Digital Health

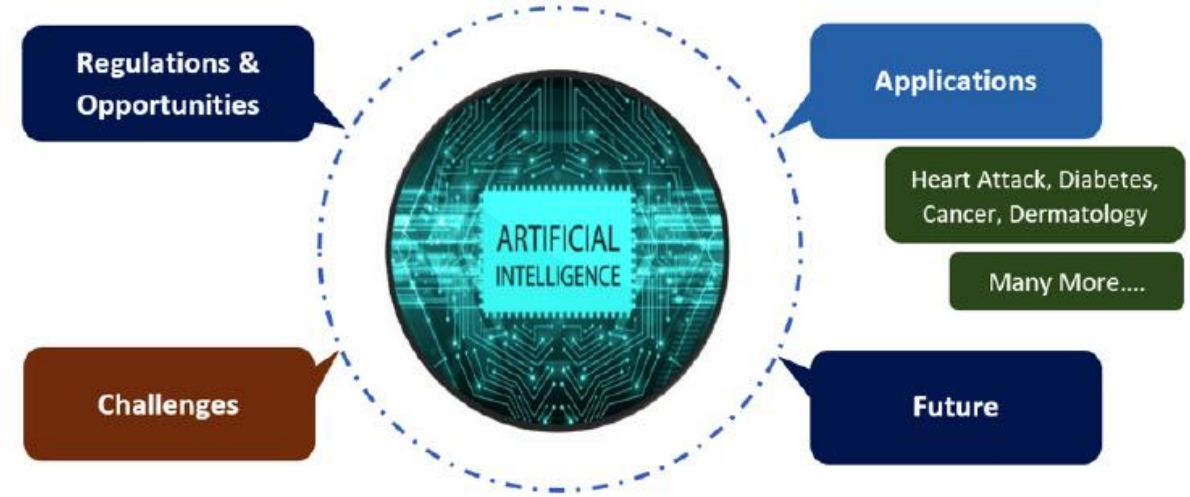
January 14, 2022
MEDdesign

The Power of Artificial Intelligence in the Medical Field

By Ajay Panwar

Opportunities for intelligent computer systems span widely, including extensive use in medical science. Artificial intelligence enhances cognition analysis of complex health issues and improves the diagnoses. However, there are still some challenges in terms of data quality, regulations, market penetration and adaptation.

Artificial intelligence, or AI, is transforming the medical device industry today. As medical devices continue to incorporate artificial intelligence to perform or support medical applications, new regulations require AI-driven medical devices to comply with state-of-the-art requirements and provide objective evidence for repeatability and reliability. AI has the potential to improve patient outcomes as well as the productivity and efficiency of healthcare delivery. It can also improve the day-to-day lives of healthcare providers by allowing them to spend more time caring for patients, hence improving staff morale and retention. It may even accelerate the development of life-saving therapies. Simultaneously, concerns have been expressed about the influence AI may have on patients, practitioners and health systems, as well as its potential risks; ethical arguments have erupted about how AI and the data that supports it should be utilized.



AI has the potential to improve patient outcomes as well as the productivity and efficiency of healthcare delivery, but challenges remain. Figure courtesy of Ajay Panwar.

Leading researchers and clinical faculty members presented 12 technologies and areas of the healthcare industry that are most likely to see a major impact from artificial intelligence

within the next decade at the 2018 World Medical Innovation Forum on artificial intelligence, hosted by Partners Healthcare.

AI in Medical Equipment and Healthcare

From real-time video from the interior of a refrigerator to automobiles that can identify when the driver is inattentive, smart gadgets are sweeping the consumer market. In the medical industry, smart gadgets are critical for monitoring patients in the ICU and elsewhere. Artificial intelligence can improve outcomes and minimize costs related to hospital-acquired diseases penalties by improving the capacity to predict deterioration, detect the development of sepsis, or detect the onset of complications.

