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Big Data for Digital Healthcare Industry: Challenges and Future Perspectives

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Abstract:- Every next phase of industrial innovation will be greatly aided by the use of big data, which will allow us to gain new knowledge from the vast volumes of facts that contemporary life creates. The use of big data in healthcare has a lot of potential, but there are still significant problems to be overcome, including fragmentation, increased costs, and data related assets. It's crucial to balance the benefits of improved patient outcomes against the dangers of growing work - related stress due to subpar deployment and greater complexity when thinking about the potential role of big data in the future of digital healthcare. Healthcare, the field at which Big Data congregation and consumption got a head start with schemes like TCGA and the Cancer Moon Shot, offers an instructive example as we observe varying viewpoints sponsored by the United States (US), the United Kingdom (UK), and some other governments in the integration of Big Data in care delivery with specific regard to their consolidation and compliance methodology to data. We present recommendations for laws and regulations that govern the utilization of data in healthcare, concentrating on the creation of a unique worldwide registration Number that can include data from diverse healthcare providers. We also look at the negative aspects of big data, like the absence of miscellany in big data research and the issues with privacy and accessibility that come with machine learning algorithms.

Keywords:- *Internet of Things, Personalized Medicine, Big Data Analytics, Healthcare.*

I. INTRODUCTION

Recent innovations and better management have depended largely on data. We are stronger able to coordinate oneself to achieve the most effective outcomes the more information we possess. For this reason, acquiring data is essential for every company. This data can be utilised to predict current trends and future events in a variety of contexts. As we become more and more conscious of this, we have begun to produce and gather more information regarding almost everything by introducing scientific breakthroughs in this approach. Right now, data from every aspect of our lives—including interpersonal relationships, research, our occupations, our wellness, etc.—is continuously given to us. In some senses, the present crisis can be compared to a data deluge. As a consequence, the phrase "big data" was created to describe vast and useless data. To meet our future and immediate societal demands, we must develop novel strategies for organising this data and creating insights that can be put into practise. One of these particular societal needs is healthcare. Like numerous other sectors, the healthcare industry generates data at a high rate, which has both many advantages and challenges. This introduction covers the principles of big data, such as its maintenance, evaluation, and potential applications in the future, notably in the healthcare industry.

II. LITERATURE SURVEY

The main issue that needs to be solved if EHRs are to be applied in either significant pathological aptitude is polarisation. Whenever Electronic health records fail to efficiently interconnect with one another, patient information is effectively locked into a proprietary system, leading to fragmentation. Numerous small and specialised businesses that also develop their own products exist alongside the larger manufacturers like Extreme and General Motors in the US EHR market, albeit many of them are unable to successfully or simply connect with one another (DeMartino and Larsen 2013)[1].The National Community Cancer Centers Program and the Clinical Oncology Requirements for the EHR have both emphasised the necessity of interoperability requirements for EHRs and have produced guidelines (Miller 2011)[2]. The Accreditation Committee for Health IT has established guidelines and specifications for the compatibility of electronic health records was also established (Miller 2011)[2]. The most recent new standard for healthcare data interchange is called Fast Healthcare Interoperability Resources (FHIR), and it was released by Health Level 7. (HL7). It expands upon earlier HL7 and a number of other standards, including the Reference Information Model. FHIR provides new guidelines for data sharing using RESTful APIs, and initiatives like Argonaut are attempting to promote adoption to EHRs (Chambers et al. 2019)[3]. Despite the HL7 Peripheral Oncologist EHR Operational Profile's launch, Electronic health records have not progressed and have even really be a source of frustration for practitioners as they try to combine the results from various labs or hospitals. Furthermore, they challenge to combine diagnoses from several labs or institutions, which might leave clinicians in the dark regarding the detailed medical background if they have switched physicians. (Reisman 2017; Blobel 2018)[4,5]. EHRs are controversial among clinicians even in integrated care organisations like Kaiser Permanente because interoperability problems make it difficult for them to access outside test findings or patient moving narratives (Leonard and Tozzi 2012)[6,7]. The NHS,

