Analytics Using Big Data in Healthcare Systems

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Abstract: *The present era bears testimony to the fact that various factors such as mobile phones, researchers, firms and patient records add to the huge amount of healthcare data. Despite this vast ocean of data, there is an underlying challenge to find, gather, analyze and mange this information so as to enhance human life by identifying until now unknown ailments and finding cures for the same, along with early diagnoses to enable faster recovery while minimizing the damage. Big Data Analytics helps to reduce the medical expenses, and to enhance and personalize the realm of healthcare besides improving the patient and providers connect. This paper highlights how big data analytics can be used in the health care sector, and various processes and applications in the health care system, the various categories of healthcare data, with means to use big data to improve medical results, and merging of Mobile Tech, Big Data, and Healthcare. The paper also touches on the future scope and concerns with Big Data analytics in healthcare systems.* **keywords:** Big data, analytics, healthcare, medical, applications

1. INTRODUCTION

"Big Data Analytics" as a term is nothing but the means of using superior and efficient analytical methods to huge and diverse big data sets which include structured, semi-structured as well as unstructured data from numerous sources. This data differs in size so as to validate the uniformity of the findings.

Objective: To discuss big data analytics in the field of healthcare, the various big data analytical processes and applications in healthcare systems, types of healthcare data, and the manner in which big data helps to improve medical results, and convergence of Mobile Tech, Big Data, And Healthcare, future scope and concerns with Big Data analytics in healthcare systems.

Research methodology: This research paper sheds light on some of the iconic achievements of Big Data Analytics in the realms of health care, which have resulted in some epic outcomes that have helped to save numerous lives and enhance the quality of health care. Here, secondary sources like journals, and eminent academic publications amongst others have been used to gather data, with the aim to evaluate it by means of content analysis, which can then be used to get latest information on the current situation that prevails in terms of big data in health care studies. Further, with the aim to gain a holistic view, academic as well as non-academic based literature has been included,

Expected Outcome: The impact and reach of Big Data has been majorly due to three pivotal factors, firstly, the huge quantum of data which is freely available; secondly, the surmounting costs involved in the field of health care; and lastly, a strong stress being laid on various aspects of consumerism- which means, more stress on the consumers. By means of Big Data, health care systems are able to customize their line of action for patients, and provide better care to the end users- consumers.

2. WHAT IS BIG DATA IN HEALTHCARE?

In simple terms, the word Big Data is nothing but large volume of data which is the outcome of digitalization. Using this data in the field of health care, can help in predicting and determining specific health related information regarding a specific segment or even an individual. This information can be put to positive use by aiding in prevention of epidemic spreads, as well as in curing ailments at reduced costs and a lot more. Progress in the field of health are has already helped to increase the lifespan to a great extent, and most of these changes have been possible due to the outcome of the findings through analysis of big data. With this, health care professionals can oversee a looming health scare and forewarn the patient, thus nipping the issue in the bud itself, rather than letting it spread and cause further harm. As the popular saying goes, "Prevention is definitely better than cure". This is especially true, as early diagnosis is not only less stressful but also less expensive. It is a universally accepted fact that preventive treatment is indeed a better choice when compared to curative care; and when health care professionals are able to identify the ailments before it sets in, they will indeed be able to customize a health care plan which will improve the patient's health and not take a toll on the pocket as well. However, this vast ocean of information can often pose a challenge, as the data usually differs in size and format. Therefore, stress need to be laid on the smart management of this rather instead of the volume. Some of the sources through which health care industry can gather and collate big data include:

1. Health portals
2. Research Projects
3. EHRs
4. Wearable Technology
5. Searching Tools
6. Universal Databases
7. Government Institutions
8. Payer History
9. Employee Schedules
10. Waiting Area for Patients

In the earlier days, gathering data which could be put to use was quite expensive as well as cumbersome. But now, with the advent of technology, this data can easily be gathered and analyzed in various formats that can prove to be fruitful to the health care sector. The aim of data analysis in the field of healthcare is to predict and solve any issues at the nascent stages itself, management of inventory, and active participation of all the stakeholders in the health care industry.