Heart Attack

When a section of the heart muscle doesn't get enough blood, it causes a heart attack, also known as a myocardial infarction. The longer the heart muscle goes without therapy to restore blood flow, the more damage it sustains. The most common cause of heart attack is coronary artery disease. A strong spasm, or abrupt contraction, of a coronary artery, which can block blood flow to the heart muscle, is a less common reason. Experts at the University of Oxford have used machine learning to create a "fingerprint," or biomarker.

The fat radiomic profile reveals biological red flags in the blood arteries that feed blood to the heart, such as inflammation, scarring and vessel alterations, all of which are indicators of a potential heart attack. Another example is cardiovascular magnetic resonance (CMR): CMR is a scan that detects how much of a particular contrast agent the heart muscle picks up and evaluates blood flow to the heart; the stronger the blood flow, the less likely there will be blockages in the heart veins.

Diabetes

Uncontrolled diabetes causes diabetes mellitus, which can lead to multi-organ failure in individuals. As a result of improvements in machine learning and artificial intelligence, it is now possible to detect and diagnose diabetes in its early stages using an automated procedure that is more efficient than manual diagnosis. Image-based AI-assisted medical screening and diagnosis is presently in development. Diabetic retinopathy (DR), age-related macular degeneration, glaucoma, retinopathy of prematurity, age-related or congenital cataract, and retinal vein occlusion are among the disorders where this technique is now being applied in ophthalmology.

IDx-DR is the first AI algorithm authorized by the FDA for detecting DR in non-ophthalmic healthcare practitioners' offices. The gadget is linked to a non-mydriatic retinal camera (Topcon's TRC-NW400), which sends the pictures to a cloud-based server. Based on autonomous comparison with a huge collection of typical fundus photos, the server uses IDx-DR software and a "deep-learning" algorithm to discover retinal abnormalities compatible with DR. One of two outcomes is provided by the software: (1) Refer to an eyecare professional (ECP) if more than moderate DR is discovered; (2) If the results are negative for more than mild DR, rescreen in 12 months.

Cancer

One of the most promising methods of cancer treatment is immunotherapy. Patients may be able to beat tough tumors by attacking them with the body's immune system. Machine learning algorithms and their ability to synthesize extremely complex data may open up new avenues for tailoring drugs to a person's genetic composition.

Dermatology and Ophthalmology

Every year, the quality of cell phone cameras improves, and they can now create photos that can be analyzed by artificial intelligence systems. Two of the first specialties to gain from this trend are dermatology and ophthalmology. Researchers in the UK have even developed a gadget that analyzes photos of a child's face to detect developmental difficulties. The approach may detect discrete elements including a child's jawline, eye and nose placement, and other characteristics that could suggest a craniofacial aberration. The program can match everyday images to more than 90 illnesses, allowing doctors to make better-educated decisions.

Challenges

Electronic health records are a gold mine of patient data, but doctors and engineers have battled to gather and analyze it in a way that is accurate, quick and reliable.

Due to data quality and integrity difficulties, as well as a tangle of data formats, structured and unstructured inputs, and missing data, understanding how to engage in meaningful risk stratification, predictive analytics and clinical decision support has been particularly difficult. From cellphones with step trackers to wearables that can detect a pulse around the clock, a significant amount of health-related data is generated on the road. Collecting and analyzing this information, as well as complementing it with the information provided by patients via apps and other home monitoring devices, can provide a unique perspective on individual and population health. Artificial intelligence will play a key role in deriving relevant insights from this massive and diverse data set.

The difficulty of interoperability and integration is one of the main traits that divide academic research from practical AI applications. The majority of research focuses on creating AI models that function with carefully vetted sets of health data. Data is complex, scattered, and difficult to access in real life. The absence of a sufficient data architecture is often the biggest impediment to integrating AI into current applications.

Machine learning and artificial intelligence research require high-quality reporting. The danger of bias and the possible value of prediction models can only be accurately appraised if all features of a diagnosis or prognosis model are fully and clearly reported. Machine learning studies should aim to follow best practice recommendations like the Transparent Reporting of a Multivariable Prediction Model for Individual Prognosis or Diagnosis (TRIPOD), which is designed to help researchers report studies that develop, validate, or update a prediction model for diagnostic or prognostic purposes.