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a single government-run organisation that offers free healthcare at the point of service, offers an instructive comparison in the UK. The NHS already integrates a range of health records successfully—a step ahead of the US—but relies on antiquated technologies with security flaws like fax machines (Macaulay 2016)[8]. The NHS has just started modernized its healthcare system, with certain Healthcare Institutions adopting American EHR technologies, such as most recent contract with Epic signed by the Cambridgeshire NHS trust (Honeyman et al. 2016)[9]. But in terms of widespread adoption and absorption across all of its services, the NHS continues to lag behind the US (Wallace 2016)[10]. Additionally, it will need to enforce interoperability standards and centralised standards compliance for the many EHRs already in use, allowing for the addition of services like genome sequencing to patient records.

III. OVERVIEW OF DIGITAL HEALTHCARE INDUSTRY

In recent years, there have been substantial changes in the healthcare industry. The COVID-19 epidemic, the advancement of new technology, and the shift in patients' and healthcare professionals' perspectives on the therapeutic process have all had an impact on this. We no longer need to wait in huge lines to make a doctor's appointment or go to the doctor to acquire a prescription. On the contrary, a lot of these jobs may be completed remotely using a computer, phone, or app. Importantly, electronic medical records (EHR) contain the majority of the patient's medical history information, greatly accelerating the diagnosing procedure. Telemedicine, whose advancement was noticeably accelerated during the coronavirus pandemic, has also improved the standard of medical care. Today, we can schedule a visit with a healthcare provider from almost anywhere and without leaving our homes. This is crucial, especially now that the majority of the world's population is ageing and in need of quick and effective medical care. According to Statista, spending on digital transformation in the healthcare industry has topped $1.3 trillion globally and is increasing by 10.4% annually. In turn, a Deloitte survey reveals that up to 92% of medical staff members and medical facilities have increased productivity with only digital transformation. This was undoubtedly made possible by the COVID-19 pandemic, which revealed gaps in the hospital infrastructure. EHR implementation was slow to begin the 20th decade but rapidly picked up after 2009. The collection and utilisation of such healthcare data now depend more and more on digital technologies. The creation and application of wellness monitoring technologies and computational resources that can generate alerts and share patient health data with the proper healthcare professionals have been accelerated by a real-time physiological and surveillance systems . Massive volumes of data are being generated by these devices, which can be analysed to provide real-time healthcare or medical care. Big data as from healthcare sector has the potential to improve health impacts and cut costs.

- *Internet of Things (IoT):*

The medical field has so far not adopted the big data rebellion as quickly as other areas of the economy. As a consequence, The use of big data in the medical industry remains in its infancy. Healthcares and biomedicals big data haven't so far fused in an effort to increase patient records, for example, with pathogenic mechanisms. The decrypting of innumerable therapeutic effects or other computational physiology subjects can assistance from such unification. As a result, combining clinical and cellular databases is necessary to assess a person's health. The "internet of all things" is one of these sources of health data (IoT). In fact, IoT is essential to many different firms, notably healthcare. Prior to previously, the most of commonplace items, such as cars, cellphones, microwaves, and monitoring devices, did not normally handle or represent the data or have access to the net. However, incorporating circuit boards Integrating detectors into these goods has increased the potential for data gathering and dissemination via the internet.Platforms for connectivity are growing ever more reliant on gadget innovations like Near Field Connectivity (NFC) devices and Rfid Technology (RFID) tags and sensors, which may not only share data but also directly interface. This enables the administration and interaction of a network of iot technologies utilising RFID or NFC technology. The examination of the data gathered by these processors or monitors may reveal vital knowledge that will enable develop energy-saving technologies, improve transit, and advance healthcare. Connectivity is indeed a huge movement in the medical field right now. IoT devices contribute a great deal to big data in healthcare when they continuously produce data while monitoring people's health (or patients). The old and people with chronic disorders can receive reliable, effective, and competent healthcare services thanks to these assets' ability to connect a variety of devices.

