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Ethical principles in dental healthcare: Relevance in the current technological era of artificial intelligence

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A B S T R A C T

In the current technological era, dental practitioners are faced with various ethical challenges, highlighting the importance of bioethics in this healthcare discipline. The rise of artificial intelligence has recently sparked a debate regarding the privacy of patient data. While the advancements may offer innovative treatment options, their long-term effects may not be fully understood, raising questions about the responsible implementation of such methods. Thus, conscientious and ethical AI use in dentistry encompasses that patients be notified about how their data is used and also about the involvement of AI-based decision-making. This paper explores the key bioethical considerations in dental healthcare, with a focus on evidence-based AI development and use. The framework of ethical principles and guidelines provided would foster trust between the clinician and patients, while promoting the highest standards of care.

1. Introduction

Dr. Hal Simeroth stated, "Science brings society to the next level; ETHICS keeps us there". "Ethics" finds its origin in the Greek words- "bios" meaning life and "ethos" which means "custom".[1] In simplest terms, Ethics is the most appropriate and moral way of dealing with the situation that arises in the field of medicine, including all issues from plagiarism to patient management. It seeks to address questions related to the moral principles and values that guide decisions and actions in these areas.[2]

The ethical principles have been around for a long time, serving as the action guides in clinical medicine. International research ethics guidelines have been developed as a result of several significant events. It all dates back to the fourth century BCE, when Hippocrates, a physician-philosopher, directed physicians to "do no harm". The illegal experiments performed on concentration camp prisoners by Nazi doctors during World War II and the subsequent Nuremberg Trials in 1946 gave birth to the Nuremberg Code, which states that "voluntary informed consent is absolutely necessary." The Declaration of Helsinki of 1964 further stressed on the importance of written consent forms.[3] In 1974, guidelines for responsible research using human subjects and the 3 fundamental principles of respect for persons, beneficence, and justice were outlined in the Belmont Report. In 1979, Tom Beauchamp and James Childress published the first edition of Principles of Biomedical Ethics (now in its eighth edition).[4] It was in 1993 that the Council for International Organizations of Medical Sciences (CIOMS) issued guidelines to apply the Declaration of Helsinki in developing countries. These International Ethical Guidelines for Biomedical Research Involving Human Subjects were revised/updated in 2002 in collaboration with the World Health Organization (WHO).[5]

Dentistry is rapidly evolving with time and becoming one of the most technologically oriented professions. It is currently witnessing a surge in consumer electronics, effective health information systems, and artificial intelligence (AI)-based solutions, all leading to a "data deluge".[6] Due to this progression, the gap between "known" and "unknown" ethical conundrums and dilemmas is growing, which will only get more complicated over time. As a result, the next essential question that follows is how bioethics would help in this case, the answer to which rests in its three-fold relevance, i.e.

1. **Ethical decision-making**: It offers a set of principles and guidelines that help navigate complex moral dilemmas, ensuring that decisions are made with integrity and a sense of trust. Ethics assist the clinician in diagnosing and treating the overall "patient", and not just the objective "problem".
2. **Patient-Centered Care:** It ensures that patients have the right to make informed decisions about their health, including the right to refuse treatment or participate in medical research voluntarily.
3. **Research Ethics:** The research tools and emerging technologies are developed, tested, and used in ways that prioritize the larger good for science and society, while maintaining privacy over medical data.

Over the last two decades, Dentistry has also seen considerable growth in the number of dental specialists, practitioners and dental

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practices, as well as an increase in the number of dental negligence/malpractices cases.[7] Dental professionals now face a challenging situation as a result of growing patient demands for high-quality care as well as the technological boom. This has also created new areas of ethical ambiguity and uncertainty. Thus, it is now pertinent, more than ever, that all treating specialists, academicians and researchers, be informed and updated on this ever-changing domain of medical ethics.[8]

This narrative review endeavors to discuss the fundamentals of ethics in healthcare, specifically for AI in dentistry, in light of the emerging digital technology. It also intends to emphasize the need for a strong bioethical framework for integrating technology into the dental profession to ensure patient safety by future providers. Additionally, this will serve as a guide for the ethics review process and stakeholders, in the creation and application of trustworthy and responsible dental health technologies.

