Current and Emerging Applications of Innovative Artificial Intelligence in Modern Medicine and Technology

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ABSTRACT

Artificial Intelligence is intelligence demonstrated by machines, in contrast to the natural intelligence displayed by humans and other animals. Artificial Intelligence in healthcare is the use of algorithms and software to approximate human cognition in the analysis of complex medical data. The key point is to base medical decisions on individual patient characteristics rather than on population. Their potential to expose meaningful relationship with in a data set can be used in the diagnosis, treatment, drug creation, managing medical records, treatment design and predicting outcome in many clinical scenarios. The advancement in computer technology has encouraged the researchers to develop software for assisting doctors in making decisions without consulting the specialists directly.

Keywords: *Artificial Intelligence, Machine Learning, Personalized Medicine, Biomarkers, Medical Education, Medical Informatics, Wearable Technology, Digital Health, Self-Tracking, Self-Care, Personal Medical Devices*

INTRODUCTION

Artificial Intelligence (AI) makes it possible for machines to learn and imitate human intelligence. AI is a branch of computer science capable of analyzing complex medical data while applying relation to patients' treatment, diagnosis, treatment, and predicting outcome in many clinical scenarios. From Siri to self-driving cars or face recognition, artificial intelligence is rapidly increasing in many ways closely connected to medicine. Our increasing expectations of the highest quality health care and the rapid growth of ever more detailed medical knowledge leave the physician without adequate time to devote to each case and struggling to keep up with the newest developments in his field. For lack of time, most medical decisions must be based on rapid judgments of the case relying on the physician's unaided memory, where AI would be very important.

Computer tools can help to restore, organize, and retrieve medical knowledge needed by the doctor to not only provide a better, faster, and more effective prognostic, but also improve their decision-making skills. The Mayo Clinic, Massachusetts General Hospital, Memorial Sloan Kettering Cancer Center and National Health Service have developed AI algorithms for their diagnosis process, monitoring, treatment and patient care.

Artificial Intelligence is still in the very early stage of development, but it still cannot match a doctor's level of intelligence and certainly cannot replace a doctor physically being present. AI can be a tool to take full advantage of electronic medical records, transforming them from e-filing cabinets into full-fledged doctors' aids that can deliver clinically relevant, high-quality data in real time. How might this benefit doctors? Using Watson, IBM's artificially intelligent supercomputer, doctors can double-check the information against the latest clinical research. To emphasize, doctors at Vanderbilt University Medical Center in Nashville and St. Jude's Medical Center receive pop-up notifications within individual patients' electronic medical records (EMR). This alert will notify doctors when a drug might not work for a patient with certain genetic traits. With the

single click of that pop-up notification, the doctor can prescribe another medication more suitable for the individual. Even though AI has advanced largely, the technology cannot operate fully by them or think as a human would. Although this may be true, Artificial intelligence brings a great deal of benefits to the healthcare providers and practices around the world. To enumerate, AI provides fast and accurate diagnostics, reduces human errors, reduces cost, and implements virtual presence. Many diseases spread very rapidly and require immediate action before it will become more severe. With artificial intelligence, systems have the capability to gain knowledge from previous cases and receive access to stored knowledge anywhere around the world.

After continuous research on AI, researchers have scientifically proven that AI diagnose fast and accurate. In many situations, doctors can tend to diagnose based off emotion or off previous traumatic situations in their own personal lives. Human being is emotional and sensitive beings. Moreover, because of these emotional factors, any stress on the doctor side can possible pose a threat to the patient undergoing the operation. In-spite of humans undergoing different emotions and situations in their everyday lives, AI could be the best alternative to monitor the decisions of the doctors and greatly decrease stressful situations. Another key point previously mentioned is cost reduction.

We all know that doctors' visits can be very costly. AI enables the patient to get doctor assistance without physically visiting a hospital or clinic, which results in less money. It closely ties to the last point of virtual presence, also known as Telemedicine. Telemedicine allows specialists to assist their patients who live in remote locations.

Using presence robot, doctors can engage with their staff and patients while in the workplace and assist or clear their queries. As previously expressed, computers are getting better at reading unstructured information. The advantages of personalized medicine are widely considered to be 1) better medication effectiveness, since treatments are tailored to patient characteristic e.g., genetic profile 2) reduction of adverse event risks through avoidance of therapies showing no clear positive effect on the disease, while at the same time exhibiting (partially unavoidable) negative side effects 3) lower healthcare costs as a consequence of optimized and effective use of therapies 4) early diagnosis and prevention by using molecular and non-molecular biomarkers 5) improved disease management with the help of wearable sensors and mobile health applications and 6) smarter design of clinical trials due to selection of likely responders at baseline.

There are devices that help doctors to detect things that are easily overlooked. These devices are known as "wearable technology". These devices help to track, analyze, and guide their behavior. Body sensors are considerably great in aiding patient posture and rehabilitation while head-mounted wearable displays can provide information to surgeons to while maintaining sterility during operative procedures. A substantial example of 'wearable devices' involves Apple Watches. Apple Watches are compatible of a wide variety of awareness ranging from an elevated heart rate to a drop in blood oxygenation.