- *Big Data Analytics:*

Big data is the enormous quantities of various types of data which are developed swiftly. Data congregated from numerous sources is mostly obligatory for offerings, not for promoting customer intake. This is also supported by big data from medicinal chemistry and healthcare. The primary issue with big data is determining how to preserve this enormous volume of data. To be allowed access to the research world, the information must be kept in a way that is simple to find and comprehend for an easier classification. The employment of complex computer technologies is a significant problem with healthcare data, standards, and slightly elevated infrastructure in the hospital area. A group of specialists from several disciplines, including biology, computer technology, statistical, and arithmetic, worked together to accomplish it. With from before the computer programs made by work problem for analytics, the sensor data can be made available on an online backup platform. To convert the content saved as documentation into wisdom, these instruments would also have data analysis and pattern recognition (ML) capabilities developed by AI experts.

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It would improve the efficiency of collecting, storing, assessing, and interpreting big data first from healthcare sector once it was enacted. The main objective is to properly integrate, analyse, and present this formative assessments for understanding. EHRs can enhance clinical management and enable predictive analysis because they have a wealth of data. However, a large portion of this material is now fragmented. Non - structured data refers to data which does not adhere to a predetermined model or system approach. The only aspect that can influence our choice is the fact we are able preserve it in a number of different ways. The fact that hierarchical sequence of characters like plunge menus, input fields, and check boxes typically fall short of appropriately capturing complex data was also argument in favour of using an uncontrolled format. For particular, whenever it comes to a thorough health suspicions, macroeconomic data, treatment options, significant lifestyle characteristics, and other pertinent information, we can only gather pro documentation in an informal environment. IoT big data treatment and insights could be done a little closer to the stream with the help of mobile cloud services, cloud resources, and edge devices. Improved approaches are required to implement ML and AI approaches for big data analysis on computational complexes. A scripting language (like Python, R, or another language) which is competent for handling with enormous amount of data could be used to construct such procedures or applications. As a result, managing the massive amounts of data from scientific research calls for strong biology and IT knowledge. Biotechnologists frequently combine the two fields of study. Two of the most well-known frameworks for dealing with massive data are Hadoop and Apache Spark. We provide a brief summary of several venues here.

- *Hadoop:*

These most advanced computer clusters cannot effectively process large volumes of (big) data when they are loaded into storage. The much more reasonable way to do this is to distribute and handle vast quantities of diverse big data instantaneously across multiple nodes. Because of the sheer size of the data, thousands of computer systems are often needed to share and finish treatment in an acceptable length of time. While dealing with tens of thousands of units, one must address problems like data dissemination, computations multithreading, and error resolution. Among the most popular interoperable software for this purpose is Hadoop. Hadoop has been enthusiastically adopted by many large companies, including Yahoo, Facebook, and others, since it comes with extra features that enhance the storage and computing portions. Files that would have proved challenging to manage without Hadoop are now being utilized by investigators. Hadoop is being utilised in a variety of enormous projects, such as the identification of medications using genetic and proteomic data and other aspects of healthcare, like determining an association involving ambient air data and asthma hospitals. Therefore, using the Hadoop system won't interfere with precision medicine.

- *Apache Spark:*

Apache Spark would be another a further Hadoop substitute that is free source. It is an unified distributed information processing platform that supports the higher-level frameworks for enabling Sql commands, able to stream data, deep learning, and vertex analytics, such as Spark SQL, Apache Spark, Matplotlib, and GraphX. By reducing the level of coding necessary and enabling the smooth integration of various sorts of processing data, these frameworks boost execution speed. In-memory collected data is made possible by graph database datasets (RDDs), which can render Ignite (on various datasets) 100 times faster than Mapreduce in multi-pass research.This is particularly true if there is less material than there is storage for. This implies that Apache Spark may require a significant amount of RAM to compute exceptionally large volumes of data. Although bandwidth costs more than disk drives do, Mapper is projected to be less economical for huge files than Apache Spark. Comparable to that, Apache Tornado was developed to provide a logical basis for data stream analytics. The majority major coding are functional with this framework. It also offers excellent versatility and designed reusability for massive data exploration.

