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# Predictive Modelling in Healthcare using Machine Learning

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**ABSTRACT:** Machine learning (ML) is a type of artificial intelligence (AI) that allows software applications to become more accurate at predicting outcomes without being explicitly programmed to do so.

Machine learning is used in health care in many ways. It can analyze large amounts of data and identify patterns that are not visible to humans.

Healthcare has always been a sensitive issue for us all, and it always will be. A better life can be lived if we are able to predict various types of health issues in advance. There are many types of health problems such as cancer, heart disease, diabetes, arthritis, pneumonia, lung disease, liver disease, and brain disease, which all pose a high risk. It is necessary to have some suitable models for predicting health issues in order to reduce their risk. Thus, it became an important topic to analyze predictive models used in healthcare. This study will examine how predictive models are used in healthcare and how they can contribute to improving healthcare.

**KEYWORDS:** Machine Learning(ML), Healthcare, Predictive Models, Predicting health issues

## I. INTRODUCTION

As human beings, our health is very crucial topic for us. Predicting life threatening diseases beforehand can help us to lead a better and healthier life. Healthcare companies are always under high pressure because of the numerous risks that the medical industry has to deal with every day. The implementation of high-accuracy predictive technologies allows them to put this pressure down by eliminating mistakes that, in the worst-case scenario, can cost human lives. Additionally, predictive modeling can provide healthcare organizations with ways to improve both public and individual health care. The worldwide crisis of 2020 has shown that the industry needs predictive solutions more than ever to become able to prevent outbreaks of dangerous diseases throughout the world. This paper is focused on predictive models used in healthcare and how they are improving healthcare for all of us.

Machine learning is used in many aspects of health care. It is capable of analyzing large amounts of data and identifying patterns that humans are not able to detect. In healthcare, it is mainly used in predictive analytics and diagnosis in order to predict patient outcomes and improve diagnostic accuracy. The program can assist doctors in making better decisions, improving patient outcomes, and reducing costs. As a result, repetitive tasks can be automated, errors can be reduced, and the care can be more personalized.

## II. PREDICTIVE MODELLING IN HEALTHCARE

Predictive modeling, also known as predictive analytics, involves the application of statistical methods, data mining, and game theory to analyze comprehensive sets of current and historical medical data. This analytical approach aims to enhance patient care and achieve positive health outcomes. By considering diverse factors, including medical records, age, social and economic characteristics, and individual anatomy, predictive analysis enables the identification of patients' vulnerability to diseases such as diabetes, asthma, and other lifestyle-related conditions. Consequently, leveraging these insights can contribute to personalized healthcare interventions and proactive disease prevention strategies.

In the process of developing a predictive model, data analytics plays a crucial role in identifying common behavioral patterns and predicting individuals' responses or actions in relation to unfolding events. Prominent medical organizations worldwide are actively incorporating advanced techniques like predictive analysis, simulation, and variable modeling. These practices are aimed at optimizing decision-making, problem-solving, and identifying



opportunities to enhance the healthcare system. By leveraging these advanced approaches, the ultimate objective is to drive effective decision-making processes and uncover potential avenues for improving overall healthcare delivery.

### III. APPLICATIONS OF PREDICTIVE MODELLING IN HEALTHCARE

#### 1. Medical Imaging

Artificial intelligence and machine learning models have demonstrated remarkable efficacy in the field of radiology. A notable illustration of this is observed at the University of Montreal Hospital Centre, where an AI solution is employed to detect anatomical changes in patients and identify disease-specific markers using X-ray images. Additionally, this solution aids in predicting and preparing patients for surgical interventions. The utilization of such advanced technologies in radiology holds great potential for enhancing diagnosis, treatment planning, and patient outcomes.

Prognostic software in radiology plays a crucial role in lung screening and breast cancer diagnostics. It utilizes X-ray data to predict lung disease exposure, prioritizing high-risk patients. Additionally, prognostic models and Digital Breast Tomosynthesis (DBT) enable comprehensive evaluation of breast anatomy and early detection of breast diseases.

