ARTIFICIAL INTELLIGENCE IN HEALTH

1st week MIA_EU 0523

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Summary

- *Big Data Analytics and Its Benefits in Healthcare*
- *A Review of Big Data and Its Applications in Healthcare and Public Sector*
- *Big Data in Healthcare: Technical Challenges and Opportunities*

Big Data

- *Big data helps in providing valuable decisions by data patterns and relationship among different data set with the help of various machine learning algorithms*
- *Big data can bring a new revolution in industry of healthcare*
- *In big data exploration, diverse statistical approaches, data mining and machine learning approaches can be implemented*

Big Data

- According to researchers more 5 important characteristics are: **Variety, Velocity, Volume, Value and Veracity** as shown in Fig.
- There are 5 additional characteristics: **Variability, Validity, Vulnerability, Volatility and Visualization**
- Healthcare data which may include reports, medical images etc. are broadly divided into structured and unstructured data

Big data 5 V's

Mobile Big Data

Large data that are gathered by mobile technology may be defined as ***mobile big data***

SOME CHARACTERISTICS OF MOBILE BIG DATA ARE AS FOLLOWS:

- *Mobile big data is huge in size. Gigabytes and terabytes of storage is being required*
- *Mobile big data is rigorous. As mobile devices are portable, the data must be available every time*
- *Mobile big data is heterogeneous, and any form of data can be stored in it*

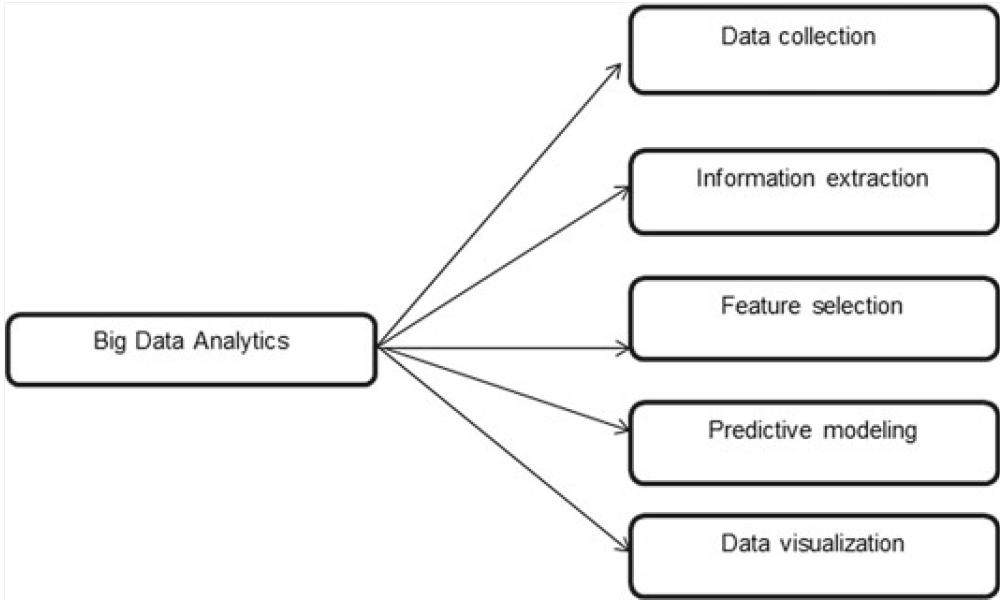
Big Data Analytics

The main challenging task is to collect huge amount of data from different sources in different format

IT CONSISTS OF A SET OF ACTIVITIES:

- *Data collection*
- *Data extraction*
- *Feature selection*
- *Predictive modelling*
- *Data visualization*

Big data analytics



Current healthcare, big data, and machine learning

1. Current healthcare practice

By 2050, the number of people aged 65 and above is estimated to reach 1.5 billion, equivalent to approximately 16% of the world population.

People are becoming older in most major regions of the world, and the main health threats affecting people are changing toward conditions which reflect aging and changing lifestyle, especially in the developing world, where the rise in chronic noncommunicable diseases such as heart diseases, diabetes, and cancer now constitutes the greatest health issues.

Current healthcare, big data, and machine learning

*The World Health Organization estimate that **by 2025**, **70% of all illnesses will be chronic**. Such conditions often require continuous care over prolonged periods of time or increased attention from healthcare providers.*

*Accompanying the rising life expectancy is **the growth in healthcare costs**, which are increasing faster than the economic growth in most places.*

There is a need for a major change in the healthcare system over the coming years to cope with the increasing health-related demands from the aging population.