IV. EMERGING TECHNOLOGIES FOR DIGITAL HEALTHCARE INDUSTRY

Every industry is being transformed by digital technology. To keep up with these trends, the healthcare business is undergoing a significant transformation. However, a patient-focused approach to healthcare is at the heart of a digital change in the industry. Healthcare firms can utilise it to customise user experiences, learn about patient needs, and streamline processes. Digital transformation is the integration of people, processes, and technologies to produce long-term results for patients and healthcare. It makes use of novel strategies, and the healthcare sector will profit most from the newest technologies. It implies that it enhances the standard of care and offers a range of services, reliable test findings, and sophisticated methods for choosing medicines to treat illnesses. The market for digital health in the United States was assessed at USD 66.5 billion in 2021, and from 2022 to 2030, it is anticipated to increase at a CAGR of 26.9%. Remote healthcare services will be delivered utilising digital channels, which are expected to fuel market expansion over the upcoming years, thanks to digital healthcare services and increased internet access. Additionally, the U.S.'s rising smartphone demand has compelled manufacturers to make investments and seize development prospects in the digital health sector. For instance, numerous applications have recently been introduced to the market, such as Doctors on demand, Google Fit, Amwell, etc. In America. Emerging technologies for digital healthcare industry in 2023 are mention below:

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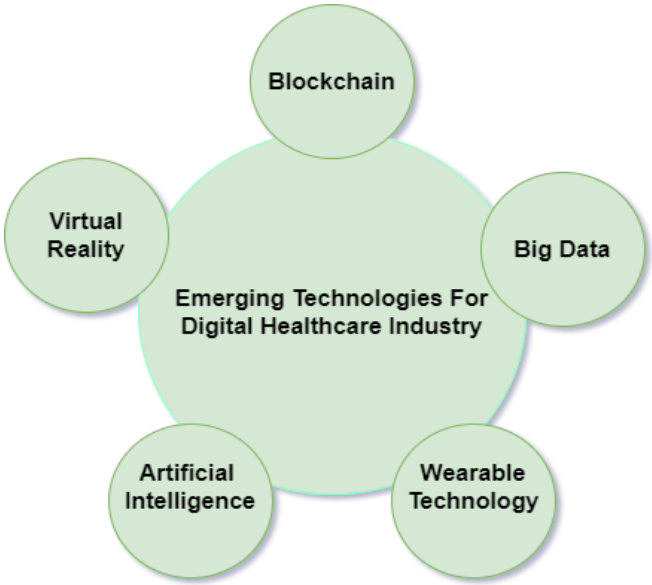

Fig.1. Emerging Technologies For Digital Healthcare Industry

➢ *Artificial Intelligence:*

We can no longer ignore how important AI has become to the healthcare sector. The use of AI is ideal for examining anomalous activity, identifying fraud threats, and locating viruses. Patients will benefit from improved living conditions and better health management thanks to this technology. The majority of this cutting-edge technology is employed to develop healthcare algorithms.

➢ *Blockchain:*

To stop medical fraud, blockchain will securely produce comprehensive transaction histories. Given that the information cannot be changed, it uses decentralised mechanisms that provide superior security. Claims are swiftly resolved because to the availability of an inventive and sophisticated payment mechanism. Furthermore, the blockchain system enables rapid access to digitised health records and promotes improved patient care.

➢ *Virtual Reality:*

The technology was initially made for video games, but it is now an essential component of healthcare solutions. Doctors are using VR technology to help patients with memory loss recall previous experiences, including their childhood homes, beloved locations, and more. Before performing difficult surgeries, virtual reality assists surgeons in visualising potential barriers.

➢ *Big Data:*

Big Data in the healthcare sector will create a patient's complete personal record, compile a family medical history for predictive analysis, reduce medical costs for individuals and healthcare organisations, and treat chronic illnesses in addition to preventing disease before it spreads. When used in conjunction with AI-based technology and online databases, big data has shown to be a miracle in the healthcare industry. Big data assists in identifying health trends and will provide consumers with quick, reliable solutions for healthcare and wellness. Business intelligence technologies could boost economic growth and provide patients and doctors with more healthcare options. Analytics will be able to understand financial circumstances and help healthcare organisations cut costs. However, predictive analysis is another tool that clinicians employ to assess a patient's health.

