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Cover Story:

Reimagined Hospitals

Bright Ideas

HealthManagement.org rounds up exciting developments that have all the characteristics of game-changers for healthcare. What do you think?

AI Breast Cancer Diagnosis Matches Two Doctors

A study suggested that AI diagnoses breast cancer from mammograms more accurately than radiologists.

A computer, specially designed and trained by a team of researchers from international bodies such as Google Health and Imperial College London, performed as well as two doctors working together.

The computer model worked on mammograms from nearly 29,000 women in the UK and US.

In the study, the computer analysed the images with no access to each patient's history but still outperformed six radiologists.

The study results indicated that the AI algorithm matched the double-reading system in accuracy and was better at spotting cancer than a single radiologist.

There was a 5.7%/1.2% (UK and US data respectively) reduction in falsely diagnosed cancer and a 9.4%/2.7% drop in false negatives, when cancer is overlooked.

Becoming a specialist in interpreting mammograms takes more than a decade and reading images is time-consuming work. While AI shows great promise in cancer diagnosis, it is largely seen as a support tool for radiologists that would tackle burnout and staff shortage.

The research team said one application could include providing automatic real-time feedback on mammography images, awarding a statistical score that could be used to triage suspected cases more quickly.

Nobel Prize for Medicine

In December 2019, the Nobel Prize Award Ceremony took place in Stockholm, Sweden. This year, the award in Physiology or Medicine was presented jointly to doctor and cancer research scientist, Dr William G. Kaelin, Jr. (Harvard University and Dana Farber Cancer Institute, USA), Sir Peter Ratcliffe (University of Oxford, UK) and Dr Gregg Semenza (Johns Hopkins University, USA), "for their discoveries of how cells sense and adapt to oxygen availability," one of life's most essential adaptive processes.

The Nobel honour was the result, in part, of groundbreaking research Kaelin had done 15 years before. It was dedicated to the understanding of the von Hippel-Lindau (VHL) gene mutations, which cause VHL syndrome that makes patients more likely to develop kidney cancer.

Kaelin's work allowed for better understanding of how oxygen levels affect cellular metabolism and physiological function, and subsequently, of the causes of abnormal cell or cancer growth which provided insights into tumour development and growth prevention. VHL patients battle a series of tumours throughout their lives, and curing VHL is one step closer to curing many other forms of cancer.

Swiss Hospitals Successfully Trial Blockchain Medical Device Tracking

Swiss hospitals have announced successful processing on a trial of medical device orders via the Blockchain.

The Cantonal Hospital Winterthur, the Cantonal Hospital Baden, the University Children's Hospital Zurich and the Spitalregion Fürstenland Toggenburg along with two medical device suppliers undertook the order trial.

Present standards of medical device traceability is inefficient and it's impossible to guarantee trustworthiness. Counterfeit scandals have highlighted the vulnerability of the medical device supply chain and the risk borne by patients.

With the European Union 2017 Medical Device Regulation, all devices require a Unique Device Identification number for identification along the supply chain.

The Blockchain system devised for the participating Swiss hospitals enables medical device route tracing. All transaction steps are stored in the Blockchain with common consensus and are immutable. The chain also makes it possible to track all transactions.

Stakeholders said that both technological and regulatory means now exist to put a vision for better patient safety into practice.

AI Predicts Future Healthcare Costs from Chest X-rays

Researchers from the University of California San Francisco (UCSF) trained deep learning (DL) applications to identify cost indicators from chest radiographs to predict future health costs covering five years.

Presented at the Radiological Society of North America (RSNA) in Chicago, USA last December, researchers said DL could pave the way for increasing the value of imaging data.

"Cost is a crucial barrier to healthcare access and cost estimation can better prepare a patient physically and psychologically," said the research team.

The team added that radiologists can presently only extract a minimal amount of data from images but the algorithm she and colleagues have developed could change that.

During the development of the algorithm, the research team used 16,533 chest radiographs from UCSF from more than 19,000 patients. The data was then broken down into sections that included patient's age, gender, postal code and cost of care to date at UCSF Medical Center within five years of their exam. This was followed with four different models of classification which were tested on 1,877 images.

