State of the AI-enhanced Technology in Dentistry – Ethical, Regulatory and Practical Challenges

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Executive summary

Importance

Dentistry is currently standing at a critical juncture where mainstream adoption of AI-enhanced technologies and software is reshaping the dental practice landscape in South Africa presenting both unprecedented opportunities and unique ethical concerns, regulatory challenges, and clinical integration barriers.

Key points

- AI adoption is fundamental shift towards more precise, efficient, and patient centered care.
- Regulatory bodies classify most diagnostic AI systems as high-risk devices.
- Developers, deployers, distributors, and providers each carry distinct duties across the AI-lifecycle.
- Maintaining rigorous human oversight is essential.
- The absence of standardized evaluation criteria, rigorous validation, and approval by regulatory bodies, limits the safe deployment of AI applications in dentistry.

Practice implications

- Dental practitioners must be familiar and comply with legal frameworks and ethical guidelines to ensure patient privacy and confidentiality.
- Patients should be informed about how their data will be collected, processed, and shared with third-party providers.
- Informed consent must be obtained before processing and sharing personal information.
- Ensure confidentiality and secure storage of patient records.
- Implement robust data security measures to prevent unauthorized access.
- Practitioners are responsible for ensuring that dental assistants, receptionists and other staff respect confidentiality of patient personal information in the performance of their duties.
- Staff training on data protection protocols and adherence to professional guidelines to enhance the security and confidentiality of patient information is critical.

Background

Advances in data-enhanced technologies such as artificial intelligence (AI) are transforming economies, sectoral fields, societies and technology adoption at an

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unprecedented rate across the globe.[1] Furthermore, advancements in big data analytics, computing power, computer vision, machine and deep learning algorithms have significantly accelerated AI's capabilities, enabling it to process vast datasets more efficiently than humans.[2,3] AI is fundamentally software-based and algorithm-enhanced, though it extends to physical entities or tools such as imaging, diagnostic, decision-making, planning, manufacturing and 3D printing.[4]

AI is a flexible toolset, providing a range of applications that address various facets of the healthcare environment, including diagnosis, treatment planning, decision-making, administrative procedures, and communication to optimize health care delivery, improve treatment outcomes, and overall raising access to, and the standard of care.[5] The healthcare sector, including dentistry, has undergone remarkable and rapid advancements in AI-enhanced imaging and diagnostic technologies.[3,6,7,8,9] The adoption of these technologies is seen as an opportunity to augment healthcare professionals' capabilities to function with greater efficiency and make better decisions.[10]

Dentistry is currently standing at a critical juncture where mainstream adoption of AI- enhanced technologies and software is reshaping the dental practice landscape, presenting both unprecedented opportunities and unique challenges for the dental profession. AI is increasingly being adopted to enhance diagnostic accuracy, automate routine tasks and increase workload efficiency, and improve treatment outcomes.[3] The key factors driving this transformation include: the necessity to stay competitive and relevant; to enhance efficiency and productivity; to improve overall practice resilience; and to improving service delivery, accessibility, and enhancing quality of life. It is envisioned that as AI technologies rapidly advance, they will offer unprecedented opportunities for economic growth, improved public services, and enhanced quality of life.

Despite the significant benefits offered by AI-enhanced technologies in transforming and improving healthcare, including dentistry, the deployment of such technologies raise several important ethical concerns, regulatory challenges, and clinical integration barriers that still hinder the need for clinical acceptance and full-scale adoption of AI-enhanced technology in dental practice.[3,7,8,11,12,13,16] The ethical and regulatory landscape for the clinical integration of artificial intelligence (AI)-enhanced technologies into dental practice is currently fragmented globally.[9] AI integration into clinical practice requires clear ethical guidelines and regulatory frameworks for deployment and ongoing evaluation of AI systems in dentistry, to ensure ethically responsible and effective deployment.[13,14] The newly gazetted South Africa Draft National Artificial Intelligence (AI) Policy published on 10 April 2026, is both an opportunity and a challenge to guide the responsible and ethical development, deployment, and utilization of AI across all sectors of society.[15] Unfortunately, the Draft Policy has been retracted due to artificially generated fake references cited in the policy.

In addition, the rapid development of AI technology has outpaced the creation of corresponding standards and guidelines for clinicians using AI in their practice. This highlights the need for revisiting for ethical, regulatory, and practical guidelines for integrating AI-enhanced technology into clinical practice.[11]

The purpose of this review is to explore current trends and future directions of AI applications in dentistry, and to consider existing ethical, regulatory and practical adoption challenges, that will enable ethically responsible and effective integration into clinical workflows.

