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PREDICTIVE ANALYSIS ON MEDICINES & DOCTORS AVAILABILITY IN GOVERNMENT HOSPITALS

[1]Madhu Kumar V, [2]Ravi Shivaji Mahipati, [3]Tarun GS, [4]Shweta Singh

[1]UG Students SCSE, [2]UG Students SCSE, [3]UG Students SCSE, [4]Assistant Professor SCSE
Presidency University, Banglore-560 064

Abstract: Government hospitals are a lifeline to millions of people in India, especially those who rely on public health services. They provide much-needed treatment, free of cost, ensuring that everyone has access to healthcare. However, during critical times such as disease outbreaks, the crisis does overwhelm these hospitals. One aspect consistently seen is the unavailability of key drugs and doctors, which results in long lines, unmet needs, patient needs, and compromised quality of care. This project focuses on harnessing the power of predictive analytics to address these issues, ensuring that hospitals are prepared to meet patient demand effectively and efficiently. Medicine shortages during peak disease periods are a common problem in government hospitals. Patients often find that vital medicines are unavailable when they need them most. These shortages are caused by a variety of factors, such as unexpected increases in demand, poor forecasting, and supply chain delays. For example, during the monsoon season, dengue and malaria cases shoot up, and the demand for certain medicines shoots up exponentially. Without adequate planning, hospitals run out of stock. This project utilizes historical patient data, current disease trends, and regional patterns to predict the varieties and amounts of medicines needed in various hospitals at specified times. Upon creating detailed reports, the system empowers hospital management to stock up on the proper amount of medications in the required amounts at the correct time so as to not experience shortages. Patients receive treatment as needed and do not spend much time to avoid losing their trust in the public healthcare system of similar importance is access to doctors and specialists, particularly during disease outbreaks or in periods of an increased inflow of patients, as on weekends, holidays, or evenings. In most cases, patients get frustrated when they fail to find a specific doctor especially in emergency conditions. For instance, during the COVID-19 pandemic, numerous hospitals were experiencing difficulties in the management of patient inflow to receive critical care. Predictive analytics This can help in solving the problem by analysing historical patient flow data, current disease patterns, and expected trends. The system forecasts the number of doctors required in different departments and generates actionable insights for hospital administrators. This allows better workforce planning, ensuring that hospitals have adequate medical staff to meet patient needs, even during peak periods. Additionally, the system can identify the Specialists to be required by the type of diseases prevalent in a given period and assist the hospital in efficiently utilising their resources. The Indian Government's health care system would be supported in this scheme to utilize analytics in enhancing the efficiency of its operations. Using analytics, the programme aims at getting rid of the inefficiencies that are leading to wastage of resources and also reducing them. Ensure hospitals are better prepared to care for their patients. The system gives actionable intelligence to help administrators make the right decisions, anticipate future problems, and plan ahead to make resource allocations in advance. It not only makes the day-to-day running of hospitals better but also enhances the overall health care infrastructure, which can withstand crises and recover more effectively.

Index Terms **- Predictive Analytics, Medicine Shortages, Doctor Availability, Government Hospitals, Healthcare Resource Management, Operational Efficiency**

INTRODUCTION

Government hospitals are the main pillars of India's healthcare service. They are a source of vital medical facilities for millions who cannot afford to access private care. These institutes serve as beacons for the majority, yet they face serious problems, mainly when the seasons of diseases arrive. Shortage of medicines and doctors at such moments results in prolonged treatments, further infuriating and weakening the patient. Against this backdrop, this study develops a predictive analytics system that will enable hospitals to better predict resource demands and hence plan ahead. The system will use data to offer strategic planning with respect to manageable care time so that stress on health providers is reduced and efficiency in management improves.

