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The Effects of Artificial Intelligence (AI) Use in Public Oral Health Programs, and on Patient Health Information (PHI) Governance, Diagnostics, and Dental Health Provider Employment over the next Ten Years in American Dentistry

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ABSTRACT

Artificial intelligence (AI) is rapidly entering clinical and administrative domains of medicine. Dentistry is no exception. This article examines plausible pathways by which AI will influence diagnostics, public oral health programs (including fluoride surveillance), patient health information governance, and employment across the U.S. dental workforce in the next decade. Four focused body sections present arguments for and against diffusion of AI with concrete examples: (1) diagnostic and chairside augmentation, (2) public-health surveillance including fluoride monitoring, (3) data governance and patient privacy, and (4) workforce and employment implications. The article concludes that AI will probably improve diagnostic sensitivity, expand preventive population-level tools, and streamline administrative burdens but will also raise risks of algorithmic bias, privacy gaps, regulatory lag, and uneven workforce displacement. These observations specifically need policy, education, support from stakeholders and careful implementation to determine whether AI amplifies oral-health equity or exacerbates disparities.

Keywords

Artificial intelligence, Oral-health, Dentistry, Diagnostics.

Introduction

Artificial intelligence encompassing machine learning (ML), deep learning (DL), and generative models has moved from research prototypes to clinically marketed tools in many health specialties. Dentistry has seen increasing applications in image interpretation, treatment planning, triage, patient communication, and practice management software. Professional bodies and regulators are already issuing guidance about safe adoption. Understanding how these trends could reshape U.S. dental care between 2025 and 2035 requires integrating evidence about current technical capabilities, regulatory trajectories, public-health interfaces (notably water fluoridation surveillance), privacy law, and labor economics. Recent systematic and narrative reviews show accelerating publications on AI in dentistry and health care broadly, while regulators like the Food and Drug Administration (FDA) and Health and Human Services (HHS) have updated frameworks that will shape how AI devices and software are deployed. The following sections outline opportunities and challenges with concrete examples and policy recommendations [1-5].

Diagnostic and Chairside Augmentation: examples for AI

AI already demonstrates strong performance for image-based dental tasks (bitewing and panoramic radiograph interpretation, caries detection, periodontal bone loss estimation) by identifying patterns that may be subtle to the human eye, especially in large-volume screening contexts [1,2]. Clinic-level AI can (a) flag likely cavities on radiographs for recall by clinicians, shortening diagnostic time and improving early-lesion detection; (b) automate measurements for orthodontic planning and implant placement; and (c) power chairside decision support that integrates prior radiographs, intraoral scans, and risk models to suggest personalized recall intervals and preventive regimens [1,6,7].

Concrete Examples

AI-assisted radiographic screening in community clinics could double throughput for preventive visits by pre-annotating images for clinician review, enabling more targeted sealant programs in underserved schools. Similarly, Computer-Aided Design/ Computer-Aided Manufacturing (CAD/CAM) workflows augmented by ML can shorten the design cycle for crowns and restorations, lowering per-unit lab time and improving fit in some cases. These gains are likely to diffuse across large group practices and teledentistry platforms within a decade as validated algorithms and FDA-cleared devices become available [1-5].

Public Health Surveillance: AI, fluoride monitoring, and population prevention

AI offers clear utility in large-scale environmental and surveillance tasks. For fluoride in community water systems, AI and ML models can integrate multi-source inputs of historical fluoride measurements, hydrological data, weather, industrial inputs, and sensor networks to predict deviations from optimal fluoride concentrations and prioritize on-site testing [9]. Researchers have successfully used neural networks to model groundwater fluoride and to forecast contamination or concentration shifts, offering a potential early-warning layer for public-health authorities [8,9].

Examples: A state health department could deploy ML models to flag systems at risk of over or under fluoridation, triggering targeted sampling or alerts to utilities; AI could also analyze social-media discourse and local health-system dental visit patterns to detect areas where fluoridation controversies have reduced coverage, supporting rapid outreach. As the Center for Disease Control's (CDC) fluoridation reporting and "My Water's Fluoride" systems modernize, AI could augment data cleaning and predictive analytics to improve resource allocation. Yet these applications require validated models, robust input data, and clear governance so predictions do not replace required laboratory measures [4,8,10,11].