Trends and advancements

Current trends indicate a significant advancement towards integrating cutting-edge AI-enhanced technologies into dental practice, with a fundamental shift towards more efficient workflow, enhanced diagnostic accuracy, and patient-centered care.[3] A recent bibliometric analysis of scientific literature provides valuable insights on current advancements in AI-enhanced diagnostic and imaging technologies that are reshaping modern dental practices.[9]

Diagnostic imaging (CBCT, Panoramic & Periapical Images)

AI-enhanced diagnostic imaging has been one of the earliest and most successful applications of AI in dentistry.[3,9] Convolutional neural networks (CNN's) have been extensively used to interpret cone beam computed tomography (CBCT), panoramic, and periapical images.[3]

- ***Modality applications:***

AI-enhanced digital diagnostic imaging systems can detect dental caries, periapical lesions, bone loss and bone pathology (i.e., cysts and endodontic lesions) with accuracy comparable to or exceeding that of human experts.[3] CBCT is an AI-enhanced tool that provides accurate 3D-imaging capabilities capable of producing in-depth analysis of bone and tooth structures, diagnosis and virtual treatment planning for dental implants, impacted teeth, orthognathic surgical procedures, prosthodontics, orthodontics, and maxillofacial fractures.[9]

3D Printing and Multifunctional Anatomical Prototypes (MAPS)

3D printing enables dental practitioners to fabricate precise anatomical models that can assist in diagnosis and treatment planning. MAPs on the other hand provide practitioners with a 3D understanding of complex cases facilitating increased diagnostic precision.[9]

- ***Modality applications:***

Surgical pre-operative treatment planning, prosthetic rehabilitation cases, and educational training, allowing practitioners and students to simulate complex procedures with greater accuracy.[9]

Digital Dental, Face Scanning and Morphometric Analysis

Facilitates in generating 3D models of dental, facial anatomy, and craniofacial structures.[9]

Modality applications:

To enhance diagnostic precision and to optimise treatment planning in periodontology.

Biosensors and personalized image recognition

Biosensors devices represent a new era in personalized and precision dentistry enabling real-time detection of bacterial infections and managing oral inflammatory conditions, facilitating swift and targeted treatment responses.[9]

Modality applications:

Periodontology - The identification of specific biomarkers allows clinicians to diagnose and monitor periodontal, implant, and oral infections and disease progression and predict treatment responses with greater precision.[9]

Oral pathology - Image recognition algorithms are used to differentiate between benign and malignant lesion from histopathological slides. AI-based screening tools for cancer can analyse photographs of mucosal lesions to identify suspicious areas, particularly useful for remote or underserved populations.[3]

Digital workflow

The convergence of digital imaging technologies, such as CBCT, intraoral scanners, digital radiography, and robotic systems with AI algorithms has created new opportunities for promoting diagnostic accuracy, treatment planning and precision dentistry.[3,9] The combination with CAD/CAM, 3D printing and AI further enhances customisation, efficiency, and patient-centered care.[3]

- ***Modality applications:***

Orthodontics and treatment planning – AI plays a major role in automated cephalometric landmark detection, malocclusion classification, and treatment outcome prediction. AI models can now analyse 3D images to plan tooth movements and predict treatment durations.3 Companies have begun integrating AI-enhanced software into clear aligner systems to optimise aligner design and movement sequence. Virtual treatment planning and augmented reality simulation enables patients to visualise treatment outcomes before treatment, facilitating communication, informed consent, and case acceptance rates.

Restorative and prosthetic dentistry - AI-enhanced CAD/CAM (Computer-Aided Design and Manufacturing) systems are revolutionizing restorative dentistry. Machine learning algorithms help design crowns, bridges, and veneers that accurately fit patient anatomy. Furthermore, generative AI devices can predict occlusal surface morphology, improving restoration function and aesthetics.[3] AI contributes to digital smile design and simulation, enabling clinicians and patients to visualise aesthetic outcomes before treatment. The combination of 3D printing and AI further enhances customisation and efficiency.