Apple began collaboration with the Stanford University the Heart Study project and the purpose of this collaboration was to assess the effectiveness of arrhythmia detection by automatic monitoring the heart using the sensors in the Apple Watch. The difference is that the watch is non-invasive and it does not require any additional specialist such as the actual ECG (electrocardiogram). By wearing this watch for a specific amount of time, the watch will be able to detect all anomalies and, as a result, identify the probability of having a heart defect. The Apple Watch calculates the heart rate by using sensors that are installed in this watch, while photosensitive photodiodes detect the volume of blood flow.

AI tools like the Apple Watch are created to further encourage consumers to better their lifestyles. Wearable AI gives patients greater control over their well-being. If your wearable tells you that you are at risk for diabetes, and you go to the doctor and are diagnosed by traditional means, then you are still getting the standard quality of care. Under these circumstances, doctors will be able to make a more conscious decision faster, as well as obtain new information from medical documentation.

APPLICATIONS IN MEDICINE

Since its early emergence, artificial intelligence has played a potentially revolutionary role in

medicine. It has significantly shaped and influenced the way in which doctors and other medical professionals are able to treat, interact with, and assess patients. Artificial intelligence has taken a big step within medical field. Now as of now most talk is about diagnostic medical imaging such as radiology, pathology, retinal imaging, dermatology inspection, and endoscopic diagnosis. There are of course other ways to incorporate these two together to even help the health care. One example would be a real-time 3D hand tracking using a GAN (Generative adversarial Networks) and convolution neural network (CNN) can be used for surgical simulation and surgical computer-based monitoring [1].

Studies show that machine learning was able to do better than a risk calculator. The standard risk calculator may not be as accurate to guess for atherosclerotic cardiovascular disease. It is important to catch it at the right time; otherwise the calculator may overestimate the risk in low risk patients ending in unnecessary stating therapy. By accounting for that they input this information through methods also results to figure what would be a great outcome. The experiment began with them putting it into the machine learning (ML) to see how it would stack against the calculator. The end result shown that ML was better since it can pull from the subjects that were already within the system. The ML recommended less drug therapy even if it was missing fewer events [2].

To be able to base medical decisions on individuals by characteristics, behaviors, and more would really be useful as well. It would let us tie personalized medicine to certain people, and there life style. Human rights guarantee people the means to satisfy their basic needs. This was a point of interest at the end of the National Consultative Ethics Committee [3]. Artificial intelligence in healthcare represents a major milestone, and we are here for the digital innovation. We would be able to advance even further with health care and technology.

It won't just be a tablet you can play games of. You will be able to see further into your family health history for any rare diseases or future problems. Computers will even provide a safer way of treatment then our standards we have set today. Every year we get further into technology with speed, performance, and adaptation. We still lack on clinical practice which is why technology is not doing great now in medicine.

The poor predictive models, lack of understanding on complex model predictions, and lack of validation via clinical trails only show the benefit of the standard health care [4]. One group went over the beneficial side of improved technology for personalized medicine. Mainly to highlight how we may overcome the future with our challenges. The point was made that physicians, patient advocates, regulatory agencies, data scientist, and health insurance organizations need to advance within the computational methods to benefit clinical practice. This is the way to go since we base people on their disease subtype, risk, prognosis, or treatment [4].

Development in AI may provide the new paradigm for data integration in drug discovery. The goal of data integration in drug discovery is to enable cross-data information to fill or improve the gaps within the medical field. Generating large amounts of data on genes/proteins, compounds, genomes, and more can be done through the development programs with drug discovery. Pharmaceuticals as well as clinical phenomena will be able to have somewhat more of a clear picture compared to as they do now. By using the AI we can equipped it to machines with human like intelligence with the ability to learn to successfully achieve all of these goals [5]. We have artificial neural networks (ANN) which are mathematical models for data processing that can mimic the neurons in the brain of a human. The result of using this would consist of parsing sensory inputs, learn, and make decisions for the AI.

There is so much potential in medical workflow and quality of health care. There are even some plans to use the AI for cloud-based tools. This tool will be used for telemedicine which is close to the GAN and CNN setup [1]. The difference is they could be far away while using the electronic interface.

This can provide support for people that may need emergency help, can't reach a certain part of the world. The AI was 90% more accurate and was significantly superior to a human [6].Even for a colonoscopy you can improve the quality of the check-up. There was a simple camera at the tip of a slender pole like item. That was turned into a polyp detection followed by an immediate polyp characterization. By this small black pole being up to perform the optimal situation for colonoscopy observation.

What happens exactly is that the camera indicates the detection of a flat adenoma. Of course this does have a person behind the movement so it can go this far. There is a real tine computer aided diagnostic system designed for use with endocytoscopy. The idea of this and prototypes was all done in Tokyo, Japan which isn't a big surprise. They worked on this to show it has detected at least 94% of the polyp [7].

It is through artificial intelligence, that medical professionals are able to use technology to automate the process when diagnosing and evaluating patients who require care [8]. Abranch of medicine that has experienced significant development due to its utilization of artificial intelligence would have to be Cardiology [9]. Cardiology is a branch of internal medicine that examines the heart, its functions, as well as the diseases and abnormalities that pertain to it [10].

