment planning. Decision making process can also be enhanced which helps in better managing of resources, thus assisting communities in attaining optimal oral health.

- **Disease prevention and health promotion:** AI can help in planning targeted health promotional programs and also used as a tool for predicting oral health outcomes. AI assisted predictive models can identify people with high risk of dental caries, periodontal diseases and oral cancer. These models can assist public health personnel to prioritise interventions in vulnerable populations.
- **AI in early detection of oral diseases:** Deep learning algorithms have been used in radiographic images to detect the first signals of dental and periodontal disease. These systems also use pattern recognition to identify minor changes that are not noticed by human sensors. This early detection can lead to timely preventive measures such as fluoride application and oral hygiene education [5].
- **Behavioural interventions and personalised oral health education:** AI can also be used to design personal health care campaigns based on a person's behaviour and socio-economic factors. For example, AI-based mobile apps can track an individual's oral hygiene habits and provide reminders, feedback, and encouragement for proper oral care [6]. AI-driven systems for personalised health education and behaviour change, guiding patients through customised oral care regimens.
- **AI in dental education system:** For students pursuing dentistry, preclinical training has historically always included conceptual

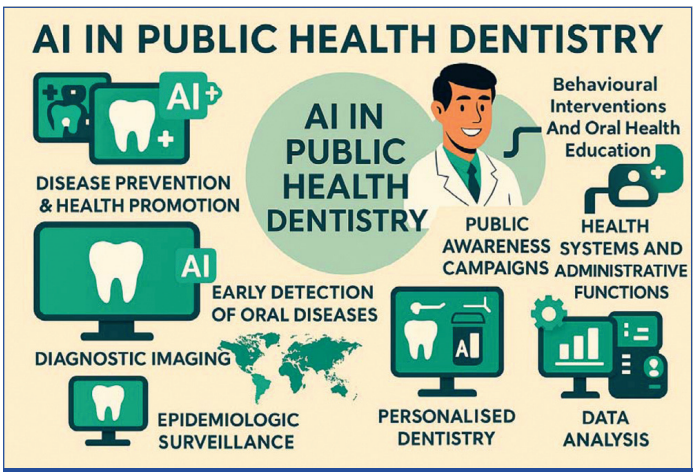
and hands-on instruction and demonstrations before operating on patients. In recent years, various learning management systems and dental training systems have included AI for a better learning experience. Students may participate in practice rounds as often as necessary to become experts in the field to lower the danger of iatrogenic harm before managing actual clinical situations. This training approach is more effective and trustworthy [7].

- **Public awareness campaigns:** AI tools for designing and targeting public health campaigns, focusing on areas such as oral hygiene, tobacco cessation, and nutrition [8,9]. Different demographic groups respond to varied communication approaches for example younger generation may be engage more of the digital content while older people prefer more of the traditional media channels.
- **AI in paediatric dentistry:** A recent review by Mallineni SK et al., states that Children's Oral Health Score (COHSI) and the Referral For Treatment Needs Of Oral Health (RFTN) are some tools which are created with the help of AI and machine learning for checking people's health; they can also aid in finding extra teeth, plaque, and to assess the indications of fissure sealants; to predict early childhood caries; to estimate dental age; to find submerged teeth; and to find teeth that are erupting in the wrong place [4].

AI in Diagnostic Imaging

AI's most prominent application in dentistry is in the field of diagnostic imaging, wherein device studying algorithms assist inside the analysis of X-rays, CT scans, and intraoral cameras. These AI-powered systems increase diagnostic accuracy by reading great quantities of data and identifying dental conditions that can be disregarded by using traditional methods.

- **Carious lesion detection:** Machine learning algorithms can assist in the early detection of dental caries from radiographs with high accuracy. Convolutional neural networks (CNNs) are widely used for caries detection, showing a performance comparable to or exceeding human experts [10].
- **Periodontal Disease:** AI-based models can diagnose periodontal pocket depths and radiographic evidence of bone loss. At risk patients for periodontal diseases can be identified based on these applications to initiate appropriate preventive or therapeutic interventions [11].
- **Oral cancer diagnosis:** AI based algorithms have been designed to analyse oral lesion images for improving the detection and early diagnosis of oral cancer. AI can aid in faster diagnosis and treatment planning by classifying oral lesions as benign or malignant [Table/Fig-1] [4,12-14].



[Table/Fig-1]: Applications of Artificial Intelligence (AI) in Public Health Dentistry [4,12,13].
*Image designed by the authors using Microsoft Copilot, Microsoft 2025.

Epidemiological Surveillance and Public Health Data

In the field of public health dentistry, AI could improve epidemiological investigations by analysing data related to the oral health. AI can predict the future prevalence of oral diseases according to socio-economic and demographic factors and also help in monitor trends in disease occurrence. These findings can direct the development of evidence-based policies.