Endodontics - AI-algorithm models assist in detecting periapical lesion, determining working length, and predicting treatment outcomes. Deep neural networks have achieved promising results in classifying root canal morphology and identifying missed canals from radiographic data. Predictive AI models also estimate post-treatment success rates, helping clinicians and patients make more informed clinical decisions.[3]

Periodontology and Oral Pathology - AI supports early detection of periodontal diseases by analysing parameters such as probing depth, radiographic bone loss, and patient demographics.[3]

Digital workflow incorporates cutting-edge techniques and biomaterials for direct production of components. Digital workflows not only improves production efficiency, but also ensure better adherence to clinical standards and improved treatment success rates, while significantly reducing treatment times, thus creating a more efficient and predictable experience for the patient.[3]

Benefits and impact of AI-enhanced technologies in dental practice

The adoption of AI-enhanced technologies marks a new era in dental diagnostics and imaging, characterized by unparalleled precision, time efficiency, and personalized

care approaches.[3,9] Adopting these advanced imaging technologies and virtual tools has the potential to augment clinicians capabilities by enabling early detection of disease, enhancing image interpretation and diagnostic accuracy, facilitate effective treatment planning, whilst enabling personalization and minimal invasive treatment plans, and optimisation of patient treatment success rates.[9]

Furthermore, virtual imaging tools in the preparation and simulation of implant, prosthetic, orthodontic and complex surgical procedures improves communication between dental professional and the patient, hence leading to better understanding and more realistic expectations regarding treatment outcomes.[3,9] In addition, AI-based tele-dentistry platforms increases accessibility to oral healthcare in remote and rural areas.[3]

Ethical concerns

An ethics-first approach should involve implementing stringent guidelines and safeguards around the ethical use of AI technologies to ensure robust protection against misuse and overuse.[16] Without robust ethical and regulatory frameworks, safeguarding patient autonomy, ensuring data privacy, addressing algorithmic bias, biased AI decisions, risk of diagnostic errors, and maintaining professional accountability and patient data vulnerabilities remain a significant concern.[9,16,17] In addition, well-defined ethical guidelines and a comprehensive legal framework governing the development, deployment, and regulation of AI applications are needed to mitigate risks and ensure compliance with patient rights.[14]

Eleven key ethical principles relevant to AI-enhanced applications in dentistry, including diversity, transparency, wellness, privacy protection, solidarity, equity, prudence, law and governance, sustainable development, accountability and responsibility, respect of autonomy, and decision-making, have been identified.[18,19] For the purposes of this review, the five normative core ethical principles relevant to AI applications in health care most frequently documented across AI Ethics documents include: (i) transparency; (ii) justice and fairness; (iii) non-maleficence (safety); (iv) responsibility; and (v) privacy, will be discussed.[8]

Transparency

Transparency refers to the explainability and *"providing meaningful, context appropriate information to stakeholders, to foster a general understanding of AI technology; to inform patients and providers affected by AI outcomes, and enable those adversely affected to challenge its outcome"*.[20]

Justice, fairness and mitigating bias demographics.

Justice and fairness encompasses both "inclusive access on to the benefits of AI technologies and the elimination of unfair discrimination, which may be perpetrated by algorithm bias in the datasets which AI systems are trained".[8,21]

Algorithm bias refers to the discriminatory data and algorithms that are inadvertently embedded in AI models, leading to biased outcomes at scale. AI systems trained on datasets lacking diversity may produce biased diagnostic outputs, impacting clinical decision-making.[9,22] Biases in AI-algorithms can perpetuate existing health inequalities, emphasizing that systems might produce skewed results if trained on unrepresentative datasets.[22,23]

Non-maleficence

This principle calls for the safety and security of patients which stipulate that *"AI technologies perform as intended, should never cause foreseeable or unintentional harm, and that their data are secured against access by unauthorised persons."*[24] Interestingly, most organisations prioritise caution against overuse or misuse of AI technologies which may lead to negative consequences.[8]

Over-reliance on AI-enhanced diagnostic decisions presents another ethical challenge. While AI-algorithms can enhance efficiency and accuracy, they are not infallible - issues such as false positives and misdiagnoses require ongoing validation through clinical trials and human oversight.[9]

Responsibility and accountability

"Responsibility and accountability recognise the importance of mechanisms that ensure that accountability (for harm caused by AI-systems) is appropriately distributed, and that adequate remedies are provided." [24] Healthcare providers have the ethical responsibility to ensure AI transparency and to maintain a 'Human-in-the-Loop" for significant clinical decisions. It is highlighted that liability and responsibility concerns could potentially fall upon developers, dentists, or government agencies, especially in cases of unwanted events or adverse outcomes from AI use.[25]

Privacy

Confirm the identity of patients or authorized healthcare partners before sharing sensitive information. Use encrypted email, secure messaging systems, or patient portals for sharing sensitive information. Always obtain patient consent before sharing information with third parties (e.g., specialists, dental laboratories, insurance companies).