#### 2. Palliative Care

Penn Medicine, a renowned academic medical center, employs predictive models utilizing electronic health records (EHR) to forecast health risks for patients facing life-threatening diseases. Named Palliative Connect, this model incorporates 30 factors to predict patient status, enabling physicians to anticipate outcomes for up to six months following hospital admission. Leveraging machine learning algorithms, Palliative Connect enables doctors to prioritize individuals at high risk of mortality, enhancing palliative consultations and striving for favorable patient outcomes while reducing population mortality rates.

#### 3. Monitoring of Vital Signs

Machine learning algorithms have the capability to monitor vital signs, including heart rate and blood pressure, to detect early indications of health conditions. For instance, through video analysis, these algorithms can monitor critical signs by observing the patient's face and identify abnormal heart rates or breathing patterns. This advanced technology enables proactive detection and timely intervention, enhancing healthcare monitoring and patient care.

#### 4. Mental Health

According to the WHO, over 800,000 people end their lives by suicide each year, and over 20 million attempt self-immolation. Various factors contribute to chronic stress, which can lead to depression, self-aggression, and suicide in the worst cases. Medical organizations and scientists use EHRs and mental health visits of specific patients to implement predictive solutions to keep people mentally healthy.

By analyzing data from both individuals who have committed suicide and living patients, the prediction-based system identifies those at high risk of self-harm or suicide attempts. This enables timely support through helper applications and qualified therapists, resulting in a significant reduction in global self-harm rates.

#### 5. Pharmacy Services

Pharmacies utilize predictive modeling for marketing, sales optimization, and forecasting medication demand, customer churn, and consumer preferences. However, ensuring personalized medication effectiveness remains crucial. Pharmacists aim to provide the right medication to the right patients by leveraging predictions based on EHR data and new clinical evidence for atypical forms of known diseases.



#### IV. BENEFITS OF PREDICTIVE MODELLING IN HEALTHCARE

##### 1. Improved Diagnostics

While some diseases have typical symptoms and predefined treatment plans, atypical symptoms in individual patients can complicate diagnosis. In such cases, specialists rely on patient data, family history, and diagnostic procedures like CT, X-rays, and MRI, combined with predictive analytics, to determine the need for hospitalization and select the appropriate treatment plan.

##### 2. Cost Reduction

Healthcare organizations opt for predictive analytics primarily due to its significant cost reduction potential. By harnessing abundant data on patients, staff, equipment, supplies, administrative tasks, and scheduling, detailed insights are generated for effective cost management and risk mitigation. This information facilitates identifying areas where expenses can be trimmed without compromising critical aspects of care.

##### 3. Improved operational efficiency

The utilization of predictive modeling applications in healthcare enhances patient management and enables improved appointment scheduling based on doctors' availability. These models effectively identify patients prone to appointment non-compliance, enabling providers to reduce schedule gaps, eliminate inefficiencies, and prevent staff overload. Predictive modeling also aids in anticipating challenges ahead of time, allowing for proactive resource allocation and supply management.

##### 4. Reducing Readmissions

The readmission rate serves as a measure of care quality provided by a hospital, and regulations in European countries and the US impose penalties for patient readmissions due to disease relapse. When patients are readmitted within 30 days with the same complaints, it indicates inadequate treatment during their initial admission. Predictive models aid organizations in preventing such readmissions by calculating the probability of readmission during the initial patient assessment, leveraging current and historical healthcare data.

##### 5. Personalized Medical Care

Healthcare institutions enhance efficiency through precision medicine, utilizing predictive modeling to improve patient-centered care based on personal health records. This approach enables the creation of personalized treatment plans for each patient, optimizing outcomes. Prognostic models are particularly effective in time-sensitive inpatient and emergency scenarios, facilitating quick decision-making. Leveraging available data, these models predict the effectiveness of procedures, tests, and medications based on individual anatomy and genetic factors.

#### V. CONCLUSION

Predictive analytics offers significant benefits to industries dealing with vast data, numerous risks, and the need to adapt swiftly to market changes. The healthcare sector is a prime example of such an industry, as medical companies operate under high pressure and bear immense responsibility for improving the health of millions. Embracing advanced technologies is crucial to enhancing efficiency and alleviating the challenges they face.

The positive impact of predictive models on the healthcare sector has been significant, revolutionizing healthcare systems and driving remarkable improvements. The healthcare sector has undergone remarkable advancements with the implementation of predictive models, surpassing its previous capabilities and achievements.

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