BIG DATA IN HEALTH CARE SYSTEMS

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Abstract
The Fourth Industrial Revolution is modifying health and medicine fields with speedy advances in genomics, genetic engineering, synthetic biology, nanotechnology, data science, artificial intelligence and robotics. These scientific and technological advances are proving to uplift the diagnoses and treatment theories. The combination of medical and technological sectors together will transform health and healthcare to become much more connected, precise and democratized, with significantly upgrade human outcomes. This paper will be highlighting the benefits of industry 4.0 on the health and healthcare delivery system of India and to develop new perspectives on the impact and governance of key emerging technologies related to health providers and healthcare systems.

Keywords: Industry 4.0, health care systems, Internet on things.

1. INTRODUCTION

Objectives: To promote understanding among the healthcare providers regarding the significance of technologies in healthcare practices and to assess the challenges in the implementation of technologies by healthcare providers.

Methodology: The study duration to carry out review was one month in the month of January 2020. The search engines that were used to conduct the search are “Google” and “Yahoo”. Keywords were identified and were searched in both search engines and the results of the first 10 pages were included. Journal articles, website articles and media articles were included and blogs were excluded for extracting information on benefits and implementation of industry 4.0 in the healthcare sector. All the search results were exported to Microsoft Excel. Duplicates and irrelevant articles were excluded by screening manually. Relevant data from the included articles were extracted to a predesigned data extraction form.

Industry 4.0: Currently the Industry 4.0 is the smart factories with connected machines and intelligent robots. The individual computer machines is not considered, but the whole network of them. It also enables to have more intelligent robots. The advancement of industry 4.0 will be driven by a smart interconnected pervasive environment. The Industrial Revolution is the name historians have given to the period in history when there was a large and rapid change in the way new machines were made. This meant that instead of things being hand made in small workshops, they were made more cheaply in large quantities by machines in factories. Products being made in large quantity now meant that they were sold for less.

Many people began to move from an agricultural based life in the country to the towns where the factories offered more and better paid work. This was the beginning of the first industrial revolution.

First industry revolution – started at 1770s, they moved from hand to machine, from farms to the first factory using steam and water power.

Second industry revolution – it started after 100 years later with electricity arrived. It gave us automation assembly line and was the real start of practice as we know today.

Third industrial revolution- another hundred years later, in 1970s that introduced computers that would allow us to automate.

The fusion of industry 4.0 with healthcare delivery systems is beneficial in many domains. Mobile devices can be used to track down chronic and non-communicable diseases, devices like contact lenses which are capable of detecting glucose levels, devices which are able to keep count of caloric intake and introducing bioelectronics medicine which is plant in the patient’s body for treating the illness like arthritis, diabetes and asthma by influencing electric signals in nerve pathways. Other areas of innovation include robotic-assisted surgery; next generation of smart inhalers that track inhaler use, avoid triggers and warn of asthma attacks.

2. INTERNET OF THINGS APPLICATIONS IN HEALTH AND HEALTHCARE

2.1. Device conducting diagnostic tests:

The Swasthya Slate is basically a mobile platform that allows you to do various kinds of diagnostic tests on a mobile phone or a tablet. The kit consists of a digital thermometer, a BP monitor, an easy to use heart rate sensor, an ECG system, a blood sugar monitor, and a water quality unit. The whole system has to be connected with an interface that sends all the diagnostics to any android mobile device via Bluetooth stream or USB connection. The Swasthya Slate can conducts 33 diagnostic tests in just 45 minutes. It relatively reduces time and increases efficiency of health providers in the healthcare sector.
2.2. Emergency response systems:
Many innovations now seek to consistently monitor the behavior of their users and intervene in case of emergency. These innovations offer services that include detection of falls, emergency assistance and navigation guidance back to residence or even boundary perimeter breach alerts (for patients suffering from Alzheimer’s or dementia, for example), together with communication systems that alert care providers or family members in case of an emergency.

2.3. Smart Inhalers:
Smart inhalers are basically inhalers with more digital characteristics which can be linked to an app which helps the patients and their healthcare providers to track their information and manage their asthama better. It collects, stores and records the data about when the medication was taken. FindAir ONE is a smart sensor that will make the customers asthma inhaler a source of unique information. It reduces the number of unexpected symptoms and finds out what is behind the patients asthma attack.

2.4. Drones:
Drones have great potential in making the transport of drugs, vaccines or medical aids faster, especially during disasters or medical emergencies. In responding to and recovering from the 2010 Haitian earthquake, and the 2013 typhoon Haiyan, drones were used to assess damage and support the allocation of resources.81,82 These approaches were also tested in the US to understand how drones could be used in disaster settings.83 Drones could be useful in transporting blood products, expensive and rarely used drugs and perishable items to remote hospitals, mass casualty scenes and even offshore ships with seriously injured passengers, especially in situations where safety, accuracy and speed are important. Ambulance drones are being used in the Netherlands and have inspired the delivery of automatic external defibrillators directly to people who have just suffered a heart attack. A system for drones that can deliver blood and heart or other organ transplants to isolated parts of Australia is also being developed.

