

Article

Integrating Generative Artificial Intelligence in Clinical Dentistry: Enhancing Diagnosis, Treatment Planning, and Procedural Precision Through Advanced Knowledge Representation and Reasoning

Hossam Dawa ^{1,2}, Arthur Rodriguez Gonzalez Cortes ³, Carlos Ribeiro ², José Neves ^{1,4}
and Henrique Vicente ^{4,5,6,*} 

- ¹ AI & Health—Research Unit in Artificial Intelligence Applied to Health, CESPU University, Rua José António Vidal, 81, 4760-409 Famalicão, Portugal; hossam.dawa@cespu.pt (H.D.); jneves@di.uminho.pt (J.N.)
 - ² UNIPRO—Oral Pathology and Rehabilitation Research Unit, University Institute of Health Science, CESPU, Avenida Central de Gandra, 1317, 4585-116 Gandra, Portugal; carlos.ribeiro@iucs.cespu.pt
 - ³ Department of Dental Surgery, University of Malta, MSD 2080 Msida, Malta; arthur.nogueira@um.edu.mt
 - ⁴ LASI—Associated Laboratory of Intelligent Systems, ALGORITMI Research Centre, University of Minho, Campus de Gualtar, Rua da Universidade, 4710-057 Braga, Portugal
 - ⁵ Department of Chemistry and Biochemistry, School of Science and Technology, University of Évora, Rua Romão Ramalho, 59, 7000-671 Évora, Portugal
 - ⁶ LAQV REQUIMTE—Associated Laboratory for Green Chemistry of the Network of Chemistry and Technology, University of Évora, Rua Romão Ramalho, 59, 7000-671 Évora, Portugal
- * Correspondence: hvicente@uevora.pt

Abstract

Generative artificial intelligence (GAI) is poised to transform clinical dentistry by enhancing diagnostic accuracy, personalizing treatment planning, and improving procedural precision. This study integrates logic programming and entropy within knowledge representation and reasoning to generate hypotheses, quantify uncertainty, and support clinical decisions. A six-month longitudinal questionnaire was administered to 127 dentists, of whom 119 provided valid responses across four dimensions: current use and knowledge (CUKD), potential applications (PAD), future perspectives (FPD), and challenges and barriers (CBD). Responses, analyzed with both classical statistics and entropy-based measures, revealed significant differences among dimensions ($p < 0.01$, $\eta^2 = 0.14$). CUKD, PAD, and FPD all increased steadily over time (baseline means 2.32, 3.06, and 3.27; rising to 3.75, 4.51, and 4.71, respectively), while CBD remained more variable (1.87–3.87). The overall entropic state declined from 0.43 to 0.31 ($p = 0.018$), reflecting reduced uncertainty. Statistical and entropy-derived trends converged, suggesting growing professional clarity and cautious acceptance of GAI. These findings indicate that, despite persistent concerns, GAI holds promise for advancing adaptive and evidence-driven dental practice.

Keywords: digital dentistry; generative artificial intelligence; entropy; knowledge representation and reasoning; clinical decision support; logic programming



Academic Editor: Yannis Manolopoulos

Received: 16 July 2025

Revised: 10 September 2025

Accepted: 15 September 2025

Published: 18 September 2025

Citation: Dawa, H.; Cortes, A.R.G.; Ribeiro, C.; Neves, J.; Vicente, H. Integrating Generative Artificial Intelligence in Clinical Dentistry: Enhancing Diagnosis, Treatment Planning, and Procedural Precision Through Advanced Knowledge Representation and Reasoning. *Digital* **2025**, *5*, 44. <https://doi.org/10.3390/digital5030044>

Copyright: © 2025 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).