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Smart Healthcare System Using Data Analysis

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Abstract: ***Amid this pandemic situation all around the world, data analysis has proved helpful by contributing to the development of Smart Healthcare System. [1]With the development of information technology, the concept of smart healthcare has gradually come to the fore. Smart healthcare uses a new generation of information technologies, such as the internet of things (IoT), data analysis, cloud computing, and artificial intelligence, to transform the traditional medical system in an all-round way, making healthcare more efficient, more convenient, and more personalized. The use of such healthcare system have helped to diagnose many victims during the absence of a doctor. Also, [2]the use of these healthcare systems do not only help patients know how to manage their health but assists healthcare providers to reduce emergency cases, track patients, staff, and inventory; for the overall control of epidemics.***

Keywords: pandemic, IoT, data analysis, cloud computing, artificial Intelligence.

I. INTRODUCTION

[4] Data Analysis has changed the way we manage, analyze, and leverage data across industries. One of the most notable areas where data analysis is making big changes is healthcare. In fact, healthcare analytics has the potential to reduce costs of treatment, predict outbreaks of epidemics, avoid preventable diseases, and improve the quality of life in general. The average human lifespan is increasing across the world population, which poses new challenges to today's treatment delivery methods. Health professionals, just like business entrepreneurs, are capable of collecting massive amounts of data and look for the best strategies to use these numbers. Data Analysis[3] is becoming the new key raw material for the healthcare industry helping AI and machine learning algorithms and data scientists utilize such crucial information and improve the various services into the sub-fields of the medical industry.

II. RESEARCH SCOPE

[10] The tremendous growth of Internet-of-Things devices enable the data collection of health-related parameters (e.g., body temperature, blood pressure, heart beat, respiratory rate, oxygen saturation, blood glucose level, wrist pulse signal, magnetoencephalogram (MEG), galvanic skin response (GSR), electrooculography (EOG), mechanomyogram (MMG), electromyogram (EMG), electrocardiogram (ECG) and electroencephalogram (EEG)). Numerous data analytic techniques are applied to analyze the data in order to realize smart healthcare applications. The world has been seeking effective measures to relieve the issues of population ageing as well as inadequate amounts of medical staff. And in this pandemic situation present worldwide, a smart healthcare system comes to the saviour.

III. RESEARCH

How does Healthcare and Data Analytics Go Hand in Hand?

[8] Analytics is driving the healthcare industry towards an upgrade and upliftment. The customer satisfaction is the priority with the minimal chaos in the management on this side. Sensor-driven data has led to various steps being taken like coaching for elderly people including real-time feedback. Patient care analytics solutions are yet another boom. The market is offering several options to choose from to select the appropriate healthcare data analytics solution provider. It is a boon to have a variety of choices but at the same time it does makes our task as the customers of these services are a little complex.

A. Data Analysis in Healthcare

[4] Data Analysis in healthcare is a term used to describe massive volumes of information created by the adoption of digital technologies that collect patients' records and help in managing hospital performance, otherwise too large and complex for traditional technologies. The application of data analysis in healthcare has a lot of positive and also life-saving outcomes. In essence, big-style data refers to the vast quantities of information created by the digitization of everything, that gets consolidated and analyzed by specific technologies. Applied to healthcare, it will use specific health data of a population (or of a particular individual) and potentially help to prevent epidemics, cure disease, cut down costs, etc.

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Now that we live longer, treatment models have changed and many of these changes are namely driven by data. Doctors want to understand as much as they can about a patient and as early in their life as possible, to pick up warning signs of serious illness as they arise – treating any disease at an early stage is far more simple and less expensive. By utilizing key performance indicators in healthcare and healthcare data analytics, prevention is better than cure, and managing to draw a comprehensive picture of a patient will let insurance provide a tailored package. This is the industry's attempt to tackle the siloes problems a patient's data has: everywhere are collected bits and bites of it and archived in hospitals, clinics, surgeries, etc., with the impossibility to communicate properly. Indeed, for years gathering huge amounts of data for medical use has been costly and time-consuming. With today's always-improving technologies, it becomes easier not only to collect such data but also to create comprehensive healthcare reports and convert them into relevant critical insights, that can then be used to provide better care. This is the purpose of healthcare data analytics: using data-driven findings to predict and solve a problem before it is too late, but also assess methods and treatments faster, keep better track of inventory, involve patients more in their own health, and empower them with the tools to do so.