2. Methods

A literature search on the topics of "Ethics in dentistry" and "Artificial Intelligence ethics" was conducted using PubMed and Google Scholar databases, including articles published from the year 2000–2023.

The articles were screened and only those relevant to ethical principles or guidelines related to dentistry and artificial intelligence were included in this narrative review. This was supplemented by going through the references of relevant review articles as well.

Publications included original research papers, review or perspective articles, published guidelines and book chapters written in the English language.

2.1. Revisiting the basics

The foundation of bioethics is built on four pillars (principles) that bioethicists often refer to when evaluating the merits and difficulties of therapeutic procedures. These are- Autonomy, Non-Maleficence, Beneficence and Justice. Other morals like veracity, confidentiality and professional integrity must also be continually upheld by clinicians to provide the highest standard of care of their patients.[9]

Autonomy ensures that sufficient information about the proposed treatment is provided to the patient. Any reasonable treatment alternatives, likely outcomes and possible effects if no treatment is opted, are also discussed. Since the right to choose or refuse treatment lies solely with the patient; clinicians must shield themselves from providing any directive guidance and not push any particular treatment over the other or make decisions on behalf of the patient. In the context of dentistry, one must explain to the patient the different types of treatments available; their salient features, pros and cons, costs involved and ultimately give a free hand to the patient. Clinicians must also avoid pushing product claims made by manufacturers or corporations and must depend only on scientific data devoid of prejudice.

In the cases where sound decision-making is impaired; like for mentally challenged patients, established protocols for surrogate decision-making must be followed. This would also involve legally authorized representatives.[10]

The next two principles ensure that first, no harm ***(Non-maleficence)*** is done by the clinician and the sole intention remains to do good (***Beneficence***). A clinician's primary objective includes keeping updated knowledge and skills, continually updating training and striving for patient's wellbeing and benefit. It also means that one acknowledges his/her limitations and knows when a specialist referral would be needed. The ultimate goal is to minimize the risk or adverse effects and prioritize patient safety at all stages. Following proper infection control protocols in the dental operatory; timely monitoring and follow-up; use of clinically proven and biocompatible materials/instruments etc. must always be taken care of.

The principle of ***Justice*** entails the aspects of fair resource allocation, affordability, prioritizing the care objectively based on the patient's oral health and treatment needs, providing clear information, conducting community outreach and attending continuing education programs.[11]

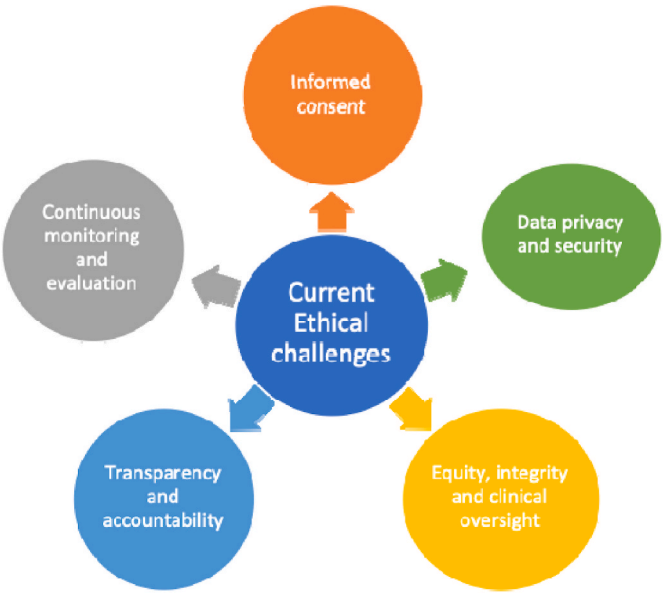

Fig. 1. Ethical challenges prevailing in the current technological era.