- ***Minimize exposure of patient information***

Privacy expresses *"the requirement that AI systems respect individual privacy both in the use of personal data and decisions made therefrom."*[24] *"Privacy is seen both as a value to uphold and as a right to be protected."*[26] In the more recent UNESCO recommendation, *"the importance of privacy is underscored as being essential to human dignity, autonomy and agency."*[27] It is noted that privacy guidelines should be aligned with the OECD's human-centred values – "AI actors should implement mechanisms and safeguards, such as capacity for human agency and oversight, including to address risks arising from uses outside of intended purpose, intentional misuse, or unintentional misuse in a manner appropriate to the context and consistent with the state of the art."[28]

Regulatory challenges

Regulating AI is a complex task, particularly in a rapidly evolving field. Therefore, effective regulation and resolution of privacy and ethical issues need to be considered for the responsible, transparent, and seamless implementation and integration of AI into clinical setting.[16,29] Institutions tasked with regulatory oversight often struggle to keep pace with advancements in AI technologies. South Africa currently lacks dedicated regulatory frameworks and institutional capacity tailored for AI-specific risks such as accountability in autonomous decision making, data protection in large scale analytic systems and algorithmic bias.[8]

Currently there is growing pressure to align with emerging global standards and ethical principles for AI governance. International trends reflect a shift towards risk-based, values-enhanced AI-regulation such as projected in European Union's AI Act,[30] OECD recommendations,[31] and UNESCO's ethical AI frameworks.[32] In addition, there is growing collaborations between regulators and professional bodies in the US and EU, actively creating ethical and legal frameworks to ensure the safe and proper use of AI in dentistry.[33]

Evolving regulatory landscape

The regulatory landscape for AI in dentistry is still evolving and requires clear guidelines and standards to ensure safe, effective, and ethical use of the technologies.[34] Currently, the use of AI in South African healthcare is not governed by specific, exclusive legislation or ethical guidance, although existing legal provisions and principles of law and ethics do apply.[35] The South Africa's regulatory environment for AI in healthcare is characterized by its infancy and lack of specificity, relying on existing legislation such as the National Health Act and the Medicines and Related Substances Act, POPIA Act, for a foundational but limited framework.[16,36] Currently there is no ethical or regulatory framework for innovation and adoption of AI-enhanced technologies and software in South Africa. In addition, there is a growing need for global frameworks to standardize and align AI-enhanced images and diagnostic technologies adoption, ethical use, and regulatory frameworks with international and regional guidelines and regulations, such as the EU AI Act, FDA, and FDI, to ensure ethically and legally compliant deployment and use in modern dental care.[9,17]

Regulatory framework

Lack of a clear regulatory framework raises ethical, medico-legal, and clinical concerns regarding the unregulated use of artificial intelligence in dentistry.[16,37] Furthermore, regulatory bodies classify most diagnostic AI systems as high-risk devices, requiring rigorous validation and post-market monitoring.[38] Regulatory frameworks are thus needed to address the ethical use of AI with specific emphasis on data protection, algorithmic bias, patient safety considerations, and the ethical implications and consequences of AI-enhanced clinical decision-making.[8,9,39] South Africa currently lacks dedicated regulatory frameworks and institutional capacity tailored for AI-specific risks such as accountability in autonomous decision making, data protection in large scale analytic systems and algorithmic bias.[8]

However, guidance may be drawn from the UNESCO recommendations on Ethics of AI [27] or the G20 AI principles.[40] which are drawn from the OECD Recommendations of the Council on AI.[20]

Core regulatory trends shaping global AI governance include: (i) Risk-based classification – Healthcare falls under higher-risk categories with additional obligations; (ii) Role-based accountability – Developers, deployers, distributors, and providers each carry distinct duties across the AI-lifecycle; and (iii) Accountability through evidence – Pre-deployment assessment documentation, logging system activity, conformity assessments, post-market monitoring, and incident monitoring are treated as proof that governance exists in practice.[41]