1) *Benefits of Data Analysis in Smart Healthcare:* [3] Collecting and analyzing such data helps to get more insights into people's health and why certain health conditions occur. And how to detect the various types of diseases in a timely using the AI-enabled machines for faster diagnosis with accuracy. The benefits of data analysis in healthcare translate into terms of timely and improved patient treatment and care experience. Moreover, prediction of deadly disease, reducing the death rates, healthy lifestyle and effective surveillance of public health and making the policies for public healthcare and management system. [6] Besides, by incorporating appropriate techniques for data analysis, patients themselves benefit, generating surprising results for the business.

a) *Helps to know the Patients Better:* The most common use of health data analysis is to gain insights about patients. Who they are, what habits they cultivate, and what procedures they have done in the past are information that can assist in diagnosis and treatment and, therefore, relevant to the analysis of health data. Using the information your business has collected about patients over the years, it is possible to make an early diagnosis of ailments and explore more effective and customized treatment channels for each patient. This is one of the main benefits of data analysis in health.

b) *Advanced Patient Care and Treatment:* Health is not a sensitive issue just because incorrect decisions can be costly or less effective. It is also a discipline in which maximum efficiency – in the speed with which customer service is provided from the moment it arrives at the hospital until the discharge regimen – is capable of saving lives.
For example, with a good data analysis, a hospital can understand what the causes of delays are in its visits and why the screening process is less efficient than one would like. All of this will contribute to reducing the waiting time for patients and increasing the chances of a good, personalized, and agile service.

2) *Types of Health Care Analytics:* [7] Not every question can be answered by using the same analysis of the data. Through the use of different types of data analytics, we can answer many of the questions being asked in health care settings.

a) *Descriptive Analytics:* Descriptive analytics uses historical data to draw comparisons or discover patterns. This type of analysis is best for answering questions about what has already occurred. We can gain insight into the past with descriptive analytics.

b) *Predictive Analytics:* Predictive analytics uses current and historical data to make predictions about the future. The models created with this type of analytics are best for answering questions about what could happen next. We can gain insight into the future with predictive analytics.

c) *Prescriptive Analytics:* Prescriptive analytics will also make predictions about future outcomes. Machine learning is a big factor with this type of analytics. The information provided can help determine the best course of action. We can gain insight on what course of action should be taken to reach the most ideal outcome with prescriptive analytics.

B. *Data Analysis and COVID-19*

[7] The impact COVID-19 has had on the health care industry is evident to anyone and everyone. You don't need to be plugged into the world of medicine to see what has been happening worldwide during this pandemic.

What most people don't see, though, is the impact COVID-19 has had on health care data analytics. It is not just providers, but lawmakers and researchers who are turning to data analytics and predictive models to help allocate resources, predict surges, improve patient care and outcomes and employ preventive measures.

Health data analytics and big data have played an integral role in the fight against COVID-19. The data is coming in at a near constant rate. Analyzing that health data has allowed for a better understanding of how to respond and treat patients.

This pandemic has resulted in an enormous surge of health data being recorded and manipulated allowing for bigger and better analytics. Unfortunately, we are also seeing that COVID-19 is "shining a harsh spotlight on health care's biggest issues." There are a lot of obstacles when it comes to sharing health data across organizations and a distinct lack of standardization in the way that data is collected and analyzed. This widespread problem was evident in the early days of the pandemic as conflicting and ever-changing information was being presented to the public. We saw a turn towards disbelief when it came to COVID-related information with many still believing misinformation and previously held beliefs on how this virus should be handled. The spotlight that COVID-19 shined on these problems, however, will allow for them to be rectified. The providers, researchers and policymakers can learn from these mistakes and work towards a better, more standardized solution for data analysis in health care.