Data governance and patient health information: examples against AI (Risks & Constraints)

AI's value depends on data: large, labeled datasets of dental images, treatment records, and socioeconomic metadata. Use of patient health information for model training raises substantial privacy and regulatory considerations under the Health Insurance Portability and Accountability Act (HIPAA) and related frameworks; secondary uses require consent models and de-identification strategies that are not fail-safe [6,12,13]. Recent legal and policy analyses highlight tensions between innovation and privacy, noting that training on poorly de-identified dental records can risk re-identification and regulatory exposure [9].

Concrete risks: (a) Commercial practice management vendors may aggregate de-identified patient charts to improve diagnostic models, but linkage attacks could re-identify patients if data are combined with external datasets; (b) generative AI used for clinical note-taking or automated messaging could inadvertently expose PHI if prompts or outputs are stored or routed through third-party services without adequate Business Associate Agreements; (c) inconsistent state laws and evolving federal guidance create compliance uncertainty for dental practices deploying AI.

HHS and Office of Civil Rights (OCR) materials emphasize that covered entities remain responsible for PHI, and developers must design privacy-preserving pipelines that incorporate federated learning when feasible (an ML technique that trains models across multiple decentralized devices without moving the raw data to a central server, where instead of pooling data, each device trains a model locally and then sends only the model updates to a central server). Differential privacy (DP), a technique that adds calibrated random "noise" to data or algorithm outputs, creating a mathematical guarantee that the presence or absence of any single individual's data doesn't significantly change the results. Instead of using raw data, a randomized function adds controlled "noise" or randomness to the model's results, like gradients during training. This protects personal privacy while allowing valuable aggregate insights for training AI models like in medical research or personalized recommendations, where specific identities are not revealed. DP should be used when feasible, where a mathematical framework for protecting individual data privacy is inputted when analyzing large datasets by adding carefully controlled statistical "noise" to query results, making it difficult to identify individuals or their specific information from the aggregate statistics [6,9,13].

Workforce and Dental Provider Employment implications: Balanced examples FOR and AGAINST AI

AI will alter the composition and tasks of the dental workforce rather than eliminate dental care jobs on a larger scale. Bureau of Labor Statistics projections show continued growth in dental hygienist employment through the next decade, driven by aging populations and preventive care demand [13]. At the same time, AI can automate administrative burdens (scheduling, billing, preliminary charting) and assist with diagnostic triage that historically consumed clinician time potentially redeploying staff to higher-value, patient-facing activities [1,14].

FOR AI: Automated image pre-interpretations and AI-assisted note generation can reduce clinician administrative load, increasing chair time efficiency and enabling practices to see more patients without increases to staff. AI-driven teledentistry can also expand access in rural areas while maintaining a smaller local clinical footprint.

AGAINST AI: Highly standardized tasks (e.g., some aspects of prosthetics design, intraoral scanning interpretation or complicated diagnoses) could be centralized in cloud-based services, reducing demand for technical roles such as laboratory technicians in small practices or labs or dental radiologists. Rapid adoption without retraining programs risks mismatches. For example, some workers may face displacement while demand for data-literate dental professionals and AI-literate hygienists/clinical assistants rises. Workforce policy and education including AI training in dental schools and continuing education would have to work collaboratively to moderate these outcomes [13-17].

Conclusion and Policy Implications

Over the next ten years, AI is likely to become an imperative adjunct in U.S. dental providers as it improves diagnostic sensitivity, enabling smarter public-health surveillance (including fluoride monitoring), and reducing administrative burdens. However, benefits are conditional when examined. To maximize public value and minimize harms, stakeholders should (1) require transparent validation and post-market surveillance for AI tools used clinically, (2) adopt privacy-preserving data practices (federated learning, robust de-identification, clear consent for secondary use), (3) invest in workforce retraining and updated curricula to equip dental professionals with AI literacy, and (4) ensure equitable access to AI so AI is not only concentrated in large, well-funded dental organizations. Regulators (FDA, HHS) and professional societies like the American Dental Association (ADA) already provide emergent guidance, though coordinated policy and continued research into real-world outcomes would also be essential to guide the industry through this transition [3-5,12,16]. Lastly, governmental policies for legislation, fiscal support and judicial guidance across jurisdictions are a necessary component to the successful implementation of AI into healthcare systems where ethical, equitable and fiscal responsibility are marked considerations for use [18-20].

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