2.2. Ethical challenges in dentistry 4.0- the current technological revolution

The development and application of technologies in healthcare necessitates the establishment of procedures that address accountability and safeguarding. Looking at the global scenario, the UK has mechanisms such as the Information Commissioner's Office (responsible for enforcing the Data Protection Act), the Health Research Authority (responsible for the governance framework for health research) and the Confidentiality Advisory Group (method for confidential health information in absence of explicit consent), to protect patient data.[12] Similarly, the Indian government has also proposed a new healthcare data protection law - Digital Information Security in Healthcare Act (DISHA) Bill and Personal Data Protection (PDP); which will have binding on AI technology ethical guidelines.[13]

Although the current technological era is well-intentioned and has tremendous potential to positively change the face of healthcare, it also presents a myriad of ethical challenges across various domains, over and above the established fundamental ethical principles (Fig. 1).

Mörch et al.[14] highlighted a current lack of information on the ethical challenges surrounding AI in dentistry and that current literature in dentistry rarely acknowledges them. They also advocated a more responsible use of the same. Recently, Malik Sallam discussed the utility of Large Language Models (LLMs) in Healthcare Education, Research and Practice. This systematic review highlighted that ethical, legal considerations and transparency, should all be carefully evaluated in order to avoid further difficulties. LLMs remove language barriers and if correctly handled, they can promote equity in research and expedite innovation in the healthcare industry. Thus, knowledge regarding AI ethics in dentistry must be disseminated at large through an applied, case-based method, including elements from normative and metaethics.[15]

2.2.1. Informed consent

The British Dental Association's Ethics in Dentistry advice sheet defines the process of expressing consent as 'a patient gives consent when he or she indicates orally or in writing consent to undergo

examination or treatment or for personal information to be processed.' This could further be in the form of implied, verbal or written consent.[16,17]

Informed consent is thus a crucial ethical and legal document allowing the patients and clinicians to engage in honest and open communication about the proposed treatment. Conceptually, it is based on the premise that everyone has a right to make decisions concerning their health, disease and treatment. It ensures that patients or their legal guardians are making well-informed and voluntary decisions after a thorough explanation of the treatment, its risks, benefits, alternatives and potential outcomes, in comprehensible language.[18]

In this sense, it has twofold benefits: it protects the physician against medicolegal claims made by patients, and it also keeps patients safe from any action taken in addition to the initial course of treatment.

Other considerations:

a) Informed consent is an ongoing process. If there are any changes to the treatment plan, additional procedures, or unforeseen complications, clinicians should communicate these changes to the patient or guardian and obtain their renewed consent.
b) Consent for Minors (concept of ASSENT): When treating minors, informed consent is obtained from the legal guardians. On the other hand, an assent is obtained from people who are not of legal age to give consent. It gives their willingness to participate in a study but does not have any legal implications. However, as children mature, they may be involved in the decision-making process according to their capacity to understand the treatment and its consequences.

Before introducing any technology in dental healthcare, the process of consent is must. The patients have the right to be fully informed about the use of AI technology, which must be developed only if there is a favorable benefit-risk assessment i.e. its benefits should outweigh the risk involved. At the same time, the risks must be justifiable when the social and scientific value of AI technology is considered.[19]

To encourage the use of AI technology, data on cost effectiveness and operating costs should be included when accessible. If a participant or user experiences an adverse event as a result of using technology, they must be entitled to compensation. The patient/participant also has the right to refuse consent. There should not be any coercion from the government/sponsor/researcher/dental professional and all other stakeholders for using such technologies.[19,20]

2.2.2. Data privacy and security

AI technologies must be developed in a way that minimizes unintended consequences and outcomes. The data should be fully anonymized and disconnected from the worldwide technology before its ultimate utilization. All feasible steps should be taken to protect patients/participants from stigmatization or discrimination on the grounds of their medical condition.

Developers should also make sure that every step of the process is transparent so that users can freely decide about how to share their data and use the tool. As part of the **"Right to be forgotten"**, consumers should be given the provision to access, modify, or remove such data from the technology at any point in time.[19]

2.2.3. Equity, integrity and clinical oversight

To reduce any algorithmic bias, the performance of the algorithm must be evaluated in different races, ethnic groups, age groups, social classes, and other relevant human characteristics.[18] The technology should perform satisfactorily in varied conditions. Model explicability implies that the results and interpretations provided by algorithms should be logical and explainable based on scientific plausibility viz it should be able to answer 'how does it work?' and 'who is responsible for the way it works?'.[21]