Current healthcare, big data, and machine learning

The rising need for technology

A rise in a health-conscious population has been observed. This includes ***consumer goods and services*** *to increase health and wellness such as healthy nutrition, fitness, and meditation retreats. Other increasing trends include wearable and mobile health technologies.*

Technology is indeed changing the way patients interact with healthcare and how the healthcare system understands the patients.

With the rise of electronic medical records (EMRs), personalized genomics, lifestyle and health data, and the capacity for better and faster analysis of data, digital trends are profoundly changing the healthcare system.

Current healthcare, big data, and machine learning

*Recently, many digital stakeholders are seeking **to disrupt the healthcare system** by taking a technological approach to healthcare data.*

*For instance, Google is building systems **biology programs and analytical tools** and applying these in areas such as digital pathology. Furthermore, companies like Garmin, Fitbit (Google), and Apple are using information including **heart rate and sleep data from their smart watches** to predict an overall state of health of an individual.*

Technology development is disrupting healthcare in many ways with one of the recent developments that has made the largest impact being the digitization of medical records, the EMRs.

Current healthcare, big data, and machine learning

The EMR provides a systematized, digital collection of patient health information, which can be shared across healthcare settings. This includes notes and information collected by the clinicians in the office, clinic or hospital and contains the patient's medical history, diagnoses, and treatment plans.

One can imagine that for each patient a substantial amount of healthcare data is accumulated over the course of their life, which can potentially be used to obtain a better understanding of medical conditions, diagnoses, and treatments.

With the increasing adoption of EMRs and health monitoring technology, it is now possible to pull data together for individual patients and consolidate these to identify the needs of a subject.

Although there is a complex transition from the "old"/established system of data logging to the new digitalized world, this is believed to lead to high value for patients.

New models in healthcare

It is time to replace the old models with new ideas that can make healthcare more cost-efficient and improve healthcare standards across the entire system.

Important characteristics among some of the new care models that are nowadays presented are:

Increased process management: Standardization of operational and clinical processes, increased use of new technologies and analytics including self-management and remote monitoring of patients, and more focus on performance.

Focus on people: Strong leadership and effective people development and improved workforce models such as optimum use of highly qualified clinicians and displacement of less-skilled tasks to new professions such as health coaches.

Current healthcare, big data, and machine learning

Focus on patients: Motivating patients to take an active role with self-management and larger differentiation of healthcare services depending on patient needs and desired outcomes.

Wider scale: Increasing operating scale to support expansion of healthcare services and ensure improved performance management.

The new care models require new business models from the healthcare sector including the healthcare providers and industry.

Medical device companies are transforming into service entities where lab and remote management constitute important ways to engage with users and drive extra revenue.

Pharmaceutical companies are focusing more on service and added value of products.

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In some parts of the world, insurers are also becoming active in the practice of prevention and offer loyalty programs and lower premiums as incentives for healthy behaviour to reach the goal of reduction in pay-outs and a more health-conscious population where focus is on prevention instead of treatment or a cure.

We are currently at a point with excellent opportunities to transition from a reactive to a more proactive healthcare view. Whereas today's healthcare system is mainly reactionary, providing healthcare based on requests and demands from patients, tomorrow's system may be based on health maintenance and health solutions. The value- and outcome-based system changes the way healthcare positions itself with regard to the patient.

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Value-based treatments and healthcare services

The primary mission of healthcare is to create/maintain a healthier/healthy society and improve the lives of its citizens.

Value can be defined as **patient health outcomes generated per unit of currency spent**. It is believed that value is the only goal that can bring together the interests of all participants in the healthcare environment and prevent reduced healthcare services.

Such a value-based system will require a major restructuring in healthcare management and delivery, including payment models.

It is often perceived by healthcare practitioners that increasing services such as the number of office visits is equivalent to good healthcare. However, good healthcare outcomes are not reflected by more visits or tests but by better value and health status.

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Today, it is possible to collect **data on clinical activities and health status of patients** before and after treatment.

This occurs in part through the EMR system, where following patients over a period result in better outcomes over time.

Further, using **public datasets**, health status of a patient population can be calculated and analysed with health risks assessed for everyone.

Many countries in Europe have embraced digitization of medical records. This high level of digitization has facilitated national efforts for pilot studies and numerous collaborations, focused on patient outcomes.

Current healthcare, big data, and machine learning

Denmark as an example included a digital approach consisting of **remote monitoring and video consultations**.