The method resulted in an accurate prediction of the patient's five-year healthcare spend and identified if they would be in the top 50% of healthcare spenders.

Machine Learning Helps Predict Risk of Heart Failure

Researchers at Brigham and Women's Hospital and UT Southwestern Medical Centre developed a machine-learning algorithm which can identify the risk of hospitalisation from heart failure for patients with Type 2 diabetes.

The ACCORD (Action to Control Cardiovascular Risk in Diabetes) trial took place over five years and analysed data from 8756 patients. The machine learning algorithm was developed by taking into account 147 different variables, including biological, clinical and demographic data. The WATCH-DM risk score took into account key factors such as weight, age, hypertension and creatinine and HDL-C levels, diabetes control, QRS duration, MI, and CABG.

Results of the study found that 3.6% of patients developed heart failure during the five years of the study. By using the WATCH-DM risk score, researchers found that the risk of heart failure within five years increased by 24% per 1-unit increment in the risk score.

Researchers are now working on developing the machine learning model to be used in the electronic health record of Brigham and Women's Hospital and also UT Southwestern Medical Centre. Implementation of the WATCH-DM risk scores in real-time could prove beneficial for centres focusing on personalised medicine as patient outcomes could be predicted immediately and prevention care initiated as soon as possible.

First Digital Clinical Trial Encourages Physical Activity

As little as a daily ping on your phone can boost physical activity, researchers from the Stanford University School of Medicine and their collaborators report. This was the first-ever entirely digital, randomised clinical trial, which sought to answer two key questions: Is it feasible to successfully run an entirely digital, randomised clinical trial? And is it possible to encourage people to exercise more by using a smartphone app? The study shows that the answer to both questions is yes.

MyHeart Counts is an app that was first deployed on smartphones in 2015, and was launched to help track physical activity and other heart-related information, such as heart rate. Now, it's the main tool for a full-on randomised clinical trial, including patient recruitment, consent and interventions. It also returns data to participants.

On a weekly, rotating basis, the digital trial "prescribed" one of four simple interventions for each participant enrolled in MyHeart Counts - things like reminders to walk more or stand up. Regardless of the type of intervention, there was approximately a 10% increase in activity compared to the participants' baselines.

Heart-on-a-Chip Technology Directly Measures In-Vivo Cardiac Performance

Data from a study of investigational candidate, MYK-491, showed that a human iPSC-derived organ-on-a-chip technology can directly measure in vivo cardiac performance. MYK-491 increases the contractility of the heart (systolic function) with minimal or no effect on myocardial relaxation and compliance (diastolic function) by acting directly on the proteins in the heart muscle responsible for contraction.

Reported at the AHA Scientific Session in Philadelphia last year, the human heart-on-a-chip technology provided confirmatory preclinical evidence already seen in other preclinical and clinical studies: MYK-491 appears to increase systolic contractility without impacting diastolic relaxation. This platform may serve as a valuable human translational model for cardiovascular drug discovery with its ability to capture the nuances of human heart contraction and relaxation mechanics, said Michael P. Graziano, PhD, chief scientific officer of TARA Biosystems.

Additionally, findings published recently in the Journal of Toxicological Sciences, show that the 3D-cardiac tissue platform predicts responses to a wide range of drugs known to affect cardiac function in humans, something that has been a challenge in pre-clinical models until now.

Deep Learning AI May Identify Atrial Fibrillation

A study published in The Lancet found that artificial intelligence (AI) technology was able to diagnose patients with intermittent atrial fibrillation even when their hearts were at a normal rhythm. The 10-second test could help identify patients at risk of unexplained heart attacks or strokes.

Intermittent atrial fibrillation can be difficult to detect and current monitoring for atrial fibrillation can take weeks to years. The challenge remains in detecting atrial fibrillation early in patients who have suffered from an unexplained stroke so that anticoagulation medicine can be administered.

