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A systematic review of artificial intelligence in dentistry

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ADMINISTRATIVE INFORMATION

Support - Deanship of Graduate Studies and Scientific Research at Jouf University.

Review Stage at time of this submission - Piloting of the study selection process.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 6 March 2025 and was last updated on 6 March 2025.

INTRODUCTION

Review question / Objective "Which types of AI approaches are applied in dentistry, and to what extent and in what way is AI is improving the diagnosis in dentistry, the quality of decisions made and the outcomes of dental procedures?"
This review will use the PICOS framework comprising Population, Intervention, Contrast, Outcome, and Study Design. CAD/CAM technologies will be involved in the study, computerized representations of the clinic, apex, bitewing, orthopantomographic, or CBCT radiographs and 2D and 3D patient and simulator's facial images. The primary focus will be on the application of robotics, natural language processing and deep learning, in dental care evaluation, therapy and prognosis.
The outcomes to be measured will include accuracy, efficiency, support for the critical conclusion, the area under the curve and applications of AI in various specialties of dentistry.

Rationale Artificial Intelligence (AI) is transforming dentistry in that early diagnosis is more accurate with advanced treatment planning, treatment coordination and patient monitoring. AI has had a rich deployment across the sphere of healthcare, and dentistry makes no exception. AI holds a large potential in dentistry and one of the best areas where it could be applied is medical image analysis. For instance, a sub-type of AI known as convolutional neural networks (CNNs) is used in the diagnosis of dental caries, apical lesions and bone loss from periapical radiographic images as well as panoramic images.
Other than diagnostics, there is the application of AI in treatment procedures. There are great opportunities in the application of AI, but there are also several problems with AI in the dentistry field. To unlock the full potential of AI as a resource,

much attention has to be paid to AI's limitations both ethical and technical, as well as to its availability for a wider range of use. Future advancement in modern dentistry will be premised on findings derived from focused studies exploring the applicability of AI in dental practice.

Condition being studied AI application in dentistry is fundamental since it is changing the dental field in a way that makes care data-based, accurate and timely. It is proficient in the study of big data and displaces arduous jobs that burden clinicians while enhancing the lives of patients. To unlock the full potential of AI as a resource, much attention has to be paid to AI's limitations both ethical and technical, as well as to its availability for a wider range of use. Future advancement in modern dentistry will be premised on findings derived from focused studies exploring the applicability of AI in dental practice.
This review will address the following research question.
“Which types of AI approaches are applied in dentistry, and to what extent and in what way is AI is improving the diagnosis in dentistry, the quality of decisions made and the outcomes of dental procedures?”

METHODS

Search strategy “Machine learning dental applications, neural networks and role in oral care, databases such as PubMed, Scopus and the Cochrane Library for studies published between 2014 and 2024.
Search terms included:
• "AI in dentistry,"
• "Machine learning dental applications," and
• "Neural networks in oral health."

Participant or population CAD/CAM technologies will be involved in the study, computerized representations of the clinic, apex, bitewing, orthopantomographic, or CBCT radiographs and 2D and 3D patient and simulator’s facial images.

Intervention Application of robotics, natural language processing and deep learning, in dental care evaluation, therapy and prognosis.

Comparator None.

Study designs to be included Original studies (research articles) with specified key words from 2014 till 2024 in English language.

Eligibility criteria
1. Studies along with specified keywords;
2. Articles (Research) available from 2014 to 2023;
3. Studies on English-language; and
4. Original research articles.

Information sources Databases such as PubMed, Scopus and the Cochrane Library will be searched for studies published between 2014 and 2024.

Main outcome(s) The outcomes measured will include accuracy, efficiency, support for the critical conclusion, the area under the curve and applications of AI in various specialties of dentistry.

Data management Data will be managed by the corresponding author and will be available on request.

Quality assessment / Risk of bias analysis Quality assessment will be done using The Cochrane Handbook for Systematic Reviews of Interventions (v5.1.0) criteria. Key findings will be summarized.

Strategy of data synthesis Data extraction will focus on capturing critical details from each study, including the authors’ names and publication year, the input data sources, study objectives, AI models employed and the resulting outcomes.

Subgroup analysis Subgroup analysis will be done if a statistically significant subgroup difference (interaction) is detected. Pronounced differences between the subgroups will be highlighted if found.

Sensitivity analysis The key variables that might introduce bias will be identified. The researchers will assess the risk of bias, publication bias, study design differences and heterogenicity. Sensitivity analysis will be done using meta analysis and sub group analysis. If findings change significantly, possible reasons will be identified. Methods used for sensitivity analysis will be mentioned. The analysis will be reported in form of tables or forest plot.

Language restriction English language.

Country(ies) involved Saudi Arabia, United Kingdom. UAE, Pakistan.

Keywords Artificial Intelligence, Diagnosis, Machine Learning, Dental Sciences, AI Models.

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