The operator should have complete control over AI-based clinical decision-making, possessing a manual override. This **'Human in The Loop' (HITL)** model of AI technologies gives room for humans to oversight the functioning and performance of the system.[19]

2.2.4. Transparency and accountability

Since the technology innovators are not well-versed with biomedical ethics, the involvement of representatives from health sector at all stages would greatly benefit the use of AI-based tools. Reddy et al.[22] proposed the "Governance Model for Artificial Intelligence (AI) in Health Care", wherein it is suggested that a data governance panel (constituted by the AI developers) including patient and target group representatives, clinical experts, and people with relevant AI, ethical, and legal expertise can be set up. This panel would review training datasets and ensure there is enough and representative data to support the necessary model outputs.

The details about the technology development and deployment must be easily available to all the stakeholders enabling them to make informed choices about sharing their data and usage. Conflict of interest arising at any stage of development must be disclosed and available on public platforms. Legal and regulatory steps must be in place to ensure accountability in case things go wrong due to inaccurate interpretation and/or recommendation by AI.[19]

2.2.5. Continuous monitoring and evaluation

It is essential to have a well-defined robust mechanism in place to continually monitor the operational and security performance of the AI technology. A multitude of ethical principles and guidelines have been previously published by various international organizations, governments, enterprises and academic groups; for example, Ethical Guidelines for Application of Artificial Intelligence in Biomedical Research and Healthcare by ICMR,[19] Ethical Guidelines for Trustworthy AI by European Union,[23] American Medical Association (AMA)[22] and Ethics and Governance of Artificial Intelligence for Health: WHO Guidance,[24] etc. Similarly, it is proposed that relevant measures are undertaken to regulate and review the use of AI in dentistry. In one of the recent papers, Rokhshad et al.[25] have provided a framework and a checklist to evaluate AI dental applications from this perspective. Furthermore, there is a need to encourage multiple parties to discuss and assess the risks, and social and ecological impacts of AI in dentistry, and to strengthen international cooperation and communication.[26]

2.3. Amalgamation of artificial intelligence in the dental curriculum

Dental education aims to educate future oral healthcare providers to provide ethical, technical treatment while providing patient-centered care with empathy and compassion.[27] The rapid development of AI applications in dentistry warrants the careful integration of AI into dental curricula to ensure its ethical and responsible use. Thus, a paradigm shift in the landscape of dental education is needed, from the standpoint of both teachers and students.[28] It is imperative for them to understand that AI technology is an adjunct tool. It only supports and enhances the clinician's decision-making ability and should not supersede it.

Another aspect to be considered is the need for high-quality training data. It is essential that educators work closely with medical professionals, data scientists, and regulatory bodies to ensure that data used to train AI algorithms is both accurate and ethically obtained.[29] Thus, technology and data analytics must be given more weightage in dental education, and dental professionals must become proficient with their use.[30]

Kim et al.[27] put forward a perspective paper to discuss various considerations for integrating AI into the dental curriculum wherein some very useful suggestions were made-

i. In order to prevent proxy errors, dental educators must encourage students to critically think about appropriate interpretation and purposefully make visual predictions before using AI.

