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The Role of Predictive Analytics in Remote Health Monitoring

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ABSTRACT

Medical technology and patient data should have the same goal, which is the maximization of the usefulness of a historical trend for patient care improvement. Without the proper infrastructure and resources to take action on patient health data that indicates high certainty that something will occur, the full potential of connecting trends and patterns cannot be completely utilized. One method is to have a patient use a remote health monitoring device to transmit health data to the cloud for predictive analytics which, over time, can develop unique health patterns that can predict actionable data by caregivers. Medical prediction modelling techniques use artificial intelligence to generate a prediction profile (algorithm) from patient data that can be implemented, so that a new patient can get an instant prediction for an accurate diagnosis. Precision medicine, personalized medicine, and genomic medicine all describe medicine based on genomic makeup. These approaches are methods to determine unique disease risks that are based on predispositions in a person's genome at birth, in combination with environment and lifestyle factors which can be monitored remotely. Predictive Analytics used in medicine, especially with remote health monitoring, can also reveal data associations, such as medications, hospital readmission rates, probability of disease, infection predictions, and prediction of future wellness. Predictive Analytics (PA) using patient data garnered from remote health monitoring can help in preventive medicine for diseases that can be prevented or ameliorated for at-risk patients by making lifestyle changes to avoid risks, resulting in lowering medical costs.

Keywords: patient data, remote health monitoring, predictive analytics, precision medicine, personalized medicine, and genomic medicine, pharmacogenomics

1. INTRODUCTION

Evolving changes in the United States' healthcare delivery model are leading to developing data-driven methods for management of quality of care [1]. Today there is more information produced in one day than could be absorbed in a lifetime [2]. However, data that lacks a framework or the context of metadata, annotation or interpretation is useless and cannot reach its complete potential. This is especially relevant to medical practitioners. Medical technology and patient data should have the same goal, which is the maximization of the usefulness of a historical trend for patient care improvement. Without the proper infrastructure and resources to take action on patient health data that indicates high certainty that something will occur, the full potential of connecting trends and patterns cannot be completely utilized. For the potential of raw data potential to be realized, clinical event prediction and consequent mediation need to be content and clinician driven [2]. Analytics, which is data and information, plays a significant role in assessing predictive risk, clinical decision support, and patient throughput methods [1]. Predictive analytics can provide confirmation, suggestions, and actions for each predicted classification or outcome [2]. One method is to have a patient use a remote health monitoring device to transmit health data to the cloud for predictive analytics which, over time, can develop unique health patterns that can predict actionable data by caregivers.

1.1 Predictive Analytics

Today, physicians have access to immense amounts of medical data that can be used for comparison of treatment outcomes for diseases, but this type of in-depth research and statistical analysis that can be integrated into a patient's medical profile is beyond the expertise of most physicians [3]. Thus, physicians, and even insurance companies, need to use Predictive Analytics (PA) to sift through huge quantities of

information to predict patient outcomes [3]. Remote health monitoring can ease this burden, since individual patient health data can be collected and analyzed for health changes that may require action.

In the history of medicine, physicians have primarily focused on sick care, not healthcare, treating sickness instead of prevention. Predictors are valuable when data from past treatments and current medical research can be translated into preventive action [3]. Statistics and modeling can foresee future occurrence based on current and historical data by examining data patterns to determine if such patterns are apt to re-emerge [4]. Medical prediction modelling techniques use artificial intelligence to generate a prediction profile (algorithm) from patient data that can be implemented, so that a new patient can get an instant prediction for an accurate diagnosis [3]. Predictive Analytics used in medicine, especially with remote health monitoring, can also reveal data associations, such as medications, hospital readmission rates, probability of disease, infection predictions, and prediction of future wellness [3].