1.1 Why Predictive Analytics is Essential for Government Hospitals

Government hospitals have to work with very tight constraints—limited budgets, unpredictable patient inflows, and sudden outbreaks of diseases. All these conditions make it tough to plan resources well. Predictive analytics can now turn the tide by allowing the hospitals to proactively prepare for surges in demand, thereby making healthcare more responsive and efficient.**1.1.1 1.1.1Tackling Medicine Shortages**

You visit a hospital during a dengue outbreak, only to find out that necessary medicines such as platelet concentrates are unavailable. It is not merely an inconvenience; a shortage of medicine might be life threatening for patients. Medicine shortages during disease peaks commonly occur in government hospitals. Predictive analytics does this by taking into account the patient history, seasonal patterns, and real-time data to predict what medicines will be required, in what quantity, and in which location. In monsoon, when water-borne diseases like cholera and typhoid show a sharp surge, the system can predict more demand for antibiotics and rehydration solutions. Hospitals are thus well-stocked with the medicines in time, thus averting the stress of shortages. By ensuring that the right medicines are available at the right time, the system not only improves patient outcomes but also builds trust in public healthcare. It also reduces wastage by avoiding overstocking of less-needed medicines, striking a balance between availability and cost efficiency.

1.1.2 Ensuring Doctor Availability

Another common grievance by patients is that doctors are not available when needed most: on weekends, holidays, or during the evening. Patients with an emergency are left to wait for hours or are not seen by a specialist. This problem is worse when the hospital receives more patients, like in flu season or an outbreak of any disease. The predictive analytics system solves this problem by studying past and current data to understand patient inflow patterns. For example, if a hospital finds that there is an increase in respiratory issues during winter evenings, the system can recommend scheduling additional pulmonologists during those hours. Similarly, for rural hospitals that face a rush on weekends, the system can advise deploying more general physicians or specialists to handle the spike. This proactive approach ensures timely care for patients and prevents burnout among doctors. It balances the workload of health care providers through the alignment of staffing levels with patient needs, which leads to quality care and happy patients.

1.2 Who Benefits from This System and What It Aims to Achieve

1.2.1 Targeting the Right Stakeholders

This is a predictive analytics system designed for the Indian Government healthcare department that manages public hospitals all over the country. By introducing this system, the department can finally be able to handle the long-existing issues in the management of resources and healthcare service delivery. It will also prove very useful to the hospital administrators. It equips them with actionable insights in planning resources, anticipating demand, and responding better to patient needs. Patients benefit directly from it too. With better medicines available and quicker access to doctors, their experiences at public hospitals will improve.

1.2.2 Driving Key Improvements

This is an initiative aimed at bringing a significant change in the way government hospitals function. Them significantly. It is not only about managing resources but making it a healthcare system that is efficient, reliable, and patient-centric. Improvement includes: Eradication of Medicine Shortages: The threat of life-saving drugs being out of stock at critical times has been taken away from patients' lives. Optimizing Staffing: The hospital can ensure the right number of doctors available when and where they are most needed. Improving Operational Efficiency: With data-driven planning, the hospital can make the most of its resources, minimize waste, and thus improve.

1.3 The System's Scope and Real-World Applications

1.3.1 Predicting Medicine Needs

The heart of the system lies in its ability to predict medicine demand. With a history of years of patient data, which it uses to identify trends, the system is able to predict what medicines are needed, how much should be stocked, and where to deliver them. During a malaria outbreak, for instance, the system might predict the surge in antimalarial drugs and mosquito repellents in a particular region. Stocking these items beforehand in these hospitals will mean that patients in such areas would not be made to wait, thus the need for the same. This makes this system effective due to the ability to adopt changes. Local changes in trends will mean preparation is done in rural areas while different in an urban center hence ensuring that use is done where they are needed to help the patients across the geographic area.

1.3.2 Managing Doctor Staffing

The system also addresses the critical issue of doctor availability. It ensures that hospitals are never caught off guard by forecasting staffing needs based on patient volumes and disease patterns. For example, if flu cases are expected to rise in the coming weeks, the system can recommend patient satisfaction. increasing the number of general physicians and respiratory specialists on duty. It could also indicate rescheduling to avoid peak holiday season rushes in the emergency room, which is typical during holidays. This preparedness minimizes wait times, increases the quality of care, and ensures that no patient is ever left unattended. Doctors benefit from better planned schedules, hence less stress and more job satisfaction.

NEED OF THE STUDY.

