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Recovering from a Pandemic? Analysis and Implications of Utilising Predictive Analytics for Improving UK Government Healthcare Financing

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Abstract:

The COVID-19 pandemic has exacerbated existing challenges in the UK healthcare system, including rising healthcare costs, inefficiencies in resource allocation, and the need for additional financing to support pandemic response efforts. This study explores the potential of predictive analytics, specifically machine learning models, to improve healthcare financing in the UK. Using time series data from 1980 to 2021, we employ three machine learning models—Linear Regression, Prophet, and Theta—to forecast healthcare expenditure as a percentage of GDP from 2023 to 2030. The results indicate a positive relationship between health financing and health outcomes, with healthcare expenditure in the UK expected to continue rising. The study highlights the effectiveness of predictive analytics in forecasting future healthcare financing levels and underscores the need for ongoing investment in healthcare infrastructure to ensure improved health outcomes for all citizens. The findings provide valuable insights for policymakers and stakeholders in the healthcare sector, both in the UK and internationally.

1. Introduction:

The global healthcare sector faces significant challenges, including rising costs, inefficiencies in resource allocation, and the need for additional financing to address public health emergencies such as the COVID-19 pandemic. The UK healthcare system, while well-established, has struggled with these issues, particularly in the context of the pandemic, which has placed unprecedented demands on healthcare resources. This study aims to explore the potential of predictive analytics, specifically machine learning models, to improve healthcare financing in the UK by forecasting future healthcare expenditure and identifying trends in resource allocation.The study is motivated by the need to address the growing gap between healthcare demand and available resources, particularly in the wake of the COVID-19 pandemic. By leveraging predictive analytics, policymakers can make more informed decisions about resource allocation, ensuring that healthcare systems are better equipped to respond to future crises. This research contributes to the growing body of literature on the application of predictive analytics in healthcare financing, offering insights into the potential benefits and limitations of these technologies.

2. Literature Review:

The literature review explores the role of predictive analytics in healthcare, focusing on its applications in resource allocation, disease prediction, and healthcare financing. Predictive

analytics, which encompasses machine learning and big data analytics, has been widely used in healthcare to improve patient outcomes, optimise resource allocation, and reduce costs. However, there is a dearth of research on the application of predictive analytics specifically in healthcare financing, particularly in the context of the UK.

The review highlights the potential of predictive analytics to address challenges in healthcare financing, such as inefficiencies in resource allocation and the need for additional funding to support pandemic response efforts. It also discusses the limitations of traditional healthcare financing models and the potential benefits of adopting predictive analytics to improve decision-making and resource allocation.

3. Methodology:

This study employs a quantitative research design, using time series data from 1980 to 2021 to forecast healthcare expenditure as a percentage of GDP in the UK. The data was sourced from the Organization for Economic Co-operation and Development (OECD) indicators database, supplemented by government reports and academic studies. Three machine learning models—Linear Regression, Prophet, and Theta—were used to analyse the data and forecast future healthcare expenditure.

Linear Regression:A statistical modelling technique used to understand the relationship between a dependent variable (healthcare expenditure) and one or more independent variables (time).

Prophet:A time series forecasting model developed by Facebook, designed to handle datasets with strong seasonal effects and features such as holidays and events.

Theta:A two-parameter exponential smoothing method that forecasts future values based on a weighted average of past observations.

The models were used to predict healthcare expenditure as a percentage of GDP from 2023 to 2030, with the results compared to actual values from 2017 to 2021 to assess their accuracy.

4. Results and Discussion:

The results of the analysis indicate a positive relationship between health financing and health outcomes, with healthcare expenditure in the UK expected to continue rising over the next decade. The study found that the percentage of GDP allocated to healthcare in the UK has increased steadily over the past two decades, with a sharp rise in 2020 in response to the COVID-19 pandemic. The machine learning models used in the study—Linear Regression, Prophet, and Theta—were effective in forecasting future healthcare expenditure, with all three models predicting continued growth in healthcare financing.

Linear Regression:Predicted healthcare expenditure as a percentage of GDP to increase from 8.72% in 2018 to 9.08% in 2030.

Prophet:Predicted healthcare expenditure to increase from 10.97% in 2020 to 13.14% in 2030, with some fluctuations due to seasonal effects.

Theta:Predicted a steady increase in healthcare expenditure, with a sharp rise in 2020 in response to the COVID-19 pandemic.

The study also compared UK healthcare expenditure with that of other European countries, finding that the UK ranks seventh in healthcare financing as a percentage of GDP, behind countries such as Switzerland, Germany, and France. The findings suggest that while the UK has maintained a relatively high level of healthcare funding, there is a need for ongoing investment in healthcare infrastructure to ensure that the increased funding is effectively utilised to improve health outcomes.

5. Conclusion and Recommendations:

The study concludes that predictive analytics, particularly machine learning models, can play a crucial role in improving healthcare financing in the UK. By forecasting future healthcare expenditure and identifying trends in resource allocation, predictive analytics can help policymakers make more informed decisions

about resource allocation, ensuring that healthcare systems are better equipped to respond to future crises.The study recommends that policymakers consider adopting predictive analytics as part of their healthcare financing strategies, particularly in the context of public health emergencies such as the COVID-19 pandemic. It also highlights the need for ongoing investment in healthcare infrastructure to ensure that increased funding is effectively utilised to improve health outcomes for all citizens.

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Appendix:

Table 1: Healthcare expenditure as a share of GDP in the UK (1980-2021)

Year	% of GDP
1980	5.10
1985	5.10
1990	5.10
1995	5.60
2000	7.20
2001	7.60
2002	7.90
2003	8.10
2004	8.40
2005	8.40
2006	8.60
2007	8.80
2008	9.10
2009	9.90
2010	10.00
2011	9.90
2012	9.90
2013	9.80
2014	9.80
2015	9.80
2016	9.70
2017	9.60
2018	9.70
2019	9.90
2020	12.00
2021	11.90