

## INTRODUCTION

Artificial intelligence, AI, refers to machines having the capability of performing human tasks and it is a science of computer engineering. In order to make a fully functional and intelligent machine, we must incorporate math and statistics, combined with human ingenuity with the application of digital techniques and intelligence.

One of the subdomains of AI is machine learning, ML, wherein the machine can learn patterns in data to make predictions. Deep learning is a technique of ML that utilizes multi-layer mathematical and complex statistical operations for learning and making inferences. Machine learning encompasses speech recognition, face recognition, robotic devices, decision support system, image recognition, sensors, and internet search modality.

AI started being accepted as a field of engineering and technology with the invention of robots. The term derives from the word "robota", which means biosynthetic machines. Artificial intelligence is a multi-interactive and multi-disciplinary field with origins in decision theory, cognitive science, logic, linguistics, neuroscience, computer and robotics. As such, Artificial intelligence has even been used in traditional Chinese medicine, as an auxiliary arm for diagnosis and treatment planning (2021 Chuwen Feng).

"Microsoft has agreed to acquire speech technology pioneer Nuance Communications in a major move to expand its cloud offerings to the healthcare industry." The acquisition gives the company "access to technology that uses voice recognition, artificial intelligence and natural language processing to streamline healthcare processes".

The future holds the promise of transformational changes in our social, culture and economics status. These advancements will be integrated fully in our every day life, as it did with the industrial revolution affecting the use of electricity, engines, computers, electronic gadgets and internet.

The use of robotics in dentistry is well known, especially Da Vinci's robotics. Da Vinci's sketchbooks of machines, metal sculptures and robots helped design and produce this innovation.

This scientific field was initiated in 1956 and this term is applicable to a range of items in medicine such as medical statistics, data revision, medical diagnosis and human biology. Artificial intelligence (AI) in medicine is used as a type of Physical Robotics, which are robots used to assist the physician in surgery or even the elderly patients.

This type of robotics also includes Nanorobots. These are inventions created as a new way of delivering drugs and medications. Another type of AI in medicine is called Virtual Robotics, which includes investigative health management systems as in electronic health records, management of the treatment and a reference source to guide the physicians whether it would be in their treatment planning or decisions making.

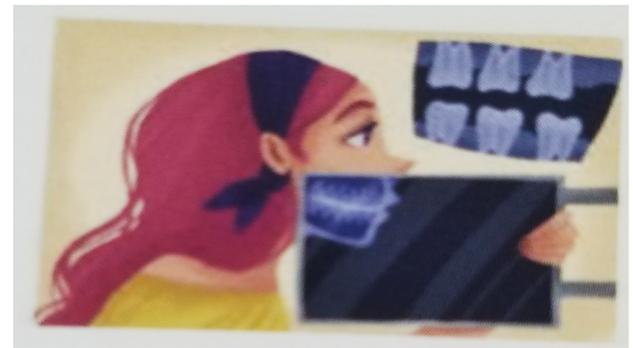


## METHODS & MATERIAL

This presentation is a literature review from the following databases: PubMed, dental journals and Scientific explorations in computer application in health system.

We have known that human intelligence receives information and data as a collection of inputs from the environment, then it uses the old memory perception to process the data and interprets it for a response. The machine, as the artificial intelligence, uses the environmental input (software and engineering with coding), to learn and map the data learnt in order to produce an outcome.

This machine learning, processing, mapping of the input and reprocessing will allow the operator/dentist to decipher and translate the output for action, i.e. surgery and implant placement.



## OVERVIEW

AI-based applications is streamlining our health care, relieving the dental workforce from routine tasks, increasing health at lower costs for a broader population, and eventually facilitating a more personalized, predictive and preventive treatment. However, AI has not entered routine dentistry by large, mainly due to:

- 1) Limited data availability, accessibility, structure, and comprehensiveness of data
- 2) Lacking methodology and standards and
- 3) Practical questions around the value and usefulness, in addition to ethical responsibilities.

AI imaging can be used for diagnosis, imaging analysis and care delivery, while using robotics for implants, model construction and smile design are actual treatment delivery for our patients.

AI can analyze the management of the dental and professional offices by gathering the data over a long period of time from the front desk, personal patient contacts, phone calls and book keeping. This will allow the machine to interpret the input and produce a sophisticated and precise way of increasing patient's case acceptance, satisfaction and communications, especially at the first phone call to the office.



Any AI application in dentistry should demonstrate real and realistic values, for example, improving access to health and quality of care received in the chair. In addition it ought to focus on increasing the safety and efficiency of the care, empowerment of the patients and allowing for research support in the scientific fields.

However, with the advancement of science and technology, one must preserve the Individual's rights and patient's privacy. The giant shift from a central control to a distributed learning system may address this to an extent. AI must be trustworthy and be able to work in a general environment with certain guarantees implemented in an evidence based model, including oversights and standards encompassing it.