The government hospitals in India are providing healthcare services to millions of citizens who cannot afford private healthcare. Still, the same institutions often face challenges when trying to ensure that medicines and doctors are available at peak disease periods. During outbreaks or seasonal surges, shortages of essential medicines such as antibiotics, antivirals, and other life-saving drugs are commonplace. Such shortages can delay treatment and worsen patient outcomes. Further, the availability of doctors and specialists often falls short during high-demand periods, such as weekends, holidays, or evenings, leaving patients without timely medical attention. These problems are further worsened by the lack of a proactive, data-driven system for resource planning, leading to inefficiencies in healthcare delivery. This study addresses the need to integrate predictive analytics into government hospitals to improve resource management. Predictive analytics can utilize historical and real-time data on patient inflow, disease trends, and resource utilization. With medicine demand forecasting, hospitals can ensure that the stock levels are optimal and avoid shortages.

Similarly, the system can analyze patient inflow patterns to predict the number of doctors and specialists required, ensuring sufficient staffing during peak times. The study also points out the need to align resources with specific disease trends so that rural and urban hospitals can prepare accordingly. This will minimize wastage, enhance operational efficiency, and improve patient satisfaction. By addressing these critical challenges, the study aims to modernize resource planning in government hospitals, ensuring timely and effective healthcare for all.

3.1Population and Sample

The population for this study will be government hospitals spread all over India, which form the backbone of the overall health care provided to millions of patients every year. It poses a lot of backbreaking tasks to manage the availability of medicines and doctors during peak seasons of diseases. The sample of the study reflects the diversified pool of hospitals with urban and rural characteristics. Different types of hospitals were included that could present diversified healthcare demands and operational scenarios.

The criteria included geographical diversity, patient inflow patterns, and historical data availability while choosing hospitals. Facilities located in regions prone to seasonal or recurrent disease outbreaks, such as dengue, malaria, or influenza, were targeted to assess the effectiveness of the predictive system during peak demand periods. The sample includes a mix of district hospitals, tertiary care centers, and rural health facilities, providing comprehensive insights into the challenges and potential solutions for resource management. This approach allows the findings to apply across the very broad spectrum of government health care institutions in India.

3.2 Data and Sources of Data

Primary and secondary sources of data have been used in this study. Primary data were collected from government hospitals based on historical patient records, disease patterns, and the availability of medicines and doctors. Data pertaining to inflow of patients, specific ailments, peak periods of diseases, and resource requirements have been collected from hospital administration records. Such data helped understand the trends and predict the requirement for medicines and manpower during peak periods.

Secondary data was obtained from government health department reports, healthcare analytics platforms, and public health studies. These sources gave further insight into the disease outbreak patterns, seasonal variations in patient flow, and historical data on resource shortages. The period considered for the data collection covered the last five years, thus ensuring that the data collected had various cycles of diseases and peak periods across different regions. It then processed and analyzed the data into developing predictive models for medicine availability and doctor staffing.

The analysis will be made more comprehensive by the combination of primary and secondary data, so a robust system of predictive analytics can be effectively implemented across all government hospitals.

3.3 Theoretical framework

The theoretical framework of this study is based on the integration of predictive analytics with healthcare management to improve the operational efficiency of government hospitals. The main aim is to develop a system that forecasts the availability of medicines and doctors based on historical data, disease patterns, and patient inflow. This system aims to address common challenges such as medicine shortages and insufficient doctor availability during peak disease periods, thereby ensuring timely and effective healthcare delivery.

The research is based on the fundamental theories of healthcare operations management, which include the theories of resource optimization, demand forecasting, and supply chain management. The framework includes predictive modeling techniques, including time-series analysis and machine learning algorithms, to forecast demand for medicines and the required doctors' staff. Applying these theories, the study aims to create a model that predicts future resource requirements and enhances decision-making processes within hospitals.

The framework further emphasizes the role of data-driven decision-making in improving hospital resource management. By leveraging historical patient data, disease trends, and real-time analytics, the system can generate actionable insights that help hospital administrators plan ahead, optimize resources, and reduce inefficiencies. Ultimately, this approach contributes to a more responsive and adaptable healthcare system, ensuring that hospitals are better equipped to handle varying patient loads and disease outbreaks.

RESEARCH METHODOLOGY

The methodology section outline the plan and method that how the study is conducted. This includes Universe of the study, sample of the study,Data and Sources of Data, study's variables and analytical framework. The detailsare as follows;

3.1Population and Sample

The population for this study includes the government hospitals across India as part of the public health care system, where a large number of patients are being served with free or at lower costs, especially in the rural and other underprivileged areas. The study focuses on urban as well as rural, as there could be a variety of operational challenges in managing medicines and doctors during peak seasons of diseases.