3. ANALYTICAL PROCESS FOR BIG DATA IN HEALTHCARE

Fig 1. describes the Analytical Process for big data in healthcare. As per the figure, Data Warehouses store large volume of data which has been gathered from diverse sources. By means on analytic pipelines, this data is then processed to provide better and affordable health care options.
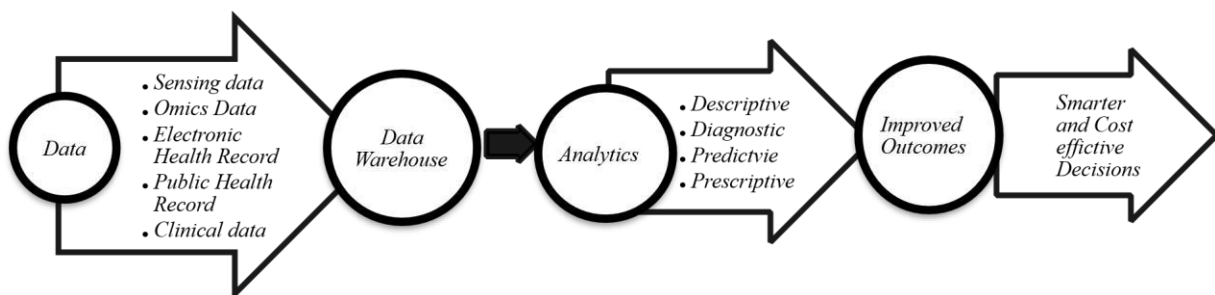
FIGURE 1. Analytical process for big data in healthcare

The following four levels of analytics are used for better decision-making:

Descriptive Analytics: This level involves observation and reporting. It is common for most organizations to invest most of their time in this level. Here, past information is collated and summarized into reports; and this critical step forms the building block for further levels, which are detrimental to completion of the process.

Diagnostic analytics: Diagnostic Analytics aims at getting reasons. Here, the aspect of "Why" gains greater prominence when compared to the "What". To illustrate, if a patient visits a health care professional, which simply states that the patient is unwell, then, this observation will be futile unless it is backed by means to reach the root cause of the ailment. Hence, the doctor needs to successfully and accurately diagnose the ailment and suggest an appropriate line of treatment. This analogy holds true for analytics as well. What begins with a simple observation, needs to move to the subsequent stages of descriptive analysis before finally reaching the diagnosis.

Predictive analytics: Foreseeing an issue and preventing it before it causes damage is an essential aspect of almost every organization, and here, predictive analytics comes handy as it helps to predict and assess the prevailing strategies to highlight any flaws or weaknesses that exist in the existing system. In the technological era, Artificial Intelligence, Machine Learning, and similar means are tools which come handy to the field of data science. By combining the power of data science, statistics and analytics, organizations can successfully execute predictive analytics for better efficiency.

Prescriptive analytics: Prescriptive analytics, the last stage of analytics is quite extensive and used at a high level. This happens when the data independently suggests a line of action. Known to be one of the most predictive and sophisticated means of analysis, it is strongly associated with datadriven decision-making.