In the United Kingdom and Spain, **incentives to reduce unplanned readmissions** have provided a push for improving effectiveness around patient discharge and remote monitoring.

Another payment strategy is **the creation of bundled reimbursements for medical conditions**. This would, for instance, include a single price for a full care cycle of an acute condition and a time-based price for care of a chronic condition or for preventive care.

Patients should have the option to choose the best or the most fitting healthcare providers based on their reported value and outcomes, and not just be assigned to a physician by the system but should have the option to select a physician or change their physician at a later stage if they choose to do so.

Patient-centered care

Patient-centered care is a healthcare approach where the individual is placed at the center and **their preferences, needs, and values are considered in all clinical decisions** and are acknowledged as essential for their well-being.

Studies have demonstrated that patient-centered care improves **the satisfaction of patients** as well as **the quality of care** and **health outcomes which can reduce costs**.

The patient-centered care approach can increase participation of the patients in the whole care path with **shared responsibilities and decision-making** in a constructive and collaborative manner.

Current healthcare, big data, and machine learning

Instead of regarding the patient as a passive component in the healthcare process, a more contractual view is needed where the ***patient is seen as an active player*** *who is an important part in the decision-making process.*

Patient-reported outcome measures are already being used by healthcare providers in many countries to determine how effectively the treatment improves patient quality of life.

The patients' involvement in the decision-making process has shown to enhance their adherence to treatment plans as well as result in improved patient satisfaction and health outcomes.

Current healthcare, big data, and machine learning

Personalized medicine

Personalized medicine is believed to provide a significant value for the healthcare system. For instance, in some conditions such as rheumatoid arthritis, many nonresponders to certain drug therapies will be identified by applying markers that predict treatment response.

***Advanced personalized diagnostics** will also provide value via solutions for data interpretation, decision-making, and analytics.*

Advances in gene sequencing have led to a decrease in cost of whole genome sequencing and it is predicted that sequencing will be common practice for clinical diagnostics in the next few years.

Current healthcare, big data, and machine learning

Until now, oncology has been **the focus for personalized medicine** due to the obvious variation among the cancer patient populations and, hence, the high potential for personalized therapy.

Other disease areas also have potential for personalized medicine including **immunology-related conditions** (e.g., transplants and autoimmune disorders), and **paediatric diseases**, among others.

Indeed, this method is now being thought out for conditions that were previously thought incurable. One such condition is **amyotrophic lateral sclerosis (ALS)**. ALS is a devastating motor neuron disease that manifests itself in a progressive manner whereby the death of upper and lower motor neurons leads to an eventual paralysis of the patient.

Current healthcare, big data, and machine learning

While studies on humans have been rather limited, personalized medicine can allow researchers to categorize patients together based on their characteristics. This categorization can be achieved by utilizing certain biomarkers and perhaps with identification of similar mutations shared between patients.

It is hypothesized that gene therapy holds great potential for personalized medicine and that some successful early tests have been conducted on animal models that show immense promise for those suffering from this fatal condition.

These treatments are more expensive than conventional broader spectrum approach and will have to demonstrate a clear advantage for healthcare payers to cover these for patients in need of high complexity products for their condition.

Current healthcare, big data, and machine learning

Increasing data volumes in healthcare

During the last decades, **we have seen a boom in the volume of data produced** in the greater healthcare environment.

Pharmaceutical companies and academic institutions have been accumulating data from years of research and development into various databases.

Payers and healthcare providers have collected large amounts of data from patient records and have digitized and consolidated these in EMRs and other systems.

Further, governments and other public entities have begun to open their large library of healthcare knowledge including data from past clinical trials and data from insurance programs.

Current healthcare, big data, and machine learning

Finally, advances in technology have made it easier to collect and process data from different sources.

***A combination of these events has resulted in the generation of large volumes of data**, and a variety of these can be employed for healthcare outcomes including improved diagnostics, healthcare decisions, treatments, and rehabilitation.*

*There is a need for **new and improved big data tools and technologies** that can be employed to manage the growing healthcare data, and tools that can be used to extract these in libraries and find correlations between disease, prognosis, patients, and populations.*

Further, there is also a need for tools that can be used to link the data with diagnostics and treatments to integrate the new knowledge acquired with the existing healthcare ecosystem.

*The healthcare sector **is highly regulated** and large changes are neither fast nor easy to implement but we can expect a steady transition towards an increased collection, integration, and application of data across the whole sector.*