The sample for this study will be drawn from a selection of government hospitals in different regions of India, ensuring a representative mix of urban and rural hospitals. The sample size will include hospitals that have varying capacities in terms of the number of beds, the range of services offered, and the resources available for patient care. These hospitals will be selected on the basis of factors such as patient inflow during peak seasons, historical data on medicine and doctor availability, and their willingness to participate in the study. The selected hospitals will provide necessary data on past patient flows, disease outbreaks, medicine usage patterns, and doctor availability, which will be important for building the predictive analytics model.

A considerable number of samples will be taken so that statistically significant results can be ensured along with a grasp of the practical constraints of data collection and hospital participation. The hospitals taken in the sample will provide different kinds of operational environments to the study, thereby giving generalized insights in light of applicability toward various kinds of government hospitals in India.

3.2 Data and Sources of Data

Primary data along with some secondary data will be used to develop the forecasting model for medicine and doctor availability in government hospitals.

Primary Data: This will be collected through direct interviews and surveys with hospital managers, doctors, medical staff, and other professionals. These interviews will provide insight into the operational challenges encountered by the hospitals, including problems related to medicine shortages and doctor availability during peak disease seasons. In addition, patient records and hospital logs regarding patient inflow, disease patterns, and treatment data will be accessed to understand the demand for specific medicines and doctor specialties. These data will help in building a comprehensive understanding of the hospital's resource needs during critical periods.

Secondary Data: This shall comprise historical data of patients and disease trends readily available from the hospital databases, public health reports, and government health agencies. Data shall be in the form of multiple years' hospital records and patient admissions, disease incidence rates, medicine consumption patterns, and doctor availability during peak periods. Reports from the government health departments and research publications that provide information on disease outbreaks, hospital resource utilization, and past challenges facing government hospitals will also be incorporated as secondary data.

Additionally, publicly available data sources such as the Ministry of Health and Family Welfare (MoHFW) of India, the National Health Mission (NHM), and the World Health Organization (WHO) will provide valuable external data to understand the broader healthcare trends in the country.

The data thus collected will be cleaned, processed, and analyzed using advanced data analytics tools for actionable insights about predicting medicine and doctor requirements in government hospitals, so better preparedness and resource management during peak disease periods can be ensured.

3.3 Theoretical framework

The theoretical framework in this study rests on the principles of Predictive Analytics and Operational Efficiency in healthcare systems, focusing attention on the demand-supply model of medical resources of medicines and doctors for government hospitals. The framework takes into account combining historical data and real-time data with machine learning algorithms to help predict hospital requirements for resources during the course, ensuring optimal resource utilization and potential shortages.

Major theories and models used in this study include:

SCM Theory: The SCM theory can be related to the administration of medicines and doctors within a hospital environment. It holds that proper forecasting and strategic planning prevent medicine shortages and waste, particularly at peak disease seasons. Predictive analytics helps maximize the medicine supply chain by finding the quantities required at a certain time.

Queuing Theory: In the context of healthcare, this theory helps understand patient inflow and the availability of medical staff. It applies mathematical models to analyze waiting times and service efficiency, helping predict the necessary number of doctors required during peak periods, ensuring timely patient care.

Machine Learning Models: The models, particularly supervised learning and time series forecasting, are used to process large datasets of patient inflow, disease patterns, and resource utilization. The model will learn continuously from historical data and adapt to changing disease trends, thus allowing for more accurate predictions for medicine and doctor requirements.

Resource Allocation Theory: This theory is concerned with the efficient allocation of limited resources (medicines, doctors, etc.) to meet demand. It supports the idea that by understanding the specific needs based on predictive analysis, hospitals can allocate resources more effectively, avoiding both shortages and waste.

Decision Theory: This deals with decision making in uncertain settings. In the current research, predictive analytics supports the hospital manager in making an informed decision as to the medicines and staffs to be prepared, based on the expected diseases and patient flow.