It is a very extensive branch of medicine that requires great knowledge and attention from the Cardiologists themselves. When treating and examining patients, Cardiologists are often equipped with and use several different tools and medical devices. One of the most integral and heavily utilized medical devices Cardiologists use is the Electrocardiogram [11].An Electrocardiogram, or EKG as it's known for short, is a recorded display that measures and documents the electrical signals of an individual's heart [8]. The test is often administered by the supervision and guidance of a doctor in a medical facility and requires the patient to have various sensors (electrodes) attached to their chest and limbs for a reading [10]. However, through advancements in wearable health technology and artificial intelligence, doctors now have ability to administer EKG's outside of the medical facilities [11]. More specifically, the patient themselves can administer the EKG readings on their own [9].

Through devices such as the Apple Watch, patients can now take EKG's with them on the go and have the convenient ability to monitor their heartbeat/electrical signals themselves [10]. The Apple watch records an individual's heartbeat through the atrial sensor at the base of the device [8]. Once firmly strapped around the patient's wrist, the watch begins recording their heartbeat and creates a live display of the patient's current atrial electrical pattern. The patient can then store this recording onto their phone from the watch and even send it to their health care provider in a matter of minutes [8]. The significance of the Apple watches ability to do this is quite high, as it highlights not only the innovation of artificial intelligence but also that technology as a whole in modern medicine is evolving to the point where certain tools are being modified for everyday practical use.

The true medical benefit in the watches capabilities lies, however, in its ability to analyze and assess numerous hours of electrical recordings and distinguish between harmless rhythm irregularities and potentially life-threatening problems [11]. This feature of the watch can in turn save thousands of lives and catch early onset heart issues before they develop into serious life-threatening problems.

IMPACT ON DOCTORS & MEDICAL PROFESSIONALS

As artificial intelligence begins to get more integrated and embedded within the medical field, its effects, as well as impact are beginning to become more evident. In rise of all the change and innovation occurring, one of the demographics that is most heavily influenced and impacted by the integration of artificial intelligence and technology into the medical field would have to be that of doctors and medical professionals [12]. In regard to doctors and other medical professionals, the emergence of artificial intelligence within their field of medicine is one of significant importance. Through its automated process, artificial intelligence overall has provided doctors and healthcare professionals a much more simpler, efficient, and overall improved experience in the medical field.

One such instance of artificial intelligence improvement within the medical field would have to be in regards to its contributions to Radiology. Through its imaging in Radiology, artificial intelligence can help in automatically and efficiently identifying abnormalities found in scans of patients and can overall provide accurate and timely diagnoses. This can in turn help in determining if a certain lesion is benign or malignant, providing doctors and medical professional's accurate and extensive aid when coming up with a diagnosis [12]. In the long run, artificial intelligence in medical imaging and Radiology provides the opportunity for doctors to obtain greater efficacy and efficiency in clinical care.

DISCUSSION

Though artificial intelligence may still be a relatively new concept, its possibilities are endless. With its ongoing integration into the field of medicine combined with its continual progression, artificial evidence offers medical professionals and patients alike a new and potentially lifesaving experience like no other. One such area of the modern medical field that artificial intelligence seems to improve is that of electronic health records (EHRs). In a project referred to as "Deep Patient" a group of researches and medical students at the Icahn School of Medicine at Mount Sinai sought to the push the current medical boundaries by combining artificial intelligence with that of electronic health records.

Through its integration with artificial intelligence, the EHRs that they created had the potential to provide doctors and medical professionals the potential ability to detect, diagnose, and uncover new insights in connections with potential patient diseases. Using deep learning, which mimics that of the neural brain networks, "Deep Patient" was able to store information, uncover patterns and connections, as well as learn new things without being programmed to do so [13]. Though it is still being continuously developed, "Deep Patient" offers a brief glimpse into the future of the medical field, a future that has the potential to save countless lives and aid medical professionals in their ongoing battle to combat sickness and provide aid.

The rapid growth and incorporation of Artificial intelligence within the medical community can be largely attributed to the dynamic adaptability and easy implementation of AI software's across a plethora of medical branches. The ability of AI's to store, organize and correctly access relevant knowledge of vast amounts of data and information, is what makes the use of artificial intelligence so revolutionary. The memory capabilities of AI systems are essentially limitless, allowing AI systems to access countless information ranging from journals, to medical textbooks and patient histories in order to produce and aid in patient assessments. Although memory capabilities of AI systems on their own are an extraordinary and useful concept, the truly groundbreaking advancements of the use of AI's comes when AI systems memory capabilities are paired with its ability to cognitively and intellectually think. AI systems are so effective at detecting and efficiently automating data that at times they surpass the efficacy of humans which can be seen in some parts of radiology, where AI methods excel at automatically identifying complicated patterns in imaging data and preparing quantitative assessments of the radiographic characteristics. Artificial intelligence in the medical world isn't just a promising concept, but a quickly evolving revolutionizing notion that has the ability to change the way that medicine is practiced and help physicians more efficiently and accurately treat their patients.

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