Conclusion

Artificial intelligence has great potential in medical science beyond what we can imagine, and the current applications are only the beginning. As briefly discussed, immunotherapy has significant promise in cancer treatment. As we know, cancer is a deadly disease that impacts vital parts of the body. Customizing diagnosis according to the patient's genes is just outstanding. It is imminent that AI will help us in effectively diagnosing diseases, developing personalized medications for complex treatments, and much more.

In addition, many of the disease states discussed are a leading factor for a patient's cause of death (i.e., heart attack). Not to forget the adverse events from diabetes are unimaginable—including cardiovascular complications, kidney damage, eye damage. Retinal image analysis

also helps diabetic patients, as it aids the doctor with fundus image analysis, which can more swiftly help determine the next stages in a patient's therapy. Doctors would be able to attend to more patients who require treatment. Emerging healthcare technologies focus on minimizing eye specialist visits, lowering total treatment costs, and increasing the number of patients seen by each practitioner. AI can assist the healthcare provider in reaching his or her objective more effectively.

Although this technology helps in the healthcare industry, it should not be used to replace a clinician time. Advances in AI are bringing with them new possibilities for running and grading algorithms. But as stated, this is just the beginning era of Artificial Intelligence-Machine Learning in medical science. The more we focus on the improvement of data quality and automation in the analysis of medical data, the more the algorithms can assist us in identifying useful patterns — patterns that can be used to make accurate, cost-effective judgments in complex procedures.

February 28, 2020
Ameing for Asia

Artificial Intelligence Applications, Regulatory Approvals on Rise in Asia

By Ames Gross

The Chinese government is investing heavily in the development of new technologies that leverage AI. This includes solutions to address the COVID-19 outbreak.

The use of artificial intelligence in healthcare is accelerating rapidly, as devices and products that mimic human learning and behavior are on track to get regulatory approval in the United States, Europe and increasingly, Asia.

As recently as one year ago, **artificial intelligence** was still largely in the research phase, but now hundreds of medical AI applications are nearing approval by regulators. In Europe and the United States, more than 100 AI products have already been cleared for clinical use. A flood of approvals in Asia are not far behind, with some already issued in South Korea, China and Japan.

Drawn to the new technologies because of their promise for speeding diagnosis and treatment of chronic diseases and growing the efficiency of medical delivery systems, the Asian giants are moving fast to get a handle on the new technologies. China's regulatory authority last year issued its first technical guidelines for AI-based software products, and the government is investing vast sums in development of the new technologies.

AI technologies rely on deep learning and sophisticated computer data analyses to detect disease early, achieve greater accuracy in diagnoses and offer more personalized medical treatments. They are developing rapidly across disciplines, but have been particularly in vogue in radiology, where the use of computerized images and software is already well

established. AI technologies can harness large troves of data and image recognition software to provide solutions for image analysis and diagnoses. AI algorithms are being used to interpret chest radiographs, detect cancer in mammograms, identify cancerous skin lesions and colon polyps, analyze computer tomography scans, spy brain tumors on magnetic resonance images and even predict the development of Alzheimer's disease from positron emission tomography. Other applications of AI rapidly coming into play include drug development, health management and analysis of electronic medical records and genetic markers.

In China, AI is Deployed against COVID-19, and More Widely for Disease Prediction

Chinese health officials and private companies are seeking to leverage artificial intelligence to solve the nation's most pressing healthcare conundrums—a dearth of medical resources, high costs, arduous training periods for physicians, and an elevated rate of faulty diagnoses. Since the outbreak of the COVID-19 virus, AI is being marshalled to address all those issues right away.

At the end of January, the Shanghai Public Health Center (SPHCC) and Yitu Healthcare, a Shanghai-based startup, launched what they call the Intelligent Evaluation System of Chest CT for COVID-19. It uses AI technology to improve on traditional methods to evaluate chest lesion images, which usually require several hours. While those traditional methods are plagued by low efficiency and difficult clinical promotion, Yitu says the new AI system marshals image algorithms to intelligently diagnose and quantitatively evaluate CT images of COVID-19. It rapidly grades the severity of local lesions, diffuse lesions and whole lung involvement, allowing complete quantitative analysis in seconds.