- **Integration and data analysis:** AI may combine data from multiple sources, including patient records, epidemiological reports, and medical studies to find trends in oral disorders across different locations. For example, national health databases employ AI algorithms to identify high-risk populations for oral cancer [15].
- **Predictive modelling:** AI models can be used to predict the future burden of oral diseases at a population level. This model allows various public health institutions to implement target prevention strategies in consideration of various socio-economic, lifestyle, and environmental factors that contribute to oral health results [16].

Personalised Dentistry and Treatment Planning

AI plays a key role in individual treatment by analysing an individual's oral, medical history, and lifestyle elements for identifying the disease and suggesting treatment options. The concept of personalised dentistry based on AI, can greatly improve patient treatment results and satisfaction.

- **AI for treatment recommendations:** AI systems can analyse patient data to recommend relevant dental restorations, orthodontic treatment methods and personal therapy including periodontal. By integrating patient preferences and clinical results, AI can help dental professionals make more reasonable decisions [17].
- **Orthodontics:** AI has been particularly useful in orthodontics, where it can assist in treatment planning by predicting the future alignment of teeth based on the patient's current condition. AI models help optimise the placement of brackets and wires, resulting in more efficient and effective orthodontic treatments [18,19].
- **Telemedicine:** "Telemedicine" as the practice of medicine facilitated by electronic communication, information technology, or other means between a physician in one location and a patient in another, with or without an intervening healthcare provider [20]. Telemedicine has proven to be cost-saving compared to standard face-to-face visits, resulting in reduced healthcare spending by patients [21,22]. The COVID-19 pandemic outbreak led to a sharp rise in the utilisation of telemedicine [23]. Data protection, ethical issues, safety, licensing, and malpractice, because of state licensing and legislation, even continuing education courses in the dental field, like X-ray protection refresher courses, are barred or may demand things, like having a camera on and face visible in the whole continuing education course [24].

AI in Health Systems and Administrative Functions

Beyond clinical practice, AI has applications in streamlining administrative and operational functions in public health dentistry. AI can help in reducing workload of clinicians and data managers by automating routine administrative tasks such as patient scheduling, record-keeping and billing.

- **Resource allocation:** AI can be employed to manage dental workforce distribution by identifying areas with insufficient dental care providers. AI-powered tools can also help allocate resources more effectively by predicting areas of high demand for dental services [25].
- **Decision support systems:** AI-based decision support systems assist public health administrators in planning oral health campaigns and managing patient flow in dental clinics, especially in underserved communities [26,27].

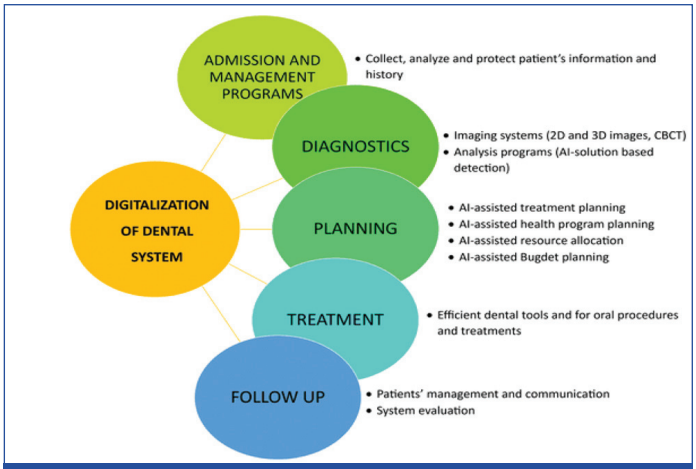
Future Implications of AI in Public Health Dentistry

In the next few years, AI is expected to be applied for predictive modelling of dental diseases so that the diseases are detected earlier and risk can be better assessed. Machine learning techniques will evaluate various parameters like patient demographics, genetic susceptibility, lifestyle variables, and environmental exposures in order to predict high-risk individuals of dental conditions such as dental caries, periodontal disease and oral cancer [5]. AI-enabled systems will also be used in mobile dental health applications and tele dentistry platforms for monitoring health in real-time and consulting patients. The platforms will provide personalised recommendations regarding habits of oral care and dietary habits to avert oral disease from arising [28]. AI will play an even more advanced role in diagnostic imaging in the future. Deep learning algorithms, especially in radiographic examination, will enable computer-aided interpretation of X-rays, Cone Beam Computed Tomography (CBCT) scans, and intraoral photographs with great precision. Additionally, AI will enable remote consultations via tele-dentistry and allow dental professionals to evaluate the oral condition of patients remotely. This will especially benefit rural and underprivileged communities where dental services are not readily available [29]. Perhaps the most intriguing potential use of AI in dental public health is its ability to render customised dental care. AI will be employed to design personally customised treatment programs based on an individual's own genetic makeup, medical background, oral history, and other variables such as economic status. For instance, AI algorithms can forecast the results of orthodontic treatment plans and aid in the selection of the proper materials for restoration procedures depending on a patient's individual requirements [30]. With the combination of AI and digital dentistry, it will become possible to deliver customised treatment for dental conditions such as caries, periodontal disease, and even oral cancer according to patient-specific risk factors and needs [31]. This tailored solution guarantees improved treatment plans and may result in increased patient compliance and satisfaction. AI will make possible major advancements in oral health surveillance at the population level. With large datasets from national health surveys, dental histories, and even social media posts, AI can identify trends and forecast outbreaks of diseases. Machine learning algorithms will guide public health professionals in the identification of vulnerable groups and interventions among them. AI will also play an important part in epidemiological studies, as researchers will be able to establish the correlation of oral health with other systemic illnesses [32].