By combining these theories, the study seeks to create a data-driven, predictive framework that enhances the operational efficiency of government hospitals, ensuring that the right medicines and doctors are available at the right time, ultimately improving patient care and hospital resource management.

3.4 Software specifications

a) FRONT-END PART:

- CSS(Cascading Style Sheets)
- JSX(JavaScript XML)

b) BACK-END PART:

- JAVA SCRIPT
- PYTHON
- PKL

c) DATABASE:

- Supabase

3.5 Outcomes

a) Improved Medicine Availability: Through the predictive analytics of the system, the demand for medicines is precisely predicted using historical patient data and trends of the disease. Thus, the system allows hospitals to have the right quantity of medicines available during peak times, like flu season or disease outbreaks. By doing this, the system ensures that patients get their necessary treatments while avoiding shortages in medicines, hence enhancing overall care.

b) Optimized Doctor Scheduling: It provides predictions on inflow data of the patients to the overall system, determines the specific number of doctors needed for departments or specializations, and evaluates predictions to help hospitals schedule the doctors efficiently, meeting demands during particular periods such as weekends, holidays, or possibly when certain diseases appear. This avoids patients' instances where they could not find a required doctor, thus reducing patient dissatisfaction and improving healthcare delivery.

c) Enhanced Operational Efficiency: Predictive analytics help in optimizing resources for the hospitals. Rather than waiting for medicine and doctor needs to arise, administrators plan ahead using data-driven predictions. This ends up creating streamlined health care delivery in hospitals with less bottlenecks and downtime from shortages in personnel or resources. Workflow becomes more efficient, and it ends up creating hospitals where quicker and better service happens to the patients.

d) Better Patient Experience: By giving the correct and timely information regarding doctors' availability to patients, proper appointments can be scheduled with the right specialists. Repeated instances of finding no available time or no specialist will be significantly less if the schedules of doctors are optimized and availability is predicted. Results in a better experience as patients can plan their visits with greater certainty, which improves their total satisfaction level with the healthcare system.

e) Efficient Resource Management: The predictive model predicts which drugs are likely to be in demand based on present disease trends and historical data. It also predicts patient inflow and staffing needs based on the seasonality of diseases and other outbreaks. In this way, hospitals can efficiently allocate resources; the right number of medicines, as well as the right doctors, will be available where and when they are needed, thus achieving more efficient utilization of hospital resources, waste minimization, and proper resource allocation.

f) Data-Driven Decision Making: Data-driven insights from hospital administrators and healthcare planners in terms of staff, medication stocks, and care planning for the patients can ensure informed decisions on these aspects. Historical and real-time data allow them to identify when and where resources will be needed the most, which would help them adapt their strategies appropriately. This makes less use of guesswork because decisions are founded on concrete evidence and trends, not assumptions.

g) Role-Based Access Control: The system ensures user access is controlled strictly based on their role in the hospital. For instance, an administrative role within the hospital gives a staff member access to data about resources and scheduling, but doctors can only have access to information related to patients. This ensures that certain data are safeguarded, ensuring only authorized people view or make modifications to information. This has helped improve patient record and hospital data security.

h) Real-Time Updates: It has ensured that updates with respect to medicines availability and doctor are done in real time. These will be possible because it sends signals whenever medicines are about to run low and whenever the services of a particular doctor are going to be out-of-reach on account of emergencies or because of unforeseen absence. Thereby, prompt adjustments could always be done regarding these, with the ultimate results that hospitals shall adapt quickly on changing conditions as well as proceed to administer healthcare services more effectively.

i) Scalable System: It's designed to scale across multiple hospitals, regions, or departments. As the hospital grows or new hospitals are added to the network, the system can easily integrate into their already existing infrastructure. Such scalability enables a predictive analytics system to be used on a greater scale and be applied in every healthcare system in order to benefit the whole and ensure that all locations operate consistently with regard to operational efficiency.

j) Cost Reduction: Predictive analytics helps hospitals save unnecessary costs through optimization of staffing and inventory management. It allows them to forecast the right number of doctors required and predict which medicines will be in demand so that they can avoid overstaffing or overstocking, which often results in wastage of funds. The system also reduces the cost of emergency procurement by preventing shortages and making the necessary resources available at the right time. This cost efficiency is particularly crucial to government hospitals since they need to manage tight budgets while providing quality healthcare.

