

# Advancing SDG 9 through digital technologies in dentistry



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**Mojtaba Dorri**<sup>1</sup> and **Mojtaba Mehrabian**<sup>2</sup> situate SDG 9 in the context of technological advancements and innovation within the field of dentistry, exploring how artificial intelligence and digital dentistry have allowed the provision of more sustainable choices, reduced the cost and environmental impact of certain processes, and improved inclusivity and access to dental services for all, especially in developing countries.

**S**ustainable Development Goal 9 (SDG 9) focuses on 'building resilient infrastructure, promoting inclusive and sustainable industrialisation, and fostering innovation'.<sup>1</sup> SDG 9 is centred on three main pillars: industry, infrastructure and innovation. It acknowledges that industrialisation must be inclusive, environmentally sound, and sustainable; that infrastructure must be resilient; and that technology must play a central role in achieving these aims through resource – plus energy efficiency and access to digital technologies.<sup>2</sup> With eight targets and 12 indicators,<sup>2</sup> SDG 9 will have multiple impacts on dental industry.

Promoting good oral health habits and ensuring universal access to healthcare not only benefits global wellbeing but also aligns with environmental goals, fostering inclusive, productive, and healthy lives for all.<sup>3</sup> In dentistry, sustainability is crucial and involves many stakeholders, including the oral health team, government, scientists, educators, manufacturers, distributors, dental equipment technicians, waste collectors, processors, and patients.<sup>3</sup> Dentists should prioritise oral disease prevention and health promotion to reduce treatment needs in the future while minimising materials consumption, without compromising patient safety and quality of care. The dental industry should be encouraged to develop more sustainable and low-impact dental materials and technologies.<sup>3</sup> Governments and policymakers should facilitate and reward sustainable choices. Patients need

to make informed decisions and consider the adverse effects of their treatment choices on the environment and future generations.

Digital health technologies and artificial intelligence (AI) have revolutionised the field of dentistry, offering more sustainable choices and numerous advantages in diagnosis, treatment planning, education, and patient care.

Digital technologies and AI offer unique opportunities to improve the accessibility and outreach of dental services and education.<sup>4</sup> Telehealth platforms, such as those facilitating remote consultations, especially in underserved areas, help mitigate global warming by reducing the carbon footprint associated with fewer patient journeys.<sup>5</sup> AI can help with diagnosis, treatment planning, and even delivery of treatments regardless of geographic constraints.<sup>6</sup> AI

in workforce training and development. This also aligns with SDG 9's emphasis on inclusivity and technological innovation.

Electronic health records (EHRs) and digital practice management systems streamline administrative tasks, improve communication between healthcare providers, and enhance patient care.<sup>6</sup> This contributes to SDG 9's objective of promoting sustainable industrialisation and fostering innovation.<sup>8</sup> Computer-aided design/computer-aided manufacturing (CAD/CAM) technology has transformed the fabrication of dental restorations through a same-day workflow. This not only improves treatment outcomes but also reduces the cost and the environmental impact associated with traditional laboratory-based fabrication processes and promotes precision

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can reduce inequalities by contribution to the development of more accessible and affordable oral healthcare systems by minimising transportation needs, improving self-diagnosis and monitoring, triage, tele-services and enhancing precision dentistry.<sup>7</sup> Additionally, to meet the worldwide need for oral health services and address the shortage of skilled oral healthcare providers in various regions, AI-supported technologies can assist

dentistry. Advanced imaging technologies, such as cone-beam computed tomography (CBCT) and intraoral scanners, allow for more accurate and efficient diagnosis and treatment planning. This eliminates the harmful chemical contamination<sup>5</sup> and reduces the need for multiple appointments and unnecessary procedures,<sup>6</sup> leading to more sustainable practices in dentistry. ▶▶