AI has the potential to reduce costs and optimise resources in field of dental care [33]. For instance, AI controlled medical management systems can ensure efficient use of dental specialist and equipments by predicting the prevalence of oral cavity diseases. Tools based on AI can also automate management work such as planning, patient management, and claims to reduce operational costs [Table/Fig-2] [34]. In the countries where resources are limited, AI can overcome the gap between the medical services, promote telecommunication and help to diagnose the people in the remote areas. This approach can expand the oral health approach in rural areas and marginal communities.

Global Expansion of AI in Dentistry

The possibilities for AI to help bridge dental health disparities around the world are tremendous. In under-served areas, AI-enabled tools such as diagnostic equipment, mobile apps, and tele-dentistry will bring quality dental care to under-served populations. The scalability of AI-based systems will improve dental disease prevention and management in areas where there is a lack of trained dental professionals. Future AI-based programs will respond to equal access to dental care with global health objectives like the United Nations Sustainable Development Goals (SDGs) [35].



[Table/Fig-2]: AI based digitalisation of dental system.

Overcoming Ethical and Regulatory Challenges of AI Applications in Dental Public Health.

Since development of AI is being pursued in public health dentistry, it will be necessary to conquer the ethical and regulatory issues in using it. The future will involve making AI systems transparent, fair, and accountable. Regulatory authorities will have to create guidelines for ensuring safety and reliability in AI technologies, and strict norms must ensure confidentiality of patients as well as security of data [13]. There is still a controversy surrounding use of AI in ethical decision-making process which needs to be addressed with refinement of the AI technologies. A key to sustaining trust in AI technologies can be maintained provided that patients stay in control and that AI is merely a means to assist healthcare providers and not substitute for them. The use of AI requires large datasets which are most likely to contain sensitive health related information. Protecting such information from unauthorised access and keeping it private is necessary to ensure patient trust and compliance with regulations. Access and equity in most developing countries, access to AI technology remains limited. Differences in technology availability can widen pre-existing health inequities, especially where it is resource-limited or in rural communities. There are ethical issues involved with the ethics of AI-driven decision-making, especially in clinical practice. Translucence and accountability for AI models must be ensured in order to prove they are utilised ethically. Integration of AI with existing public health infrastructure is challenging because of the complexity of AI models and the need for specialist training in healthcare set-up.

CONCLUSION(S)

AI has the potential to provide novel solutions to diagnose and prevention of disease, personalised treatment using predictive models and sophisticated health monitoring in public health administration thereby transforming public health dentistry. Even though the application of AI in diagnostics and epidemiology holds much promise, work needs to be done to address the issues of data privacy, access, and integration with dental healthcare systems. Realising the potential of AI in enhancing the oral health of the world will be contingent upon collaboration between dental experts, policymakers, researchers, and developers of AI.

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PARTICULARS OF CONTRIBUTORS:
1. Associate Professor, Department of Public Health Dentistry, Bharati Vidyapeeth (Deemed to be University) Dental College and Hospital, Sangli, Maharashtra, India.
2. Assistant Professor, Department of Community Medicine, Bharati Vidyapeeth (Deemed to be University) Medical College and Hospital, Sangli, Maharashtra, India.
3. Associate Professor, Department of Public Health Dentistry, Bharati Vidyapeeth (Deemed to be University) Dental College and Hospital, Sangli, Maharashtra, India.
4. Assistant Professor, Department of Public Health Dentistry, Bharati Vidyapeeth (Deemed to be University) Dental College and Hospital, Sangli, Maharashtra, India.
5. Assistant Professor, Department of Public Health Dentistry, Datta Meghe Institute of Higher Education and Research (Deemed to be University), Sawangi, Maharashtra, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Tanushri Mahendra Dalvi,
Associate Professor, Department of Public Health Dentistry, Bharati Vidyapeeth (Deemed to be University) Dental College and Hospital, Wanlesswadi, Sangli, Maharashtra, India.
E-mail: tanushri.dalvi@bharatividyapeeth.edu

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