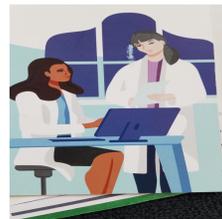


## VIRTUAL & AUGMENTED REALITIES

Virtual Reality, VR, is a system that enables the viewer to close the outside world using their headsets for example, in order to immerse fully in a virtual environment. Physician, dentist or an oral surgeon, and the specialty students will be in OR and the patient, in a flower garden or an art show. As for dental students, they can use VR for surgical procedure instead of watching a video or peaking over the faculty's shoulders. Surgeries and implant procedures in a virtual reality via video recordings are great aids in educating practitioners. On the patient's side, VR has shown to be a very effective tool in order to distract the patient, while reducing their apprehension and anxiety.

Augmented Reality, AR, as in SnapChats or Dent Sim in dentistry (image navigation system) enables students to perform procedures on a mannequin while getting real time feedbacks. The motion of the operator gets tracked and information gets sent back, in order to enhance the skills and improve the effectiveness of the techniques.

As such, Bioelectronics developed by Dr. John Rogers of Northwestern University, allows for sensors and smart devices to detect slight movement, changes or pressures areas on the skin in order to improve the patients' health. These devices can bend, stretch and twist. In dentistry, we use smart tooth brush for treatment of oral disease and inflammation.



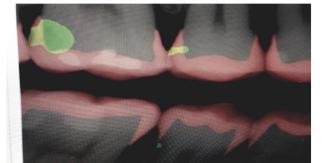
## DENTAL APPLICATION

AI and Machine Learning, incorporated into dental office and dental profession is set to transform the profession. Technical challenges will rise with the evolution of this science and with the newer generation of AI, we must remain cautious about the data security, ethical dilemmas and the patient's privacy, in addition to the necessity of digital literacy calling upon our dental community and educational settings.

The colleges have to implement the curriculum and teachings necessary in order to have a generalized body of knowledge regarding AI, AR and VR. ADA, as a standardization body, will monitor and establish the skill set and best practices needed for the dental informatics and its regulatory oversight.

AI with the aid of digital x-rays, CBCT, practice management and digital billing has been influencing our profession. The newest addition to this field is robotic-assisted dental surgery, From the DaVinci system developed in the mid 90's to Yomi dental robotic by Neocis, there's no better time in dentistry. This robotic system allows for the printing of the surgical guides for implants with intense accuracy of location, angulation, depth and control.

The two arms of robot will aid in holding the implant drill and the splint in place at the surgical site, all controlled by the technical assistant using a laptop. The robot can not act autonomously because of its programming. It actually will resist any movement outside the planned procedures. (Photo University of Michigan Dental Journal)



## DENTAL APPLICATION

With an increase need for reliable and speedy home care information delivery system, especially during the pandemics, the use of AI-CHATBOTS provided patients with essential communication allowing health care workers to reach them efficiently.

Technological advancement has offered Teledentistry, wherein with the help of a camera, teledentist can access the patient for consultation. Teledentistry platform also allows patients to capture images and send all the relevant information remotely to the health care provider. This can expand into an inter-professional video chat where the physician, dentist, caretaker and other professionals and the patient can actually see and talk to each other.

Increased ability for the clinician to implement the information received and provide a treatment plan for the patient based on a discussion and discovery, is tremendously helpful and can be vastly used without any increase in the provider's workload.

AI also increases the accuracy of diagnostic supportive programs. Dentists who are already using digital workflow, 3D printing and CAD/CAM, have the ability to analyze x-rays and upgrade/upload the health records and submit insurance claims digitally.

AI can increase the accuracy of diagnosis of oral diseases, can identify dental anatomy, caries, anomalies, periodontitis and open margins. Additionally, in real time, it can provide up-to-date caries risk or periodontal bone loss level, in order to educate the patient.

AI facilitates dentist-payer-insurance submission. It is able to codify the work needed with cost reduction and increased efficiencies. It also allows monitoring of the treatment and the outcome. In the near future, dental related AI in wearable devices will be able to give real time analyzed diagnostic data to the practitioner or the health care facility. (Photo by TeleDent)



## CONCLUSION

The future implications of AI applications which includes job displacement, management of human-robots interactions, automation and cultural displacement are apprehensive. Engaging in strategic planning in an AI driven workplace will shift the research and management practice to a proactive assessment strategy, resulting in a better understanding of the possibilities and challenges of AI. This will help minimize the unfavorable effects of AI on worker safety, health and our overall well-being. The role of dentist is to use scientific principles and technological advances along with clinical mastery to prevent, cure and diagnose the oral ailments.

We explore and understand the concepts of disease and the treatment modalities by utilizing technologies and evidence based research data. AI and machine learning have improved our clinical IQ and practice management by identifying deficiencies and adapting the most accurate input in order to achieve the best outcome. Smart tooth brush, digital dentures, Teledentistry, intraoral cameras and caries detector devices are all examples of the advancement.

What the future holds is another application of AI technology, called Nano technology, i.e. nanodentistry, using nano-robotic science for treatments in orthodontics, restorative, periodontics and endodontics. Nano technology can also help in dental material (nanofillers), nano solutions (for bonding), antibiotic delivery system, bone replacement, and anesthesia.

Repair of craniofacial lesions and variety of soft and hard tissue technologies using nano technologies are under way.

Superior work flow, safety and efficiency with higher quality of treatment are in combination with the societal and ethical issues of these applications, which require further reflection about the proof of values, and the development of sound interdisciplinary strategies for their wider and safer applications.

