Perspective

Artificial intelligence in clinical dentistry: The potentially negative impacts and future actions

Yung-Kai Huang [a], Li-Ping Hsu [b], Yu-Chao Chang [c,d]*

[a] Department of Oral Hygiene, College of Dental Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan
[b] Department of Industrial Management, Lunghwa University of Science and Technology, Taoyuan, Taiwan
[c] School of Dentistry, Chung Shan Medical University, Taichung, Taiwan
[d] Department of Dentistry, Chung Shan Medical University Hospital, Taichung, Taiwan

Artificial intelligence (AI) refers to the simulation of human intelligence in a machine programmed to think like humans. The idea of AI was initially beginning by the computer scientist Alan Turing which is known as the Turing test.[1] This test could measure the ability of a machine to exhibit intelligent behavior equivalent to that of a human. AI has quietly initiated every aspect of our lives in forms of various conveniences including clinical dental healthcare. The applications of AI in clinical dentistry will improve disease prevention diagnosis, treatment optimization, outcome prediction, and also environmental sustainability.[2,3]

AI is mainly based on electronic, but not biological in nature. Machine learning is a subset of AI applied to learn the statistical data patterns and structures to build a model for the predictions of the outcome of unseen data.[4] However, it requires to collect and share the massive amount of data which may generate many concerns about safety, privacy, and even ethics. Therefore, the potentially negative impacts and future actions of AI in clinical dentistry still need to be addressed and discussed (Table 1).

AI is very highly relied on the knowledge of computer information. Data protection, extraction quality and reliability are the critical issues. The storage of such massive data needs to invest the large volume such as data-sharing system or cloud. From the beginning, the format of each data collection should be consistent to avoid the variety and enhance the accuracy. Unfortunately, current health databases are not as sophisticated. Due to lack of good quality digital data, only less than 20% of the world's medical data were available in AI machine learning algorithm.[5] For example, the unverified diagnosis codes, the insufficient information of disease severity, lifestyles, habits, and unmeasured confounders are the well-known limitations of databank analysis studies by using Taiwan's National Health Insurance Research Database.[6,7] Thus, the collection of authentic data with the same format is a crucial step to fully apply AI in dentistry. Moreover, the medical information security as well as patients' privacy are still the main concerns of AI in current dental practice. By the regulation of cyber security management act could guide the AI in clinical dentistry going forward.

Clinically, in addition to basic knowledge and clinical skills, history taking, physical examination, patient-dentist discourse, and medical humanities are emphasized in modern dental curriculum.[8] The implementation of AI in

* Corresponding author. School of Dentistry, Chung Shan Medical University, 110, Sec.1, Chien-Kuo N. Rd., Taichung, 40201, Taiwan..
  E-mail address: cyc@csmu.edu.tw (Y.-C. Chang).

Table 1 The negative impacts of artificial intelligence (AI) in clinical dentistry and future actions.

Negative impacts	Actions
The accuracy and security of data	Cyber security management
Less communication and humanistic care	Narrative medicine
Patient autonomy and medical ethics	Shared-decision making

clinical dentistry would reduce the face-to-face interaction with patients and their families. The incorporation with social, cultural, environmental factors into daily oral healthcare delivery models is worth to be established with humanistic care as patient-centered care. Narrative medicine competency empathy, professionalism, trust, and reflection empowered into dental professional team may tackle these indifferent appearances.[8,9] Taken together, narrative dentistry seems to be a good tool to assist the transformation of AI in daily dental health care.

Patient autonomy, informed consent, ethics, and morality are the crucial human characteristics that could be difficult to integrate into AI. Medical health care data are the most sensitive and secret documents. However, AI is merely a tool developed within electronic systems. It is not a person that cannot ascribe patient autonomy, personal identity, and wellness. AI applied in clinical dentistry may replace face-to-face communication between patients and dentists. Shared-decision making acts as a bridge between patient and dentist to ensure better treatment outcome with greater patient's satisfaction, and might foster a sense of accomplishment of dentists.[10] Therefore, it is important to instill shared-decision making when transforms AI in clinical dentistry for respecting patient's confidentiality and obtain the correct informed consent.

The application of AI in clinical dentistry will improve the quality of health services. It requires health professional team to handle huge amounts of data from history, physical, laboratory, imaging, and genetic examination data. The manpower needs and workforce challenges seem a problem of accurate data collection in the baseline. In addition, medical care and service always contain the human nature. The problems of public sector, patients' privacy, and patient autonomy rights should be considered in AI applications into daily medical care. The clear understanding of the potentially negative impacts of AI in dentistry might overturn the current situation. Moreover, human-centered AI would be taken consideration in the coming future of dental health care.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

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