RESULTS AND DISCUSSION

1. Improved Resource Allocation in Hospitals

It makes resource allocation easy for government hospitals by using predictive analytics for medicines and doctors' availability. This system can predict which medicines would be in high demand during outbreaks of diseases. Thus, it ensures that the hospital is sufficiently stocked with that medicine. Besides, it uses historical patient data to predict requirements for doctors to make staffing more efficient. This proactive approach helps to minimize shortages, reduces waiting times, and ensures timely treatment, thus enhancing operational efficiency and patient satisfaction. The hospitals will optimize their use of doctors and medicines by preparing in advance for these predicted surges.

2. Reduction in Medicine Shortages

It makes resource allocation easy for government hospitals by using predictive analytics for medicines and doctors' availability. This system can predict which medicines would be in high demand during outbreaks of diseases. Thus, it ensures that the hospital is sufficiently stocked with that medicine. Besides, it uses historical patient data to predict requirements for doctors to make staffing more efficient. This proactive approach helps to minimize shortages, reduces waiting times, and ensures timely treatment, thus enhancing operational efficiency and patient satisfaction. The hospitals will optimize their use of doctors and medicines by preparing in advance for these predicted surges.

3. Enhanced Doctor Availability and Management

Predictive analytics also plays a critical role in ensuring adequate doctor availability. The system can predict high demand for specific types of doctors, such as specialists or general physicians, during peak periods. For example, if the flu season or a dengue outbreak is expected, the system can forecast the need for more respiratory or pediatric specialists, adjusting staff schedules accordingly. This helps prevent frustration for patients who come in expecting to see a doctor, only to find long wait times or unavailability. The ability to better match staffing levels with patient needs reduces burnout for healthcare professionals and improves care quality.

4. Operational Efficiency and Cost Savings

Predictive analytics improves operational efficiency by enabling hospitals to make data-driven decisions. It helps the hospitals predict the demand for both doctors and medicines, thus allowing them to optimize their inventory and staff schedules to avoid waste and overstaffing. Hospitals can use their budgets better by ensuring that they only buy what is needed and hire the right number of staff for each day. It can, therefore, go a long way in saving significant costs, particularly when resources are limited, such as in government healthcare. Such cost savings can then be invested back into other vital sectors of the hospital.

5. Patient Experience and Satisfaction

The integration of predictive analytics has a direct positive impact on patient experience. The timely availability of medicines and reduction in wait times for doctors are the primary factors that can significantly improve the quality of care provided to patients. Predictive models that predict the inflow of patients during weekends, holidays, and evenings help hospitals prepare better for high-demand periods. This reduces patient frustration caused by long wait times or unavailability of medical professionals. A more responsive healthcare system enhances patient trust in government hospitals, leading to higher patient satisfaction and improved healthcare outcomes.

CONCLUSION

The "Predictive Analysis on Medicines & Doctors Availability in Government Hospitals" system is meant to address major challenges that the Indian government hospitals face, especially at the peak time of diseases. Predictive analytics help the hospitals to predict the requirement of medicines and the number of doctors required according to the data of patients in the past and the present. It will ensure the efficient utilization of resources in a proactive manner. Management, reducing shortages of medicines and ensuring the right number of doctors are available to handle patient inflow, especially during weekends, holidays, and evenings when shortages are most likely to occur. The system's ability to predict medicine availability is a key benefit, as it ensures that essential medicines are stocked in advance, based on disease trends and patient needs. This predictive This capability minimizes the chances of medicine shortages and ensures timely treatment for patients, improving overall care delivery. Similarly, the prediction of doctor availability helps hospitals optimize doctor schedules to meet demand, reducing wait times and ensuring patients have access to the necessary specialists when required. Operational efficiency is significantly enhanced by this system, as hospitals can make data driven decisions regarding resource allocation, staffing, and medicine procurement. This Operational bottlenecks and waste are reduced as a consequence and ultimately saves healthcare system costs. The system provides data security

due to role-based access, whereby sensitive information will only be seen by authorized personnel. The system is scalable as well, therefore it can cater to several hospitals or regions and is an advantage for the big implementation in the whole of India. Consequently, this solution ensures that not only It improves the care and satisfaction of patients while ensuring better management of hospital resources that leads to cost-effective healthcare operations. The potential of the system is to significantly improve the functioning of government hospitals, which in turn will benefit patients as well as healthcare providers.