➢ *Wearable Technology:*

Electronic devices like Fitbits or smartwatches are examples of wearable technology in healthcare apps. People typically wear these devices on their wrists. They record information on a user's exercise and health habits and instantly transfer it to a doctor. However, clinicians can use this data to assess health metrics, create patient diagnoses, and for other purposes with the use of on-demand mobile apps. Wearables are thus becoming more and more important in the treatment of chronic disorders, from reproductive cycle trackers to ECG apps and cardiac monitors.

V. ADVANTAGES

To use the net of Iot systems, a physician can track and analyze a variety of metrics of his or her customers in their unique locations, including at residence or the business. In light of this, getting timely counseling and assistance might stop a child from having to go to the clinic or even seeing a doctor, that would also drastically reduce the cost of healthcare. Connected devices used during healthcare include nanosensors, system resulting for recording vital signs, reusable medical spy cameras, and other types of sensors or professional instrumentation. These Internet of Things (IoT) gadgets generate lots of mental wellbeing information. Sensor big data has really been very beneficial in a variety of fields by enabling research and prediction. On a larger scale, the data from such devices may aid in tracking employee health, replicating illness progression, and determining how to stop a certain disease pandemic. IoT hypothesis testing would require modern software systems due to its distinct nature and requirement for trimming types of technology. We would be expected to actually handle management of IoT gadget data plus nanosecond analysis of it. National healthcare professionals are seeking to lower costs and raise the quality of service by using complex algorithms on data produced both and outside the organization.

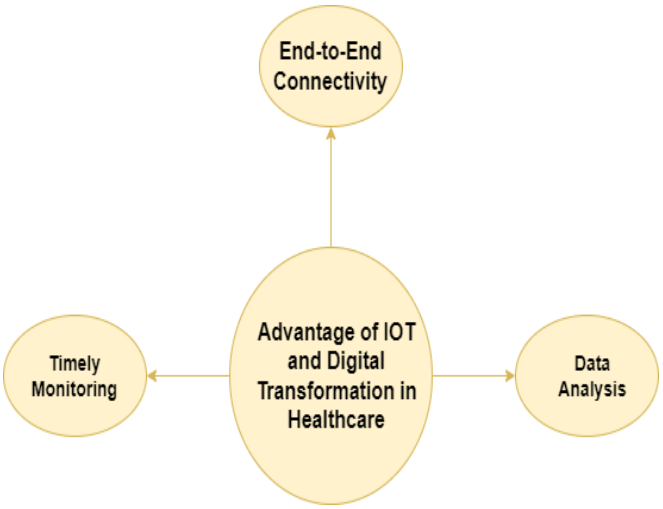

Fig.2. Advantage of IOT and Digital Transformation in Healthcare

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➢ *End-to-End Connectivity:*

By utilising healthcare mobility solutions and other cutting-edge technology, IoT helps the healthcare industry automate a patient care process. Interoperability, machine-to-machine connection, information exchange, and data transfer will all be improved through innovative technology. When the medical team notices problems and illnesses in patients, they will tailor a treatment.

➢ *Timely Monitoring:*

When someone has diabetes, a medical emergency, or has an asthma attack, real-time monitoring can save their life. Using medical gadgets to monitor a patient's condition will enable doctors to access and exchange health information promptly. The wearable device will provide accurate information at the right time, such as weight, blood pressure, blood sugar levels, and ECGs.

➢ *Data Analysis:*

After gathering the administrative data manually from various devices and sources, a sizable volume of patient-related information is very difficult to manage and maintain if availability is unattainable. The devices will do real-time data analysis and do away with storage problems. Utilizing critical healthcare analytics and data-driven insights allows the company to take timely, informed decisions.

