

## Artificial Intelligence: Need to Reboot Dental Education.

### Abstract :

We are heading towards a digital era and have to brace ourselves to adapt to technological innovations. The interest in competencies, knowledge processing and measuring specific learning is accelerating throughout the world. Artificial intelligence (AI) is rapidly impacting the delivery of healthcare, medical education and dentistry is no exception. In dentistry, the tremendous amount of patient data requires intelligent softwares for computation and AI can be utilized for patient diagnosis, treatment planning, education and research.

The speed at which new AI technologies are developing and introduced into clinical practice, warrants equipping our graduates with necessary knowledge and skills to exploit AI technologies to maximum benefit. Dentists are always at the front foot of embracing a new technology. Hence, understanding the various concepts and the techniques involved will have a clear advantage in the future. This review is an attempt to provide a perspective on the benefits of AI in dentistry and also emphasizes on the need to bring dental education reforms to foster competency based education model and Artificial intelligence.

**Keywords:** health education; competency; artificial intelligence; curricular reforms; machine learning; technology.

### Introduction:

The current era in India has observed big medical education reforms as the concept of competency based medical education (CBME) is adopted. Medical Council of India has launched CBME program in 2019 through the "Graduate Medical Education Regulations (GMER). [1] The CBME curriculum is driven by program outcomes in mind and frames the abilities needed by graduates to achieve particular knowledge, attitude and skills by developing specific milestones, instructional methods, and assessment tools. [2] At present, the medicine practice has entered the age of artificial intelligence (AI), a technological advancement, that has mesmerized the global scientific community. The rate of data accumulation in the medical field; need to use this data for research and improved clinical decision making has upsurged over the time thus necessitating skilled machine-man relation. [3] AI has significant implications in various fields of medicine like diagnosis, biomedical analogies, development of drugs, image analysis, research and health care. [4] The concept of competency based education (CBE) is still trailing in dental education system and this is high time to put an end to ongoing debate for overhauling dental education system in India. The challenges in the current standard of

dental education need to be identified and met to bridge the divide between theoretical concepts and clinical/practical skills. [5] Health care system is aimed at holistic patient care approach and thus, an education system is required that stimulates critical thinking, self-directed learning, integration among disciplines, competency-based curriculum and use of technological advancements. Dental graduates must acquire a set of basic and subject-specific competencies to begin autonomous, self-reliant dental practice contributing to appropriate oral health management. [6] Dentistry has always been at the vanguard of technological front, the need of the hour is to critically evaluate existing dental education program to make it at par with developed nations. The current situation

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demands to get acquainted with AI technology; the concepts and techniques involved as impending time will definitely need the implementation of its applications(Figure 1).[7]

### **Artificial Intelligence(AI): virtual brain:**

AI is the endeavor to imitate or simulate human intellect in machinery and displaying several behaviors related with human brain like the ability to reason, learning from experience, planning, problem solving, maneuvering, innovation and social intelligence.[8] It encompasses a “combination of computer vision (the processing and understanding of digital imagery), machine learning (data-driven algorithms that enable computers to learn underlying patterns about the data they process), and predictive analytics (statistical modeling used to find or forecast patterns and outcomes)”.[9] The machine learning(ML) is the concept where a specific task is carried out by acquisition and interpretation of extensive data by computer systems. Neural networks represent the heart of the process of ML and are formed by well linked layers of algorithms, called neurons thus simulating the brain network.[10] Usually, the neurons are assembled or aggregated in the form of layers and each layer will perform differently or give different signals. Based on the type and weightage, different inputs will continue to be varied until the desired output is generated from the neural network. Potentiometers are used to encode the weights.[11] One of the variation of ML technique is deep learning which uses multi-layer mathematical operations for learning and manipulating on complex data. The deep neural networks have facilitated the computers to perform tasks like speech identification and computer vision.[12] Artificial intelligence has been used for handling and evaluating extensive datasets in the field of health care. In dentistry, AI has multipurpose applications with the goal of improving patient care and increasing profitability. Different AI softwares/tools have been introduced with different applications (Table 1). AI is not a replacement for the role of a dentist but is an adjunctive aid.[13,14,15]