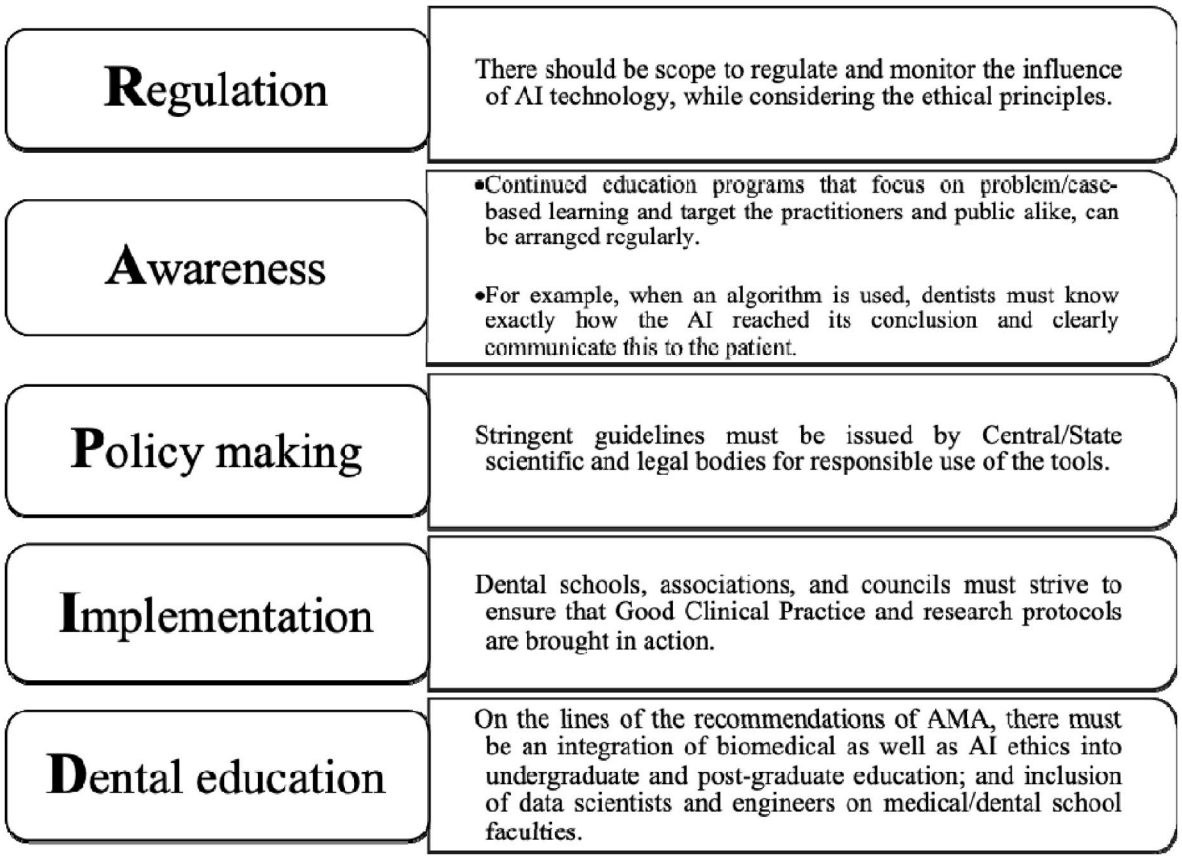

Fig. 2. RAPID approach for enforcement of the AI ethics in dentistry.

ii. The focus should also be on critical thinking and reasoning along with an emphasis on "soft skills," especially communication skills. In this manner, patients foster trust in the clinician's diagnosis and treatment decision-making, even if it's AI assisted.
iii. While AI, particularly generative AI, offers easily accessible resources for students to use, it can also be misused because it can produce erroneous or incomplete content. Hence, proper citation, referencing, and plagiarism in using AI must be emphasized in addition to the use of proctoring software and AI content detection programs. There must also be appropriate instruction in query building to generate more comprehensive information. Students must be cautioned to assess all sources to avoid the bias introduced due to AI-based interpretation of the same.[31]
iv. An advisory group (like that of ADEA) can be formed, while position papers and policy statements can be developed and discussed among members. The periodic continuing education requirements in AI and governing bodies at the state and national levels would ensure continuous re-assessment, revision, and renewal of the algorithm.

The prevailing conflict between AI development and accompanying moral challenges can lead to its limited clinical use. In view of this, as well as the fact that aspect of AI ethics in dentistry still remains under-researched, we propose a five-step "RAPID" approach (Fig. 2) that promotes and upholds bioethical values to be implemented.

3. Conclusion

AI technology holds tremendous potential to further revolutionize dentistry but must not be used without ethical guardrails. Developing ethical competence in AI-based dental education and training, clinical practice and research would be beneficial in professionalization of dentists by promoting better decisions and clinical outcomes. A sound patient-doctor relationship would also enhance the impact and thus the overall image of the dental profession. It is hoped that the enforcement of the proposed novel RAPID approach would aid in realizing this goal in future.

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Patient consent

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Conflicting interest

There are no conflicts of interest to declare.

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