C. Application of Data Analysis in Healthcare

1) *Electronic Health Records:* [4] It's the most widespread application of data analysis in medicine. Every patient has his own digital record which includes demographics, medical history, allergies, laboratory test results, etc. Records are shared via secure information systems and are available for providers from both the public and private sectors. Every record is comprised of one modifiable file, which means that doctors can implement changes over time with no paperwork and no danger of data replication. EHRs can also trigger warnings and reminders when a patient should get a new lab test or track prescriptions to see if a patient has been following doctors' orders.
2) *Real Time Alerting:* [4] Other examples of data analytics in healthcare share one crucial functionality – real-time alerting. In hospitals, Clinical Decision Support (CDS) software analyzes medical data on the spot, providing health practitioners with advice as they make prescriptive decisions. However, doctors want patients to stay away from hospitals to avoid costly in-house treatments. Analytics, already trending as one of the business intelligence buzzwords in 2019, has the potential to become part of a new strategy. Wearables will collect patients' health data continuously and send this data to the cloud.
   Additionally, this information will be accessed to the database on the state of health of the general public, which will allow doctors to compare this data in a socio-economic context and modify the delivery strategies accordingly. Institutions and care managers will use sophisticated tools to monitor this massive data stream and react every time the results will be disturbing.
3) *Enhancing Patient Engagement:* [4] Many consumers – and hence, potential patients – already have an interest in smart devices that record every step they take, their heart rates, sleeping habits, etc., on a permanent basis. All this vital information can be coupled with other trackable data to identify potential health risks lurking. Chronic insomnia and an elevated heart rate can signal a risk for future heart disease for instance. Patients are directly involved in the monitoring of their own health, and incentives from health insurance can push them to lead a healthy lifestyle (e.g.: giving money back to people using smartwatches). Another way to do so comes with new wearables under development, tracking specific health trends, and relaying them to the cloud where physicians can monitor them. Patients suffering from asthma or blood pressure could benefit from it, and become a bit more independent and reduce unnecessary visits to the doctor.
4) *Reduce Fraud and Enhance Security:* [4] Some studies have shown that 93% of healthcare organizations have experienced a data breach. The reason is simple: personal data is extremely valuable and profitable on the black markets. With that in mind, many organizations started to use analytics to help prevent security threats by identifying changes in network traffic, or any other behavior that reflects a cyber-attack. Of course, data analysis has inherent security issues and many think that using it will make organizations more vulnerable than they already are. But advances in security such as encryption technology, firewalls, anti-virus software, etc, answer that need for more security, and the benefits brought largely overtake the risks.
   Likewise, it can help prevent fraud and inaccurate claims in a systemic, repeatable way. Analytics help to streamline the processing of insurance claims, enabling patients to get better returns on their claims and caregivers are paid faster.
5) *Smart Staffing and Personnel Management:* [4] Without a cohesive, engaged workforce, patient care will dwindle, service rates will drop, and mistakes will happen. By working with the right HR analytics, it's possible for time-stretched medical institutions to optimize staffing while forecasting operating room demands, streamlining patient care as a result. Too often, there is a significant lack of fluidity in healthcare institutions, with staff distributed in the wrong areas at the wrong time. This imbalance of personnel management could mean a particular department is either too overcrowded with staff or lacking staff when it matters most, which can develop risks of lower motivation for work and increases the absenteeism rate. Though data-driven analytics, it's possible to predict when you might need staff in particular departments at peak times while distributing skilled personnel to other areas within the institution during quieter periods. Moreover, medical data analysis will empower senior staff or operatives to offer the right level of support when needed, improve strategic planning, and make vital staff and personnel management processes as efficient as possible.