4. APPLICATIONS OF BIG DATA ANALYTICS IN HEALTHCARE

Researchers, health care centers and medical professionals make use of this vast quantum of data to gain more clarity on various aspects of medicine, to prevent any threats to health as find superior courses of treatment for prevailing ailments. Fig 2 highlights some of the fields whereby big data is used in the healthcare field.
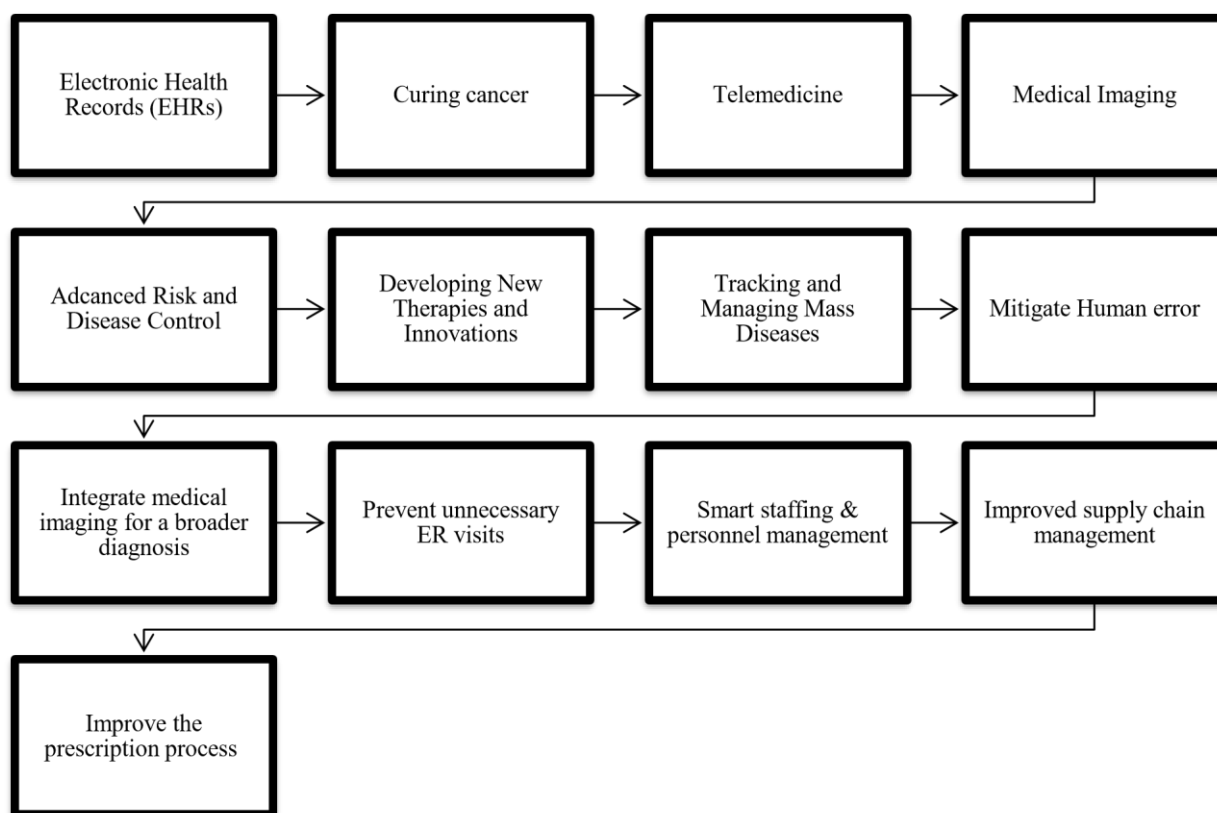
FIGURE 2. Applications of Big data in healthcare   Some

of the applications of big data in healthcare are:

Electronic Health Records (EHRs): Big data has now become an integral and eminent part in the field of medicine. These days, it is fairly common for people to have a digital profile which includes critical information regarding their age, their medical history and the findings of any tests that they have undergone. These records are then shared via secure information networks to both public as well as private sector service providers. Each record comprises a single file which is editable, so that the concerned parties can easily edit it time and again without worrying about the data being replicated. Besides this, EHRs also send messages and alerts to remind patient regarding a test which is due or to keep tract of the medication which needs to be taken as per the prescription.

Big Data for curing cancer: The Cancer Moon-shot Program is an ideal example of how big data has been put to use in the field of healthcare. By developing this program towards the end of his second term, the former President of USA, Mr. Barrack Obama ensured that the progress which would have otherwise taken more than a decade has been made in almost half the time span. Another pathfinding use is when scientists and researchers can access tumor samples in bio banks which are linked to the patient treatment history, and by analysing this, they can observe and gain valuable insights into various cancer proteins and mutations along with the therapeutic approaches which will help to find a cure or at least increase the effectiveness of the line of treatment to get better and more fruitful results. **Telemedicine:** In the recent times, Telemedicine is rapidly gaining popularity. This method is commonly used in the initial stages of consultation and diagnosis. Telemedicine not only aids in keeping a check on the patients from a remote location, but it also helps to train medical professionals without having to be in the same vicinity or being physically present. A significant leap in telemedicine is telesurgery, which enables surgeons to conduct an operation on a patient without being physically present, and instead using robots by means of high-speed real-time data transfer. Besides, telemedicine can also help in designing personalized treatment programs to prevent hospitalization. Joining hands with predictive analytics, health care professional is able to accurately predict medical scares and avoid the issue from turning more severe. By helping to prevent the need for hospitalization, telemedicine not only lowers the expenses

involved, but also enhances the level of service provided in the health care industry. Thus, patients can easily be spared the need to wait in a queue to consult the doctor, while the doctor too can avoid excessive paperwork, and instead monitor and cure patients from any location without having to be in physical proximity. This move has given an impetus to people who find it difficult to travel or reach a medical health care facility.

Medical Imaging and Big-Style Data Integration: As per a recent survey, around 600 million imaging treatments are done every year in the United States of America, and this clearly highlights the significance medical imaging. It is indeed a timeconsuming effort to manually analyze and preserve these images. Another factor of concern is the high cost involved in storing them for a specified duration, as deemed mandatory by the law. As per Carestream, a medical imaging provider, by utilizing big data analytics, these photos can easily be interpreted as the algorithms which have been designed are an amalgamation of studying large number of images, which can aid in identifying particular patterns in the pixels and convert them into numbers, so as to help radiologists and other medical professionals in their diagnoses. Delving deeper into this, it is possible that radiologists will no longer have to take a look at the images themselves, and instead they could choose to take a look at the outcome of the algorithms, which will definitely have a wider scope when compared to the human memory. In this respect, we can say with certainty that the training and skillset of radiologists is indeed going to be altered.