2.5. Virtual Home Assistant:
Many senior individuals living alone require daily assistance. Unfortunately, family or paid care providers might not always be available. Virtual home assistants can help fill this void. Many technologies now allow elderly people living alone to stay connected with their family through voice and video. These assistants can help with medication adherence, by reminding their users to take their medication, and care coordination, by providing a constant link with remote care providers or family members. Seniors appreciate the sense of autonomy these assistants provide at a considerable low cost.

2.6. Medical adherence tracking:
In November 2017, the FDA approved for the first time a drug with a digital ingestion tracking system. This product by Otsuka Pharmaceutical and Proteus Digital Health, called Abilify MyCite (aripiprazole tablets with sensor), has an ingestible sensor embedded in the pill which records that the medication was taken. The product is approved for the treatment of schizophrenia, acute treatment of manic and mixed episodes associated with bipolar I disorder and for use as an add-on treatment for depression in adults. The system works by sending a message from the pill’s sensor to a wearable patch, which transmits the information to a mobile application so that patients can track the ingestion of the medication on their smartphone. Patients can also permit their caregivers and physician to access the information through a web-based portal.

2.7. Robotics:
The main advantages of surgical robots are their precision and the possibility of performing minimally invasive operations and, furthermore, their ability to access all the anatomical areas of the patient, thus providing a high degree of versatility in the operating context. For example the Da Vinci Surgical System is an entrant into the field of robotic technology. This system is undergoing considerable research and is being practically applied in general surgery, cardiothoracic surgery, urology and gynecology (McLeod and Melder, 2005). Its main application is the procedure for removing the prostate or replacing the heart valve, but it can actually be used for any localized surgical procedure. Although the advantages of the machine are many, it is not possible to consider the disadvantages, i.e. the very high costs (Fiani et al., 2018). The second robotics application area is the rehabilitation sector. Robotic rehabilitation has the prospect, nowadays, of promising a return to almost complete motor normality even after severe traumas and major disabling pathologies. Example of this application involves the use of exoskeletons that allow a re-education of the limbs, posture and movement. Also in this case high costs are the main disadvantages.
2.8. Rare Disease Detection:
Rare diseases pose challenges for AI. While their detection is one of them, we also need to ensure our healthcare systems are not inclined towards detecting rare diseases when the diagnosis could be something commonplace. Through a series of neural networks, AI is helping healthcare providers achieve this balance. Facial recognition software is combined with machine learning to detect patterns in facial expressions that point us towards the possibility of a rare disease.

Face2gene is a genetic search and reference application for physicians. In this solution, AI scans through the image data of a patient’s face and spots signs of genetic disorders such as Down’s syndrome.

Another similar solution is Moon developed by Diploid which enables early diagnosis of rare diseases through the software, allowing doctors to begin early treatment. Artificial Intelligence in Healthcare carries special significance in detecting rare diseases earlier than they usually could be.

2.9. AI-Powered Chatbots:
AI-powered bots can help physicians in healthcare diagnosis through a series of questions where users select their answers from a predefined set of choices and are then recommended a course of action accordingly. The same research study also predicts that the success of chatbot interactions where no human interventions take place will go up to 75% in 2022 from 12% in 2017.

Knowledge management systems will become a critical part of chatbots for AI where the common questions and answers would be accumulated throughout the life of a solution, aiding in the learning process of the chatbot.

2.10. Knowing when someone in a coma will awaken:
When doctors are trying to decipher how much a patient’s brain has been damaged by trauma, they use a coma scale. After performing a series of tests, the doctors give the patient a score. That score reflects the patient’s prognosis and may play a part in decisions regarding the use and possible withdrawal of life-support machines.

In a Chinese trial, an AI system trained on brain scans came up with its own score, which was very different from that given by the doctors. One patient was given a seven out of 23 score by doctors, but after the technology analyzed his brain scans, the AI gave him 20. A score of seven indicates such a low likelihood of recovery that the patient’s next of kin would be given the option of withdrawing life support. But true to the AI’s prediction, the patient eventually woke up. The AI got nearly 90% of cases right by tracing brain activity invisible to the human eye, such as small changes in blood flow to the brain. The system is now an integral part of the hospital’s daily processes and has helped give the correct diagnosis in more than 300 people.

2.11. Health Monitoring with AI and wearable’s:
Health monitoring is already a widespread application of AI in Healthcare. Caregivers can have a new way to keep a closer watch on patients on general care floors and in ED waiting areas in need of more frequent monitoring, using wearable biosensor technology. This discreet, lightweight biosensor provides the ability to wirelessly monitor vital signs, posture, activity, and detect falls, automatically and frequently.

The Willow Curve is the first digital bio-sensory bio-therapeutic laser smart device. The Curve is non-invasive, non-prescription pain free treatment that is safe and effective for clinical and home use. With over 150 bio-sensory bio-therapeutic components you can customize treatment to relieve joint and muscle pain for over 30 painful conditions. The Willow Curve is a portable laser smart device designed to temporally reduce pain without the use of potentially harmful medications or invasive surgeries.