6) *Learning and Development:* [4] Expanding on smart staffing point, in a hospital or medical institution, the skills, confidence, and abilities of your staff can mean the difference between life and death. Naturally, doctors and surgeons are highly skilled in their areas of expertise. But most medical institutions have a range of people working under one roof, from porters and admin clerks to cardiac specialists and brain surgeons.
   In healthcare, soft skills are almost important as certifications. To keep the institution running at optimum capacity, you have to encourage continual learning and development. By keeping track of employee performance across the board while keeping a note of training data, you can use healthcare data analysis to gain insight on who needs support or training and when. If everyone is able to evolve with the changes around them, you will save more lives — and medical data analytics will help you do just that.
7) *Advanced Risk and Disease Management:* [4] Data analysis and healthcare are essential for tackling the hospitalization risk for specific patients with chronic diseases. It can also help prevent deterioration.
   By drilling down into insights such as medication type, symptoms, and the frequency of medical visits, among many others, it's possible for healthcare institutions to provide accurate preventative care and, ultimately, reduce hospital admissions. Not only will this level of risk calculation result in reduced spending on in-house patient care, but it will also ensure that space and resources are available for those who need it most. This is a clearcut example of how analytics in healthcare can improve and save people's lives. As a result, healthcare analytics can improve the quality of patient care while making the organization more economically streamlined in every key area.
8) *Telemedicine:* [4] Telemedicine has been present on the market for over 40 years, but only today, with the arrival of online video conferences, smartphones, wireless devices, and wearables, has it been able to come into full bloom. The term refers to the delivery of remote clinical services using technology.
   It is used for primary consultations and initial diagnosis, remote patient monitoring, and medical education for health professionals. Some more specific uses include telesurgery – doctors can perform operations with the use of robots and high-speed real-time data delivery without physically being in the same location with a patient.
   Clinicians use telemedicine to provide personalized treatment plans and prevent hospitalization or re-admission. Such use of healthcare data analytics can be linked to the use of predictive analytics as seen previously. It allows clinicians to predict acute medical events in advance and prevent deterioration of patient's conditions.
   By keeping patients away from hospitals, telemedicine helps to reduce costs and improve the quality of service. Patients can avoid waiting in lines and doctors don't waste time on unnecessary consultations and paperwork. Telemedicine also improves the availability of care as patients' state can be monitored and consulted anywhere and anytime.
9) *Developing New Theories and Innovations:* [4] The last of our healthcare analytics examples centers on working for a brighter, bolder future in the medical industry. Data analysis in healthcare has the power to assist in new therapy and innovative drug discoveries. By utilizing a mix of historical, real-time, and predictive metrics as well as a cohesive mix of data visualization techniques, healthcare experts can identify potential strengths and weaknesses in trials or processes.
   Moreover, through data-driven genetic information analysis as well as reactionary predictions in patients, data analytics in healthcare can play a pivotal role in the development of groundbreaking new drugs and forward-thinking therapies. Data analytics in healthcare can streamline, innovate, provide security, and save lives. It gives confidence and clarity, and it is the way forward.
10) *Patients Predictions for Improved Staffing:* [4] Let us look at one classic problem that any shift manager faces: how many people do I put on staff at any given time period? If you put on too many workers, you run the risk of having unnecessary labor costs add up. Too few workers, you can have poor customer service outcomes – which can be fatal for patients in that industry. One of the key data sets is 10 years' worth of hospital admissions records, which data scientists crunched using "time series analysis" techniques. These analyses allowed the researchers to see relevant patterns in admission rates. Then, they could use machine learning to find the most accurate algorithms that predicted future admissions trends.
    Summing up the product of all this work, the data science team developed a web-based user interface that forecasts patient loads and helps in planning resource allocation by utilizing online data visualization that reaches the goal of improving the overall patients' care.

IV. FUTURE SCOPE

[3] The role of data analytics in the healthcare sector is going to become more vital with more demand from fast-growing technologies like AI and machine learning. And adopting data analytics will also become vital for healthcare organizations to operate with better efficiency and productiveness.

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Moreover, the availability of healthcare training data for AI will also help wearable device makers to provide more accurate information to end-users. And using such wearable devices, patient monitoring also gives useful information to healthcare service providers to improve their services and help people enjoy advanced healthcare facilities.