VI. CHALLENGES

In most nations around the world, living standards have increased recently, as have human lifespans. Longer lifespans are, however, frequently accompanied by greater health issues, such as the development of chronic illnesses, whose management necessitates many contacts between the patient and the healthcare system. In such a situation, it is necessary to continuously increase the effectiveness of the digital healthcare sector by changing the way services are provided and organised, raising the level of expertise of medical staff and managers, updating medical equipment, and modifying financing models to take into account changing circumstances. Additionally, the following are the primary difficulties in the digitization of medical care:

➢ *Medical Data:*

Since health data is sensitive and needs extra legal protection, there are unique regulations regarding its collection, alteration, and storage.The accurate documenting of patient treatment phases and patient outcomes is one of the main duties of hospitals and other medical facilities. Despite the fact that many healthcare organisations save digital records, some organisations still keep paper patient data. As a result, protecting them is significantly more difficult than protecting their digital counterparts. Nevertheless, it is important to be aware that software used to store electronic medical data frequently follows the SaaS (System as a Service) business model. This indicates that it is accessible on the cloud and does not need to be physically installed on a computer. Then, regardless matter where they are working, medical facilities and healthcare professionals can access crucial patient data from any device. Medical cloud software also offers the appropriate level of security for sensitive data, from both the medical facility and the cloud provider. In this regard, particular attention should also be given to adhering to the requirements of the RODO and HIPPA rules and using processes in accordance with the ISO and MDR requirements while digitising patient data in healthcare.

Patient needs versus digitization: Patients' own experiences are crucial to the digital transformation of health care. To create a healthcare system that uses new technology effectively and efficiently, it is vital to monitor their requirements and expectations. Patients also need constant access to medical information, ease of communication with medical care providers, and being kept informed about the status of their health as a result of their developing health awareness. The adoption of mHealth solutions is one example of how this trend is manifesting itself. Clinical issues are increasingly being resolved with the use of mobile health services. Among these, portable imaging systems, sensor-based technologies, and health apps for smartphones, wearables, and wireless devices are crucial. The fact that many of these technologies have already received regulatory approval for usage in the EU and the US is crucial. The patient, with their health and medical history, must therefore become the core point on which the operations of the facility will be centred, requiring a significant investment of time and money on the part of healthcare personnel. The range of medical services offered, the size of the institution, and the quantity of patients serviced should all factor into the technology selection.

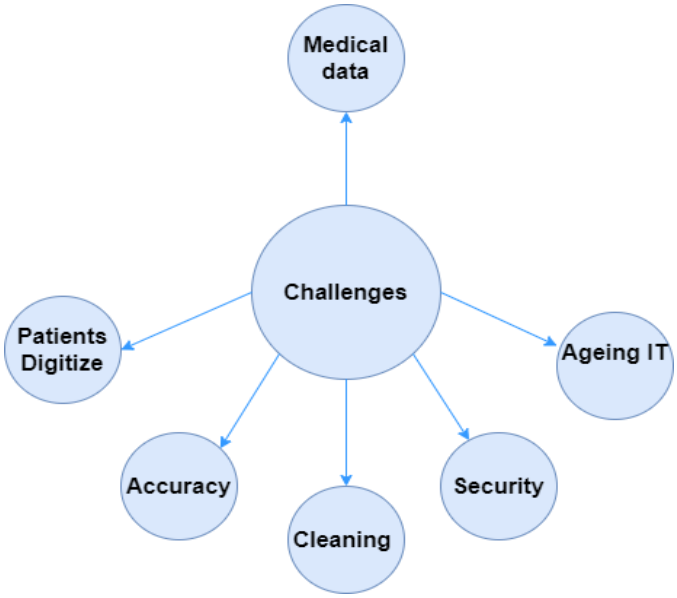

Fig.3.Challenges

Ageing IT infrastructure: Adequate hardware specifications present another difficulty in digitising the medical industry.Unfortunately, obsolete IT infrastructure, such as servers or PCs used in hospital wards or doctor's offices, frequently lacks the necessary specifications to enable cutting-edge medical software for teleconsultation or diagnostics.