### **Role of AI in dentistry:**

In dental care AI can be exploited with enormous potential to deliver higher quality services with greater efficiency (Figure 2). A dentist needs to process vast amount of information to arrive at correct diagnosis and adequate treatment planning. AI might aid to standardize the delivery of dental care by using standardized and structured algorithms. There are a lot of predictive tasks where AI can assist with decision making

and also will improve productivity in repetitive tasks. [16] Algorithmically integrating and interpreting a patient's dental and medical history along with X-ray and cone beam images will assist with diagnosis and treatment planning. It can analyze bone density, so has diagnostic and therapeutic applications in periodontics, implants, and orthodontics. [17] One of the greatest application of AI appears to be caries detection. The algorithms may be a boon to diagnosticians, especially in conditions having multifactorial etiology. This technology can help to identify individuals with a high risk of oral cancer or precancer, help patients to deal with chronic illness, avoid human bias and error and reduces the caregiver's burden.[18] However the interpretation of algorithm' results, communication and recommendation to the patient would be at doctor's behest. Speech recognition could save the typing time to enter and retrieve information. Dental chairs work on voice command thus reducing the contact. Automation tools can be alternative to the manpower in the field of patient care. [19] A future is foreseen where dental insurance companies could use the software to automate the claim review process AI will reduce diagnostic errors, facilitate patient education and provide valuable “second opinion”. AI is also recently incorporated in intelligent tutoring systems to develop scenarios that imitate or nearly resemble clinical work on patients, thus reducing the risks associated while training on a real patients to provide standardized training environments. [20]

Medical universities have commenced curricular reforms to brace the budding graduates, medical educators and physicians to the challenges of AI. Knowledge in the field of computational sciences, coding, algorithmics, informatics, robotics and other engineering fields will be warranted, to acquire digital proficiency to tackle new health problems and practice precision medicine. The future will demand digital health literacy and an upgraded curriculum for clinical expertise. [21] A lot of literature is available regarding the advantages and impending benefits of using AI in dentistry. But limited research is available on its potential influence on the education system and training in dentistry. [4] So, a framework is needed on how to develop the dental education program to include AI.

### **Rebooting dental education system: a dire need??**

AI was once only a futuristic vision, but now extensive assortment of data from many sources has brought humans and machines together to positively contribute towards medical research, education and practice. There is a need to

expand health education beyond the basic and clinical sciences. [22] The structured and staggered changes are needed in the basic or foundational courses to facilitate the use of mechanic tools involving large data sets, machine learning and robots, but still retaining the humane touché to patient care.[23] Dental professionals should be thoroughly trained in this technology and very well versed with its boon such as cost effectiveness, impact on health care, increasing efficiency, enabling patients, disease predictors, record maintenance and research.[24] The integration of AI is needed across different aspects of the curriculum impeccably as future health care providers will develop skills to confidently use it in routine practice. The undergraduates and post graduates will learn about AI fundamentals techniques, data science, mathematical aspects and consequent moral and lawful issues.[25] They will learn to handle and supervise AI tools, analyze and interpret data from a broad collection of sources and can justify the use of AI algorithms [26]. As machines won't be able to cater to emotional, physical and psychological states of the patients, so stress will also be laid on communication and empathic skills of health care providers. [27] So, Dental education program needs a “reboot” that makes better use of the technological advancements to provide best dental care. The traditional memorization based and compartmentalized curriculum should be reformed to accommodate AI era. We have to fought a two front war with current dental education model i.e to adopt CBE and include AI in curricula. We have available model of medical education which is robust enough to adapt to our needs.[24]

The field of medical care delivery is revolutionized and the focus is on multi disciplinary treatment strategies, patient safety, risk management, effective communication, teamwork, and interprofessional education. There is a dire need to reformulate undergraduate dental education program in India.[28] The covid era has brought big educational reforms by bringing in forefront virtual learning platforms. The Dental Council of India and the Union Government should take an initiative to propose and adopt competency based dental education model in near future and should consider inclusion of AI in curricula. The governing bodies should be more stern with reinforcing regulations and policies to assure quality dental education. There is a need to assess the core content and methodologies involved in delivering dental education. The reforms should be tailored to provide maximum benefits to the stakeholders, that is, students, dental educators and practicing dentists.[29]