This study used patient ECGs to develop an AI algorithm that could detect atrial fibrillation to an accuracy of 83%. The ECGs were first divided based on whether the patient had atrial fibrillation or not. By training a neural network, researchers were able to detect ECG signals that would otherwise be invisible to the human eye. Although further research is needed, this quick and inexpensive test could hold promise for the future of atrial fibrillation detection.

Portugal's National Telehealth Plan

Although telehealth is not a new concept for Portugal, it is often provided locally and is not homogenous. In November 2019 the country launched National Strategic Telehealth Plan (PENTS), which is aimed at bringing the country's telehealth services to a common standard. This involves work on infrastructure development, data interoperability improvement and upgrade of regulatory framework, to name a few. The development of PENTS is based on the input of 50 institutions and health experts, including patient associations.

Currently, there are various digital health tools available and widely used in Portugal. For example, over 2 million users of online RSE Área do Cidadão (Citizen Area) can access their electronic medical records, arrange an appointment with a physician, etc. The e-prescription service is obligatory with the Portuguese National Health Service and very popular in private healthcare sector. In the free mobile app MySNS Carteira important health-related information is stored, eg NHS access details, allergy registry or e-prescription. The app also plans to integrate video-calls for direct teleconsultations; the service is expected to be available soon. Meanwhile, the government has been supporting teleconsultation adoption via financial initiatives.

Light Instead of Endoscopic Surgery

MIT engineers have developed a material (proof of concept stage) that would break down inside the body when exposed to light from an ingestible LED. The light-sensitive hydrogel can be used for a variety of medical devices, inserted into the gastrointestinal (GI) tract, that currently have to be removed by endoscopic surgery.

Having tested the new material in a study in pigs, the researchers showed that devices made with this hydrogel disintegrate if exposed to light from a small LED. One potential advantage here is that light can act at a distance, so no direct contact with the material being broken down is needed and the chance of accidental triggering is minimal.

The gel includes a chemical bond that is broken when exposed to a wavelength of light between 405 and 365 nanometres (blue to ultraviolet). By changing the composition, the gel's parameters, such as the speed of decomposing or its mechanical strength, can be adjusted. It is noted that the gel and its breakdown products are biocompatible. Various shapes can be moulded out of the material, such as a seal for a bariatric balloon or an oesophageal stent (as demonstrated by the researchers) but also others, eg a potential field of application could be vehicles for delivering drugs to the GI tract.

New System to Track Medication in UAE

The new pharmaceutical track and trace system is being adopted by the Dubai Health Authority (DHA), a first of its kind in the United Arab Emirates (UAE). Focusing on quality and patient safety, it will monitor medication delivery throughout the full supply chain, from manufacturing (either in the UAE or elsewhere) to the point drugs reach the patient.

The authority has already started negotiations with major manufacturing and supplying pharmaceutical companies regarding the implementation of the system. It is stressed that the track and trace system is aimed at combatting counterfeit medication and enhancing accuracy and credibility when dealing with relevant insurance claims. It would also allow better management of medication inventory in the region.

The new system will be rolled out at DHA's facilities by mid-2020, and used in addition to the barcoding system which DHA adopted in 2017 (again, first in the UAE's healthcare system). On top of the barcoding system, through which each medicine is given a barcode to avoid mistakes when dispensing medication, DHA has launched several smart pharmacies for dispensing and prescribing medication through the system.

Voice Analysis for Patients With Mental Illness

Researchers from UCLA used an AI interactive voice application, MyCoachConnect, to monitor patients' mental health by analysing their speech patterns. They followed 47 patients, treated for serious mental illnesses, for over a year. When making a phone call once or twice a week, participants were asked by a computer-generated voice: How have you been over the past few days? What's been troubling or challenging over the past few days? and What's been particularly good or positive? They were expected to speak for several minutes answering each question.

According to the researchers, the application was designed to collect personalised patient responses and offer a personalised analysis for each patient using their own wording. The main focus was on the patients' word choice and the change in their responses over time. Audio features, such as tone of voice, were also analysed.

Consequent analysis showed that the application's AI could monitor patients' mental states as accurately as their physicians. The researchers, therefore, hope that AI could enable more proactive and personalised care, eg by intervening early when relevant symptoms are identified.