V. CONCLUSION

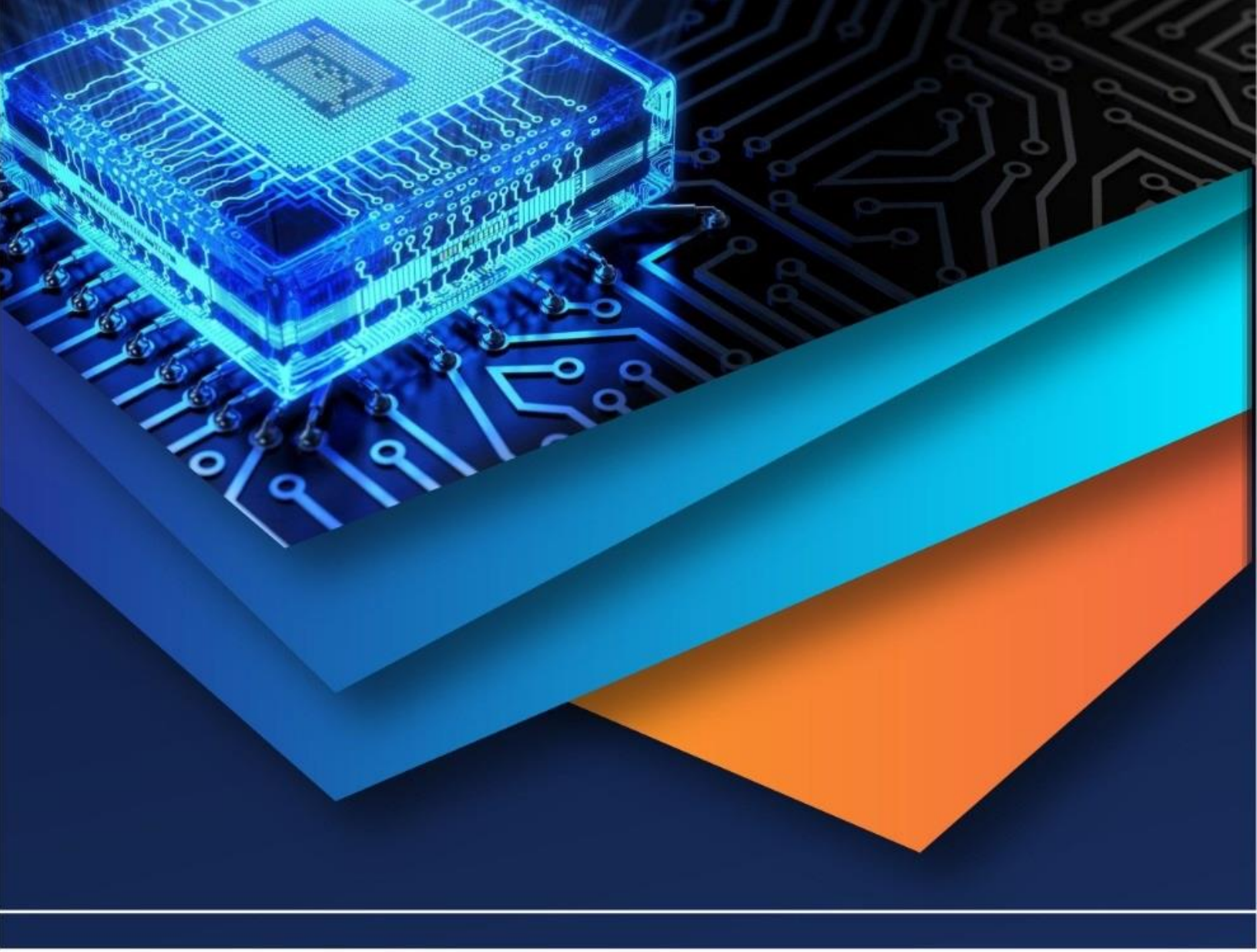
[9] Big data has a potential of revolutionizing healthcare from top to bottom. Healthcare organizations should bet big on big data to provide better patient outcomes, save on costs, and build efficiency across all departments.

More crucially, big data will help clinicians and hospitals provide more targeted healthcare and see better results. For pharma companies, big data is a driving force that'll help the design and build more innovative drugs and products.

On the overall, healthcare stakeholders can rely on big data and predictive analytics to tackles major issues like readmission rates, high-risk patient care, staffing issues, dosage errors, and much more.

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