Advanced Risk & Disease Control : Big data comes handy while helping to curb an ailment by taking preventive measures well in advance, apart from reducing the need to be admitted to a health care facility. With the help of proper preventive treatment, with surely reduce the need for hospitalization, and by analyzing the data related to the proper drugs, their impact on certain symptoms and the frequency at which it can be administered along with other critical findings, the risk will be assessed accurately; this in turn will help people to spend less on their health, while ensuring that people with genuine need find place in hospitals.

Developing New Therapies & Innovations: By making use of historical, real-time and forecast measures, big data can be applied to develop new lines of treatment and better drug combinations. This is possible via data-driven genetic facts analysis and patient-reactionary predictions. This is indeed going to be a progressive move for the field of medicine.

Aid in Tracking and Managing Mass Diseases: The COVID-19 epidemic in the year 2020 bought the entire world to a standstill, and the health care sector were at a loss as they grappled with the duel responsibility to learn as well as control the spread of the virus. By using big data management tools, medical professionals were able to gain pivotal insights into the spread of the virus and how it impacted people with various health conditions. Various social factors, such as social distancing, proper measures to use public transport and other aspects too were analyzed to identify the factors which accelerated or slowed the spread.

Prevent Human Error: Like any other sector, the health care realm too is prone to mistakes. Errors in the health care front may be related to financial errors such as excessive billing, irrelevant testing or adding incorrect information to a patient's medical records. Having said this, financial errors are not the only form of errors which exist. At times, an error may prove fatal for a patient. Errors such as incorrect medication, incorrect dosage or negligence by the health care professional may cost a patient dear. Hence, most organizations make use of big data and forecasting to immediately identify and prevent any form of error. This eventually proves to be a boon, not only for the patients who are assured of being in safe hands, but also for the health care professionals who can benefit from the knowledge gathered through big data analysis.

5. TYPES OF HEALTHCARE DATA:

There are various sources to obtain health care related data, and the medical field, with its vast and expansive streams has unending opportunities to do so legally and ethically. Given below are some of the patient-centered healthcare data types:

1. Medical reports
2. Dentistry records

3. Records of operations
4. Information about a person's behavior, such as their diet
5. Biometrics, such as the blood pressure of a patient
6. The way of life

By using big data collection tools in the healthcare industry, one can gather institutional-level insights. Besides this, information can also be gathered by hospitals and other health care facilities, or independent data providers which include:

1. Employee schedules (to decide the number of people to be on duty at a given time).
2. Queue time for patients
3. Data on insurance claims
4. Health referrals
5. Measures of employee performance (for example, number of patients cared for per hour)
6. Logistics me1trics (for example, for ordering the correct amounts of personal protective equipment)

6. HOW BIG DATA ENHANCES MEDICAL RESULTS

As per the traditional data collecting model, compiling huge chunks of data was quite costly and took a lot of time. However, in the present, technological era, the trend has changed and it is quite easy to gather and collate data into a user-friendly format. This data can help medical professionals to design enhanced solutions in numerous ways, some of which are mentioned below.

1. Better transparency and accountability to patients regarding their medical records and treatment history.
2. Enabling health care professionals to assess and finalize an ideal treatment solution for fast and effective results.
3. Cost effective and time saving measure as certain administrative tasks can be eliminated.
4. Better inventory management.

7. INTEGRATING MOBILE TECH, BIG DATA, AND HEALTHCARE:

Smartphones have constantly been evolving in their functionality and do a lot more than just making and receiving calls. In fact, smart technology has now found its way into numerous critical aspects of human life. These days, the trend of wearable technology such as Fitbit, Jawbone and many more is on the rise. These devices allow the wearers to upload data which is then collated and combined with other people's data, to track their daily progress both individually as well as relatively to others. Taking a futuristic view, it is safe to say that patients would soon be able to share this data with their health care providers who will be able to diagnose any ailment at the nascent stage, and if needed state preventive care to avoid any issue from aggravating. A successful example in this respect is by the Pittsburgh Health Data Alliance, which has been making progress in this field by leaps and bounds.