Table 1 Comparative analysis of different techniques

References	Components/techniques	Big Data	Application	Purpose
[11]	Cloud Services Azure S3 SmartCloud	✓	Healthcare	The basic objective of is to store enormous amounts of data and make it conveniently accessible.
[12]	Cloud SQL Azure MySQl	✓	Can access a well-known	They are fully functional SQL database services that facilitate the creation, upkeep, administration, and management of relational MySQL databases in the cloud.
[13]	Apache Accumulo DB2	✓	Due to the importance of EHR applications for the continuity of care and overall health systems.	Swift and flexible All applications can benefit from NoSQL databases' reliable, single-digit millisecond potential at any scale.
[14]	Electronic Healthcare Records	✓	EHR has been very helpful for reporting and Managing population health.	At the point of care, EHRs provide precise, thorough, and up-to-date patient information, supporting practitioners in better managing patient care and providing better healthcare.
[15]	Portable Monitors	×	Monitoring people with chronic conditions is helpful.	Whenever a problem arises, receive an alarm.
[16]	Decision Making	×	Deciding on a course of action	Determining the main issue

➢ *Accuracy:*

According to several research, patient information reporting is still non totally precise. This is likely due to poor EHR utility, complicated measures, and a lack of recognition of wherefor it is thus crucial to collect big data accurately. All of these elements may affect big data quality throughout its lifespan. Despite findings indicating inconsistencies in these settings, the EHRs' intended improvements to data quality and communication in clinical work environments. By utilising patient self-report assessments for their concerns, the integrity of the reporting may increase.

➢ *Cleaning:*

To guarantee accuracy, consistency, uniformity, applicability, and purity of the data after collecting, it must be cleaned or cleaned. This process can be executed directly or mechanically utilising reasoning rules to produce superior levels of precision and reliability. To avoid the creation of poor information, save effort and attempting to derail big data projects, more advanced and precise technologies use machine-learning approaches.

➢ *Security:*

Due to the frequent security lapses, cyber efforts, cybercrime, and ransomware epidemics, data privacy is an important priority for healthcare businesses. After several risks were identified, a list of mechanical precautions for the sensitive healthcare information was created (PHI). These laws, which are also referred to as the "HIPAA Security Protocols," offer businesses direction on information storage, transmission, process improvement, access, accuracy, and procedures. Simple safeguards like using firewalls, number of co authentication, speed virus protection, and encryption of personal data can be quite helpful.

Table 1 depicts the comparative analysis of different techniques.

VII. CONCLUSIONS AND FUTURE WORK

Today, a wide range of pharmaceutical and biological tools, such as smartphone apps, portable physiological sensors, and genetics, give a vast amount of data. Therefore, it is crucial that we comprehend and assess what may be achieved with this data. For example, the analysis of these kind of material can present fresh ideas for improving treatment through operational, scientific, medicinal, and other ways. The usage of physician medical specialisation or make the health may now be at its peak, according to an analysis of numerous medical therapies. The prediction paradigm is constantly being improved through the use of EHR, EMR, as well as other big data analytics of medical data. Businesses that provide clinical conversion and pharmaceutical data insights genuinely aid in generating superior and more effective outcomes are all common objectives of these businesses. Hardly few of them are immune to difficulties with federal matters like the management, sharing, and safety of private data. The pooled information from biomedical researchers and healthcare organisations has improved understanding, diagnosis, and management for a number of diseases. Additionally, it has assisted in creating a foundation for tailored improved and more effective medical care. Notwithstanding the infrastructural issues, researchers are sifting through physiological big data in an effort to learn new and insightful guidance on how to improve the state of quality healthcare today. Drug studies, the integrated assessment of pharmacological and liability concerns, and the creation of markers are new and unique approaches to the analysis of healthcare big data. Since the current physician has acknowledged the potential of big data, big data analytics

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are already applied in medical and therapeutic operations. Owing to technologies ranging from potent computing to quantum physics, the time it requires to retrieve useful intelligence from enormous amounts of data has reduced significantly. The healthcare sector has undergone digital transformation, which has improved and streamlined medical organisation management, decreased paperwork, controlled finances, and many other processes. But telemedicine is growing across the globe as a result of the medical industry's digitization. Because of this, it offers a thorough orientation to distant consultations. Flutter Agency is prepared to assist and is eager to provide fresh concepts and innovations to your sector.

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