OUTPUT

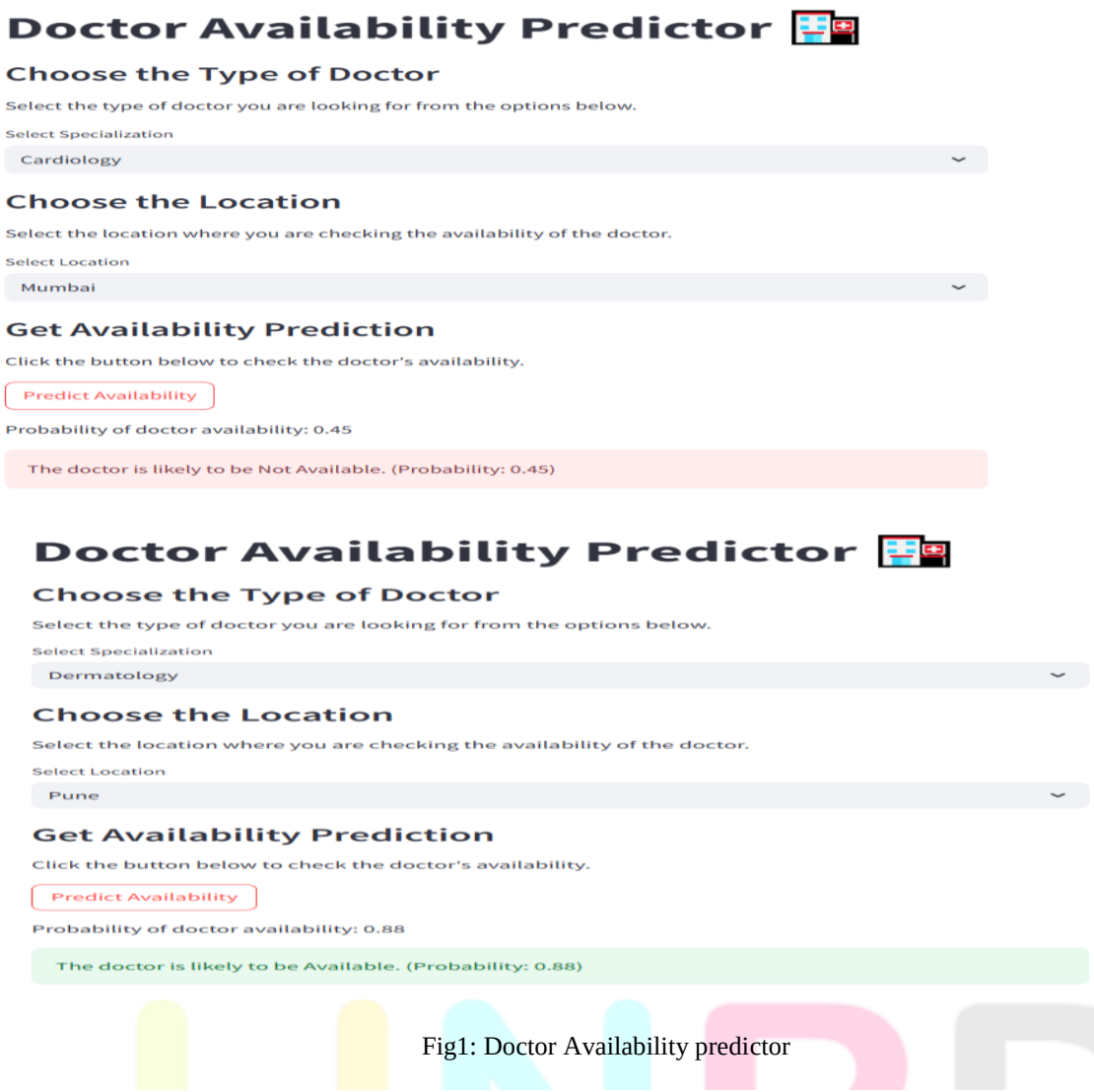
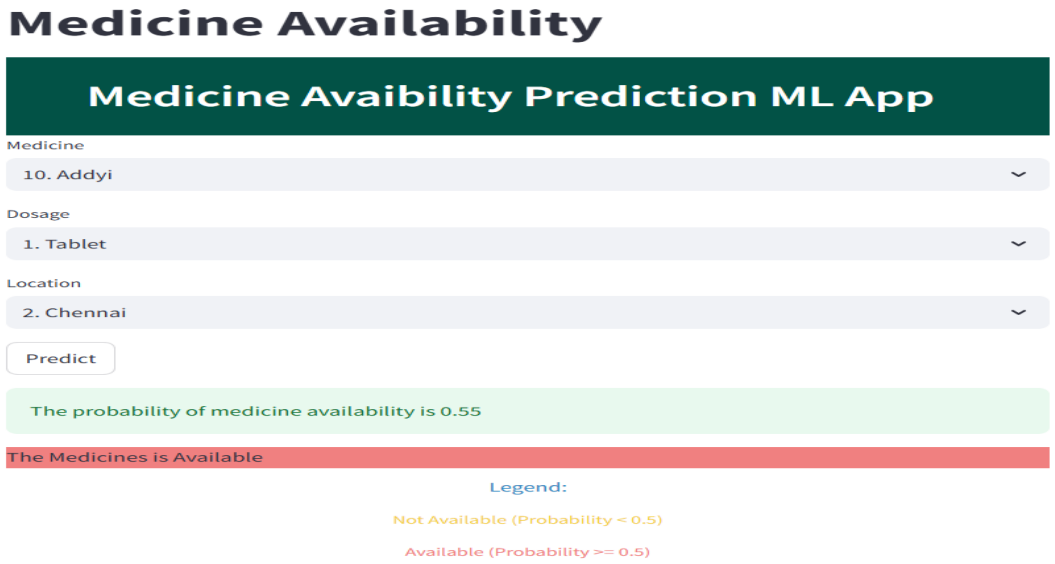