The SPHCC is also combating the spread of the coronavirus using another AI technology, a continuous temperature sensor developed by **VivaLNK**, a Santa Clara, California-based AI startup. And in mid-February, the Chinese government released a public app, also AI-powered, to gauge potential coronavirus exposures.

Chinese multinational tech company Baidu, Inc. has made its online doctor consultation platform free for users who want to consult with a doctor about COVID-19. Thus far, the platform has handled more than 4.2 million inquiries from users about COVID-19, according to Baidu. And in hospitals in several Chinese provinces, AI-powered robots are being used to boost staffing and reduce the risk of cross infection among nurses, doctors and technicians

Beyond AIs application to the COVID-19 outbreak, Chinese firms are moving forward in using AI to improve medical imaging and diagnosis over the long term.

Since 2017, when Shenzhen-based-based Tencent Holdings, Ltd. launched its AIMIS diagnostic medical imaging service, it has reached agreements with more than 100 Chinese hospitals to employ the technology. Airdoc, a Chinese health technology company, has developed an AI-driven system that diagnoses chronic diseases by analyzing retinal images. Also, Accutar Biotechnology, a Chinese AI pharmaceutical company, has raised millions of dollars in funding for its venture to use 3D projections and chemical structures to develop pharmaceuticals.

Other Chinese companies are working to develop smarter wearable healthcare prediction and diagnosis devices, too. San Diego-based 12 Sigma Technologies, a company with a deep footprint in Beijing, Suzhou and Shanghai, makes data analysis software that allows

physicians to diagnose patients quickly by inputting an X-ray or CAT scan image to scout for multiple disease indications at once. And iCarbonX, based in Shenzhen, has invested more than $350 million in developing machine learning algorithms, that company officials say can find patterns in healthcare data to prevent and diagnose disease.

Japan Healthcare Companies Deploy Machine Learning, Other AI Technologies

Healthcare firms in Japan are increasingly developing AI technologies as well. Japan's MHLW/PMDA has granting expedited review authority to some new AI-based products since the start of 2018.

Among them are endoscopy AI devices to improve detection of colorectal cancers. One Tokyo startup, AI Medical Service, is developing AI technology to detect not just colorectal, but esophageal and gastric cancers, applying neural network algorithms trained on massive sets of data captured using standard endoscopes.

Another Tokyo-based company, Fronteo Healthcare, is developing software it says uses electronic medical records to help hospitals identify older patients with a proclivity to fall and injure themselves.

South Korea, Singapore Firms Arming against Public Health Threats with AI Technologies

The COVID-19 outbreak is also spurring the development of AI technologies outside of China. In Singapore, the government announced in February it is partnering with KroniKare, an AI startup, to pilot smart phone-based temperature screening technology to identify people showing symptoms of fever. The system uses a cellular phone fitted with thermal and 3-D laser cameras to gather and analyze multispectral images and temperature data up to nine feet away. The company says the device can detect people who may have fever as they walk by a subject carrying the device.

In South Korea, AI firms are taking on the growing prevalence of Type 2 diabetes (more than 5 million Koreans have been diagnosed with the disease) by using the power of metadata to manage the chronic condition. Korean company i-SENS is among a number of firms that have developed glucose checking devices that employ AI to speedily gather data on a patient's condition and transfer it to their physicians.

The Path Ahead for AI: Faster Diagnoses, Greater Efficiency, Rapid Adoption, Better Analysis

In Asia as elsewhere, the promise of artificial intelligence is rapidly coming to fruition. Going hand in hand with the digital revolution, it is harnessing big data storage, advanced analytics and the power of networks to speed diagnoses, trace pharmaceutical use, and make doctors and other healthcare professionals more efficient. If successful, the breakthroughs will forge a new healthcare ecosystem where AI technology is the first line of preventative care and treatment, and a key partner in keeping people healthy.