Future Scope: Seeing the magnitude of benefits and gains from big data in almost every sphere and industry, the healthcare sector too will follow suit and make optimum use of this pathbreaking development. Its footprints will also be seen in the avenues of health care marketing and integration. As the popular saying goes, "Change is the only thing constant", so we are sure that adapting to the new changes, every sector will make use of Big Data for better accuracy in prediction, smoother operations and a lot more.

Concerns About Big Data In Healthcare Systems: Gathering of data, distribution, accurate search and analysis is a huge challenge for people using Big Data in the health care sector. Further, organizing the extracted data and further integrating it is yet another challenge. The evaluation of the functional effects making use of high-throughput sequencing technologies is quite a challenge owing to the ever-rising volume of genomic data available, along with

the impact of gene annotation and other flaws in the analytical practice and experiments. Another area of concerns is regarding obtaining consent from the patients to use their medical data. Many issues have come to the limelight regarding the database development that adheres to proper ethical guidelines and does not violate any code confidentiality. Some of the common challenges and concerns in utilizing big data in healthcare include:

1. **Security and privacy**: The traditional privacy and security procedures are limited to small datasets and it will be quite difficult to apply these to large streaming datasets.

2. **No fixed standards:** Multiple agents such as doctor notes, operation theatre pictures, and data gathered from wearable sensors, amongst others provide a lot of data. However, these have their own individual standards, and bringing them to a common standard is quite a challenge.

3. **Lack of real-time processing**: Complex data models which process at their own pace will reduce the patient's chances to getting the best possible health care solutions.

4. **Data reliability**: Unreliable data may lead to invalid conclusions and this is another cause of concern for the health care industry.

5. **Integration of diverse data sources**: Due to the numerous sources of data, fragmentation among hospitals, laboratories, electronic health records (EHRs), and financial IT systems is a huge challenge; and compiling all this data into an integrated system is another challenge that needs to be overcome.

8. RESULT AND DISCUSSION

Big data enables clinical research studies to be applicable to real-world situations where conglomeration of population is a challenge. Accurate classification of patient enables effective and accurate health care. Personalization and customization is another quantum leap which has been taken by the medical fraternity, thanks to the ever expansive use of Big Data in Health Care Systems. Analyzing large data sets will also have a positive impact on clinical research. In this aspect, quick and pain free data collection is imperative in order to make Big Data Analysis in Health Sector successful. It is essential to have competent health care professionals and specialized labs who will be responsible to collect the data accurately. Pervasive sensing comes handy to get faster and less intrusive health data. Using sensors for long periods of constant monitoring without needing sporadic screening, which would give a restricted view of a disease's progression. However, the widespread use of continuous sensing will generate a significant amount of data that calls for distributed inference as well as on-node data abstraction. Finally, data privacy is a critical aspect which cannot be ignored and by implementing stringent Governmental Policies, during gathering, storing and transmitting

the data, one can make sure that the data is secure.

9. CONCLUSION

It is not possible to process big data in healthcare systems using contemporary techniques. With Big data analytics will change the face of the healthcare sector and will help it to surpass the limitations of traditional data analytic methods. Big Data analytics can be used for health management, clinical decision support, disease monitoring, and epidemic control, amongst others. However, it does have its own limitations. Some of the challenges related to big data in are data collection, storage, sharing, searching, and analysis, and the health care sector too is no exception to these challenges. Besides this, there are concerns related to data security, quality, real-time processing, integration and a lot more.

REFERENCES

[1]. Price, W., & Nicholson, I. I. (2015). Big Data, Patents, and the Future of Medicine. Cardozo Law Review, 37, 14011453. Pramanik,

[2]. M. I., Lau, R. Y., Demirkan, H., & Azad, M. A. K. (2017). Smart health: big data enabled health paradigm within smart cities. Expert Systems with Applications, 87, 370-383.

[3]. Mendelson, D. (2017). Legal protections for personal health information in the age of Big Data–a proposal for the regulatory framework. Ethics, Medicine and Public Health, 3(1), 37-55.

[4]. Farid, D. M., Nowe, A., & Manderick, B. (2016, December). A feature grouping method for ensemble clustering of highdimensional genomic big data. In Future Technologies Conference (FTC) (pp. 260- 268). IEEE.

[5]. Lo'ai, A. T., Mehmood, R., Benkhlifa, E., & Song, H. (2016). Mobile cloud computing model and big data analysis for healthcare applications. IEEE Access, 4, 6171-6180.

[6]. https://www.datapine.com/blog/big-data-examples-in-healthcare/