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AI technologies can analyse the large volumes of dental data obtained using digital technology and identify patterns and insights effectively, enhancing diagnosis,<sup>9</sup> decision-making,<sup>10</sup> and patient-tailored treatment planning<sup>9</sup> for more precise, personalised, and preventive oral healthcare, ultimately promoting precision dentistry, better patient outcomes,<sup>9,11</sup> and sustainability,<sup>4,5</sup> especially for underserved populations. AI can also enhance evidence synthesis and in turn help clinicians, patients and policymakers with choosing the most effective, efficient and sustainable options.<sup>12</sup>

While technological-driven solutions hold promise in dentistry, there are challenges and risks that need to be addressed before widespread adoption. These include, but are not limited to, issues related to oral health data availability, structure, comprehensiveness, as well as concerns about the methodological rigour and development standards.<sup>7</sup> There are also practical questions regarding the value, usefulness, and ethical considerations surrounding AI solutions.<sup>7</sup> The deployment, implementation and maintenance of AI requires significant resources, and costs for digitalisation and AI may aggravate inequalities in developing countries.<sup>13</sup> Also, AI may be biased, reinforcing inequalities and discrimination, and may violate principles of security, privacy and confidentiality of personal information.<sup>4,9</sup> To improve, AI models need more and more detailed data, which conflicts with the need for transparent and secure handling of personal data, especially in the healthcare sector.<sup>13</sup>

Benchmarking AI using standard datasets ensures accuracy of AI. Advocating open data and open code can enhance sustainability by reducing redundant AI development efforts.<sup>4</sup> Furthermore, it is essential to establish human-in-the-loop validating systems to avoid biased results and maintain the quality of AI decisions.<sup>9</sup> Oral health professionals should use AI to promote equitable and sustainable oral healthcare. This involves enhancing oral health monitoring, workforce training, and service accessibility. It also requires establishing clear standards, transparency,

and legislation for AI in oral health. This will expand the use of digital health technologies, including AI, in the fields that can result in achieving SDG 9 targets.

Digital technology and AI go hand in hand in promoting innovation in the field of dentistry; they also help to foster sustainable dentistry and improve inclusivity and access to dental services for all, in developed and especially developing countries. They improve accuracy, efficiency, and patient outcomes, and build resilient infrastructure by optimising workflows, improving patient comfort, and improving waste reduction. This requires initial investment in infrastructure and training by governments and private sectors. Digital technology and AI complement, rather than replace, human intelligence. However, clinicians who use these technologies will replace those who don't. ■

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## Cardiff School of Dentistry awarded grant to study remote oral health assessment

Cardiff School of Dentistry is one of two recipients of this year's Eklund Foundation Grants.

The Eklund Foundation for Odontological Research and Education has been supporting research projects in dentistry for eight years. The 2023 Grant recipients will together receive funding amounting to around €275,500.

Since 2016, the Eklund Foundation, set up by the Eklund family (owners of TePe oral hygiene products) has distributed up to €250,000 annually, supporting odontological research worldwide.

The Eklund Foundation will award a grant of €121,742 to the Cardiff School of Dentistry project 'Evaluating the Validity and Patient Experience of Smartphone Intra-oral Photography for Remote Oral Health Assessment in Children: a Mixed Methods, Comparative Study' led by Nicola Innes, Head of Cardiff School of Dentistry, Professor and Consultant in Paediatric Dentistry, and co-applicants Waraf Al-yaseen, Lecturer in Dental Hygiene and Therapy and Jennifer Galloway, Senior Lecturer & Consultant in Orthodontics, Cardiff School of Dentistry.

The Cardiff team believe that their study will have the potential to positively influence accessibility to oral health care for many people.

Approximately €153,800 has been awarded to a research team at Karolinska institutet, Unit of Cardiology, Department of Medicine, Sweden led by Anna Norhammar, MD, Professor in cardiology, to investigate 'Periodontitis and Its Relation to Coronary Artery Disease (PAROKRANK) – a case controls study with mechanistic and prospective analyses.'

Joel Eklund, Chairman of the Board, Eklund Foundation, said, 'We are delighted to support these highly relevant studies. They have the potential to add valuable knowledge within their respective fields.'