Fig1: Doctor Availability predictor



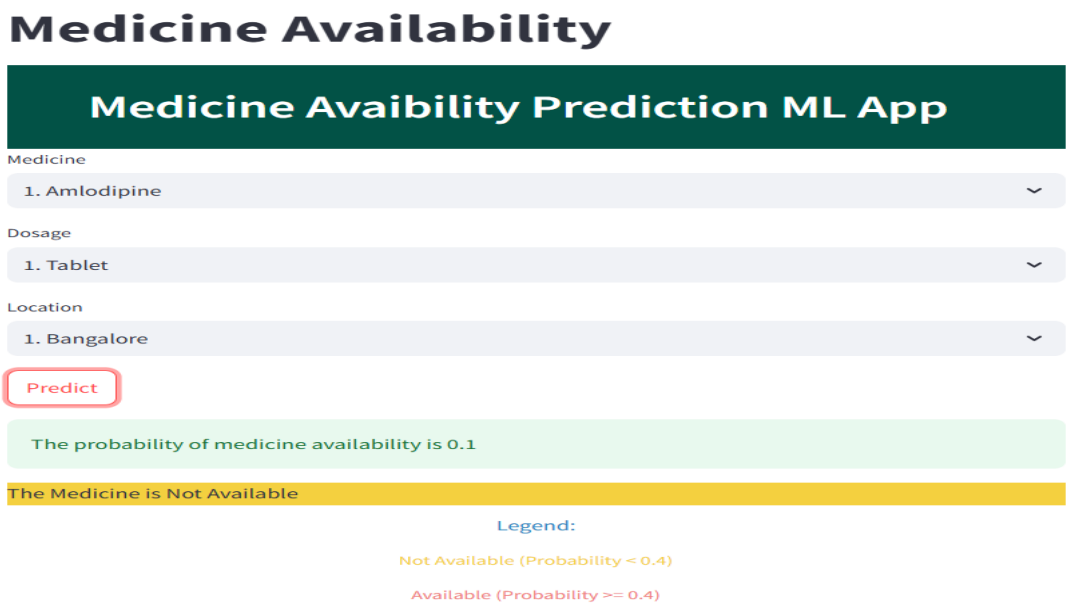


Fig2: Medicine Availability predictor

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