### **Tentative steps required: game changers :**

Dental training, which is largely a memorization based process, mainly focuses on imbibing as much information as possible and applying this knowledge to patient care. Instead we need to focus on knowledge management or processing. More efforts are required to familiarize dental graduates with newer technologies such as AI, mobile health care applications, and telemedicine the potentials of which can be enormously harnessed for patient benefit as proven in pandemic era.[30] Basic training should be provided to the trainers and students in the field of computer and software engineering, data mining and statistical concepts to comprehend the logic behind real-world AI applications.[3] The dental practice provides a continuous flow of data and in future patient data repositories would be needed in different arenas to harness technology.[31] The digitization of health care is being done at fast pace and electronic health records (EHRs) facilitate means to get hold of and process valuable information that can be exploited to make an informed decision and ensures patient safety. To imbibe this knowledge we need to train our graduates from the beginning of training to work with electronic health records (EHRs) which can form the backbone for the implementation of AI in health care. Maintaining the EHRs should be mandatory in institutes and clinics and basic skills to use the hospital's system in practice should be taught from the beginning.[32]

It is believed that some of the stress on professional students due to information overload crisis could be alleviated, thus improving mental health and give them chance to communicate compassionately with patients. [27] A very significant innovation in teaching field is “teacher bots,” a multitasking teaching associate which can convey content, provides opinion and supervises improvement. It helps the students in work, identify knowledge gaps and relieves the teachers from tedious tasks thus improving the personalized and adaptive teaching process.[33] One of the major game-changers of the 21st century is digital revolution in dental medicine, based on the available digitized data, that can tackle present and upcoming challenges in oral healthcare.[30] Curriculum development and analysis, learning, and assessment can also be implemented by adopting AI techniques. The vision of incorporation of AI-oriented education into the syllabus is not distant but will take time and meticulous planning as the technology evolves. Faculty training programs would be needed for smooth transition to machine era. AI training could be delivered via Continuing

Medical Education (CME) programs and new educators within and outside the medical community.[3,25] A complete overhauling of dental education program in India is needed at fast pace as we have double work to accommodate competency based education and AI. Many political and bureaucratic hurdles have to be prevail over as change is not always well received.

### Conclusion:

The core of medical education is elementary understanding of the biomedical sciences and clinical skills. Dentistry would be revolutionized by digital transformation in coming era, emphasizing the closer alignment of humans and machines in education to meet upcoming challenges in dental and oral healthcare. To reinforce dental branch with more expertise in a data-rich environment, program reforms could be brought to transform the health care data into additional values eventually facilitating personalized, predictive, preventive, and participatory dentistry. We advocate radical changes in different phases of the undergraduate curriculum to meet the international standard of professional education. Reforms are needed as new skills and expertise will be required to focus on knowledge management, including effective use of AI technology considering the speed of technologic innovation. Digital literacy needs to reinforce dental education.

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Table 1. Artificial Intelligence softwares/tools used in Dentistry(Ref.no:11,32,33)

S.no	Softwares used	Applications
1.	Logicon	Caries Detector helps in detection and characterization of proximal caries.
2.	Denti.AI	Interpret X -rays more accurately
3.	Orca –dental AI	Software has annotation abilities,automatically segmenting anatomical structures,jaws and teeth with accurate pathology identification
4.	Smart margin and scan clarity sore, Pearl	Dental inspection software to analyze intraoral scans
5.	Glidewell.io	To automate crown design
6.	Smilecloud	Digital smile design
7.	DEXvoice	Voice commands
8.	Videa health,Videa detect	Dental radiograph interpretation
9.	RaPid	Design assistant that performs anthropological calculations, facial measurements, ethnicity and patient preferences
10.	MeMoSA <sup>®</sup> Annotate	Early detection of oral cancer.