1.2 Lowering Costs and Admissions

The medical community is turning to channeling the power of Predictive Analytics of patient data to lower costs and readmissions, since predicting hospital readmissions is a very important issue in healthcare today [2]. One benefit of remote health monitoring and predictive analytics is meeting government regulations, such as those found in the Affordable Care Act, in which patients are not supposed to be readmitted within 30 days of hospital discharge [3]. Remote health monitoring will allow caregivers to have real-time access to a patient's health data to create individual predictive analytics that can be used to improve patient care, while simultaneously controlling costs by avoiding hospital readmissions that contribute to financial and reimbursement penalties [2]. Hospitals and caregivers can also use Predictive Analytics to more accurately evaluate when a patient can safely be released [3].

1.3 Increased Accuracy of Diagnosis

Another benefit of Predictive Analytics is increasing accuracy of diagnoses. A patient admitted to the ER with chest pain can be assessed using PA algorithms to help determine of the patient should be hospitalized [3]. Also, evidence-based research has also indicated that certain conditions may be helpful in early determination of Alzheimer's disease [3]. A patient can be prescribed appropriate exercise, nutrition, as well as memory tests, and brain game apps that can be downloaded on a smartphone for accumulation of personal patient data. The results can be entered into the cloud for analytics or an electronic medical record (EMR) to which the patient can add weekly data via a remote health monitor that develops a predictive model that tracks any changes in memory maintenance [3].

1.4 Precision Medicine

Precision medicine, personalized medicine, and genomic medicine are terms used to describe medicine based on genomic makeup [5]. These approaches are methods to determine unique disease risks that are based on predispositions in a person's genome at birth, in combination with environment and lifestyle factors which can be monitored remotely. Pharmacogenomics is a part of personalized medicine, and relates to drugs that might be personalized to an individual's genetic makeup. This can lead to customized health care, with medical treatments tailored to individual patients [6]. Due to rapid growth of big data analytics, genomic sequencing, and backing from research and healthcare organizations, predictive analytics can be used by pharmaceutical companies to create personalized, or precision, medications that meet the needs of smaller groups. Researchers can use predictive analytics to develop prediction models that are more accurate over time without huge observational population studies which result in data that has statistically significant differences which are not necessarily clinically significant differences [3].

Facebook founder Mark Zuckerberg and his wife Dr. Priscilla Chan made a $10 million donation to UC San Francisco, one of the leading precision medicine research facilities, which will be used to research the potential of recycling data for personalized care [7]. This will be carried out by leading physician-scientist Atul Butte, who is researching the frontier of big data [8] advance research without requiring creation of brand new data sets whenever a researcher has an innovative idea, or a new drug requires safety testing and effectiveness [7]. This publicly available data can allow researchers to engender insights into innovative therapies for cancer and other diseases, precision treatments, and drug breakthroughs and repurposing [8].

Future medications may be advanced by relying on predictive analytics to conclude what is most effective for individuals with "similar subtypes and molecular pathways" [3]. Unwanted side effects of big bulk medications that do not meet the needs of most patients may lead to waste and risk if a large body of patients is treated with a medication that only saves a smaller number [3]. Remote health monitors that can contribute personal health data for an individual can lead to personalized care and, eventually, personalized

medications. In 2014, the FDA approved over twenty percent of the new drugs that targeted a specific biomarker predicting treatment effectiveness

2. CONCLUSION

Predictive Analytics (PA) using patient data garnered from remote health monitoring can help in preventive medicine for diseases that can be prevented or ameliorated for at-risk patients by making lifestyle changes to avoid risks, resulting in lowering medical costs [3]. The use of a remote health monitoring system that collects individual patient health data for analytics can predict a unique accessible health pattern for providing actionable data. Future medications may be developed by relying on PA to determine what works for individuals with "similar subtypes and molecular pathways" [3]. Using predictive analytic algorithms hospitals and employers can predict with future medical costs and synchronize databases and actuarial tables to create health models and tailored health plans [3]. Using PA, researchers can develop prediction models using small population studies that determine clinical significance and become more accurate over time [3]. Remote health monitors contributing an individual's personal health data can lead to personalized care and, eventually, personalized medications.

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