Regulatory oversight needs

A recent study highlighted the imperative need for human

oversight and formal, profession-wide standards as the autonomy of AI systems increases, and notes that governing bodies are beginning to advance best-practice guidance and consent language.[42] Well-defined ethical guidelines and a comprehensive legal framework governing the development, deployment, and regulation of AI applications are needed to mitigate risks and ensure compliance with patient rights.[14] Robust data protection measures, including safeguarding against unauthorized access, are essential due to AI's reliance on sensitive patient data like medical records and diagnostic images.[43] From a legal standpoint, South Africa must navigate a complex regulatory terrain to ensure that AI aligns with constitutional rights and statutory obligations while fostering innovation.[16]

Medical devices and software

Current 'medical device' regulations in South Africa, which include software in the definition of a medical device, *"do not explicitly mention AI or algorithms, failing to adequately address novel AI software features."*[44] Medical devices (i.e. CBCT scanners), including software intended for diagnostic or therapeutic purposes, are currently regulated under the South African Health Products Regulatory Authority (SAHPRA) Medical Device Regulations, based on the Medicines and Related Substances Act 101 of 1965.[16,35]

Therefore, most artificial intelligence-based software products used in healthcare (including dentistry) would likely fall within the definition of a medical device and be subject to safety, efficacy, control, and quality requirements in South Africa, including purely software-based systems. Naidoo,[36] however, pointed out that the Medicines and Related Substances Act (MRSA) can be interpreted to include AI medical devices within its definition of 'medical device,' but its general classification of software does not explicitly cover AI-integrated medical devices, potentially leaving regulatory gaps.

Clinical adoption and integration barriers

Key factors driving adoption of AI-enhanced technologies in dentistry include: (i) higher diagnostic accuracy; (ii) improved patient-clinician communication; (iii) improved workflow efficiency resulting in greater productivity, and reduced workload; (iv) optimize diagnosis and treatment planning, and streamlining patient management protocols, thereby enhancing personalized care; and (v) to generate automated personalized reports thereby saving time on a legally required but labour-intensive task. These enabling factors ultimately lead to improved access and higher standard of care and better patient outcomes.[9,11,12,45,46]

Although AI-enhanced diagnostic and imaging technologies have the potential to enhance both quality and efficiency of dental care, their adoption and implementation is challenged by technical, infrastructural, economic, skills training and professional motivational barriers.

Substantial financial investment

A major clinical barrier is the high cost of AI technology, which makes it impractical for use in low-resource dental settings.[29] High cost and maintenance expenses remain major deterrents, especially for smaller practices.[9,47]

Integration and Compatibility issues

Poor interoperability and compatibility with existing dental software remains a technological challenge to integration.[47] Integrating new technologies and their software seamlessly into existing standardized workflows without disrupting existing hardware and software has also become another focus area needing attention.[9,14,47,48]

Maintenance and quality management

AI-enhanced technologies frequently require maintenance and upgrade support from the vendor for quality assurance. Regular maintenance and monitoring is also required for regulatory purposes. Fear of software malfunction, and patient data security were considered barriers to the application of AI in oral radiology.[49]

Professional training and skills development

Integrating AI into routine dental practice remains a challenge because dental professionals require specialised training to effectively use the AI-enhanced technologies and software while maintaining patient-centered care.[50]

Mastering AI-enhanced technologies and software therefore necessitates a steep learning curve for practitioners to ensure effective and ethical use of AI tools.[9,23,47,51]

Cybersecurity

The use of AI in dental practice heavily relies on processing large volumes of digital patient records and imaging data, highlighting the increased need for robust data security and anonymization.[52] It is also noted that cloud-based AI systems in dentistry increase the risk of unauthorized access and data breaches, potentially exposing sensitive patient information to cyber-attacks.[50] In addition, as AI-applications become

more prevalent, issues like cybersecurity and geopolitical dynamics are becoming increasingly important. Data privacy and security issues such as unauthorized access, interception, and data manipulation are critical concerns due to the sensitive nature of patient health information and the potential vulnerabilities in AI-enhanced systems within dental practice.[17,53] Therefore strong cybersecurity measures are required to protect AI infrastructure, recognizing that vulnerabilities in AI systems could have corporative and national security implications.[54]

Future directions and Impact of AI

Future directions focus on moving beyond, basic imaging analysis toward comprehensive, automated care and administrative systems, personalized treatment, and advanced robotics.[3,55] From a practical point of view, multidisciplinary collaboration between all stakeholders will be essential to refine the technologies to facilitate seamless integration of AI into present clinical workflows.[9] Future AI systems must be explainable and transparent to clinicians to increase trust and accountability.[3]

Advanced imaging analysis

AI algorithms will become more proficient at detecting complex dental conditions, oral dysbiosis, early-stage cancer and microscopic and genetic disorders.[3,55]