2.12. Detecting skin cancer:
Melanoma, a cancer that forms in the melanosocytes (the skin cells that produce melanin), is not easily identifiable by untrained eyes. The extent to which a doctor can confidently recognize melanoma depends on experience and training. AI can now diagnose skin cancer more accurately than experts. A recent study published in the Annals of Oncology showed AI was able to diagnose cancer more accurately than 58 skin experts. The AI had been trained using images of skin cancer and the corresponding diagnoses. Human doctors got 87% of the diagnosis correct, while their machine counterpart achieved a 95% detection rate. Such studies are demonstrating the positive impact on diagnostic performance that AI could provide to dermatologists, ultimately improving outcomes for patients.

2.13. Drug development:
AI can scan through data at a rapid rate that is impossible for humans to match. One of the ways this data crunching could revolutionize healthcare is in the development of new drugs. The technology can analyze data drawn from a wide variety of sources, such as clinical trials, patient health records and genetic records, and help predict how a drug might affect a person’s cells and tissues, leading to better trials and paving the way for a personalization of their medicine. This more streamlined process could bring drugs to market much faster.
2.14. Recognize depression:
California-based MindStrong has recently published a paper showing that its technology could pick up signs of depression and other mental disorders by analysing how people use their smartphones. Its proprietary technology analyses how people type – their taps, scrolls and clicks – to predict a range of cognitive traits and mood states. AI is also showing promising signs in being able to alleviate the symptoms of depression. A recent trial involving Woebot, a chatbot that has been designed according to the principles of cognitive behavioural therapy, showed that it was effective in treating the disorder.61 In the trial, 70 participants between 18 and 28 years old received either two weeks (up to 20 sessions) with Woebot, or were directed to the National Institute of Mental Health ebook. For those in the Woebot group, the depression symptoms reduced significantly over the study period.

2.15. Health and Fitness Gadgets:

Smart ECG Machine: Heart Attacks, Cardiac Arrest and Strokes are some of the biggest health concerns of 2018. Being able to recognize erratic / unusual heart rate activity from an affordable mobile device can save lives. That's precisely what you can do with the Kardia Mobile EKG machine. Transform your iOS or Android phone into an amazingly powerful ECG machine. the Kardia Mobile adds peace of mind providing early detection of Atrial Fibrillation (AF) Smaller than a credit card the Kardia electrocardiogram device transmits heart rate data to your iOS or Android device. There's support and assistance from medical professionals (premium service) if the device detects anomalies with your EKG trace. Every Kardia Mobile user is entitled to a free basic service including unlimited ECG recording. Automatic analysis of the ECG lets you know instantly if atrial fibrillation is detected. The user is also provided with an option to email the last single ECG to yourself or your doctor.

3. Challenges:
Hospital Managements collect individuals business related data in separate data warehouses for administrative purposes and clinical data that includes individual patient history, vital signs, progress notes, and the results of diagnostic tests are stored in EHR. This is done to maintain the privacy and security of the patients’ personnel details. But this poses as a challenge for the data analysts in providing cost-effective, innovative forms of information processing for enhanced insight and decision making because it includes accessing patients’ personal data for scientific research and sharing that work. Sharing data is important for efficient utilisation of ideas and insights into practices but from a business perspective it acts as a barrier in achieving their goals in market competition which again acts as barrier in the progress of health and healthcare. The most notable challenge in identifying aggregating and representing the data for analysis and visualization is the amount of unstructured data. Although the standards are followed by the hospitals management systems the contents of the defined fields are often unstructured.

4. Conclusion:
The implementation of I4.0 will certainly be a transitional process for the medical device industry because of the importance of retaining compliance and the need to prove quality systems thereby improving quality of life of the population. Nevertheless, it can and should be planned into business strategies now and benefits will be realized over time. Therefore, the Fourth Industrial Revolution’s effects on the future of health and human well-being and the implications on society need to be upraised and collectively monitored in the public discourse. In the complex world of healthcare, Artificial Intelligence can support providers with faster service, early diagnosis, and data analysis to identify genetic information to predispose someone to a particular disease. Saving seconds could mean saving lives in the healthcare space and that is the reason why Artificial Intelligence and Machine Learning hold such significance for every patient. AI working hand-in-hand with doctors, physicians and healthcare providers is likely to continue to be the current course for a while, and eventually it will get to a point where it will be a crawl-walk-run endeavor with less complex tasks being addressed by bots. The medical device industry is going through an exciting time with many new opportunities in innovative routes to patient care. Those that ignore the opportunities I4.0 offers will be in serious danger of not being able to compete in the near future as others drive down manufacturing costs and increase business agility in response to developing technologies. One of the main areas of benefit the decentralized, smart manufacturing model offers is the ability to efficiently individualize products with high quality results — something that will be critical to success in the patient-specific devices market.
References:
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