Tele-dentistry platforms

Improved sophistication of AI-powered tele-dentistry platforms will allow remote consultations, treatment planning and monitoring, increasing access to dental care in remote and underserved areas.[3,55]

Targeted personalised care

AI will enable targeted personalised care based on patients' genetic, immune, microbiome, and lifestyle behavioural factors, optimising treatment effectiveness and minimising adverse events.[55]

Robot assisted dentistry

Robot assisted dentistry will enhance the capabilities of dental practitioners and reduce the physical demand of specific dental workloads.[55]

Patient communication

Large language models (LLM) (i.e., ChatGPT), AI-driven Chatbots and virtual assistants will be able to engage with patients, provide health promotion and disease prevention information, or schedule appointment.[55] This will enhance patient communication and patient satisfaction.

Administrative efficiency

AI will enable to automate administrative tasks, such as writing reports, scheduling appointments and billing, reducing the administrative burden on the dental practice.[55]

Dental education and training

AI-enhanced simulators and virtual reality systems will continue to enhance dental education and training, allowing students and clinicians to practice procedures in risk-free environments and receive real-time feedback.[3]

Ultimately, these advancements will offer substantial opportunities to transform dental practice by providing faster, more accurate, less invasive, and more reliable diagnoses, personalized treatment planning and treatment outcome.

Conclusion

The integration of AI-driven technologies into dental practice represents a pivotal inflection point, signalling a transition from predominantly experience-based care toward data-augmented, precision-oriented clinical decision-making, and personalised care. Current trends demonstrate uneven but accelerating adoption, with AI most mostly embedded in imaging, diagnostics, workflow efficiency optimisation, and administrative automation—yet still largely adjunctive, rather than transformative in routine care delivery. Despite the potential benefits offered, clinical acceptance and full-scale adoption of AI-enhanced technologies in dentistry is still hindered by clinical integration barriers, ethical concerns, and regulatory challenges.

The evolving AI landscape is accompanied by a lack of ethical guidance on key ethical issues, particularly regarding transparency of information, safety, algorithm bias, protection of personal data, transparency, the risk of over-reliance on systems that may obscure clinical accountability, and inclusive access.

Globally, regulatory frameworks remain fragmented and reactive, struggling to keep pace with rapid technological advancement, thereby creating uncertainty around validation standards, ambiguity around accountability, liability, and governance of AI systems in clinical environments. In South Africa, existing regulatory policy frameworks are outdated, inadequate and/or non-existent to promote or encourage adoption and development of artificial intelligence

technologies and software into the dental practice setting. Establishing robust governance structures that define the roles, responsibilities, and limitations of AI in dentistry will be essential to fostering trust and ensuring patient safety. AI holds tremendous potential to advance dentistry, however its success will depend on a clear regulatory framework with strong data protection system, ethical responsible development, validation and implementation of AI algorithm models based on South African-based patient demographics, and strong ethical guidelines directed at the preservation of the clinician-patient relationship based on trust and confidentiality.

At the clinical level, meaningful adoption of AI is constrained by practical barriers including high capital investment cost, inadequate training programs, resistance to change, incompatibilities between new and existing technologies and their software, infrastructure instability, and misalignment between technological capabilities and real-world workflow demands. These challenges are compounded by a skills gap, as many practitioners lack formal training in AI literacy and digital workflows, thereby limiting both confidence in and effective utilisation of these tools. Addressing these barriers is crucial to ensuring the equitable adoption of AI-enhanced innovations into clinical practice. Embracing AI in dentistry is more than just a technology upgrade, it's a fundamental shift towards more precise, efficient, and patient-centered care.

Looking forward, the trajectory of AI in South African dentistry will likely be shaped by AI-policy initiatives, strategic investments in digital infrastructure, targeted education and training initiatives, and collaborative partnerships between clinicians, academic institutions, and technology developers to develop clinically relevant AI tools. Fundamentally, the value of AI in dentistry will not be defined by its technological sophistication alone, but by its capacity to responsibly enhance clinical judgement, uphold professional integrity, and improve equitable patient outcomes. While the adoption of AI in dentistry is rapidly progressing, it is important to note that human expertise and clinical judgement remain essential. Ultimately, sustainable integration of AI-enhanced technologies seamlessly into dentistry, and its successful use, will depend on a recalibration and alignment of clinical workflows, education, infrastructure, and policy towards more ethically grounded and robust regulatory governance systems.

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