PROJECT REPORT ON

ANALYTICS FOR HOSPITAL'S HEALTH CARE DATA

DATA ANALYTICS

PROJECT ID : PNT2022TMID21499

Submitted By,

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1. ABSTARCT

The purpose of Analytics for Hospital Healthcare data is to provide the information to patients about the average length of hospital stays. Patient duration of stay is one crucial statistic to monitor and forecast if one wishes to increase the effectiveness of healthcare management in a hospital. Data science has several applications in the field of healthcare management. At the time of admission, this metric aids hospitals in identifying patients who are at high LOS-risk (patients who will stay longer). Once identified, patients at high risk for LOS can have their treatment plans improved to reduce LOS and reduce the risk of infection in staff or visitors. Additionally, prior awareness of LOS might help with planning logistics like room and bed allotment.

Keywords :

LOS - Length of Stay
Data Analytics
Severity of illness
Bed Allotment

2. INTRODUCTION

The Analytics for Hospital Health care data is to make the patients to know about the length of stay in the hospital.The healthcare management has various use cases for using data science, patient length of stay is one critical parameter to observe and predict if one wants to improve the efficiency of the healthcare management in a hospital. This parameter helps hospitals to identify patients of high LOS-risk (patients who will stay longer) at the time of admission. Once identified, patients with high LOS risk can have their treatment plan optimized to minimize LOS and lower the chance of staff/visitor infection. Also, prior knowledge of LOS can aid in logistics such as room and bed allocation planning. To accurately predict the Length of Stay for each patient on a case by case basis so that the Hospitals can use this information for optimal resource allocation and better functioning. The length of stay is divided into 11 different classes ranging from 0-10 days to more than 100 days.By predicting LOS we can plan the required beds, checking the future availability of beds in hospitals, monitoring length of stay of patients.If we can predict the length of stay the hospital management can prepare the requirements for the patient. The patients can easily get the things and clothes required for the stay The hospital management can increase the beds available with the data.

3. LITERATURE SURVEY

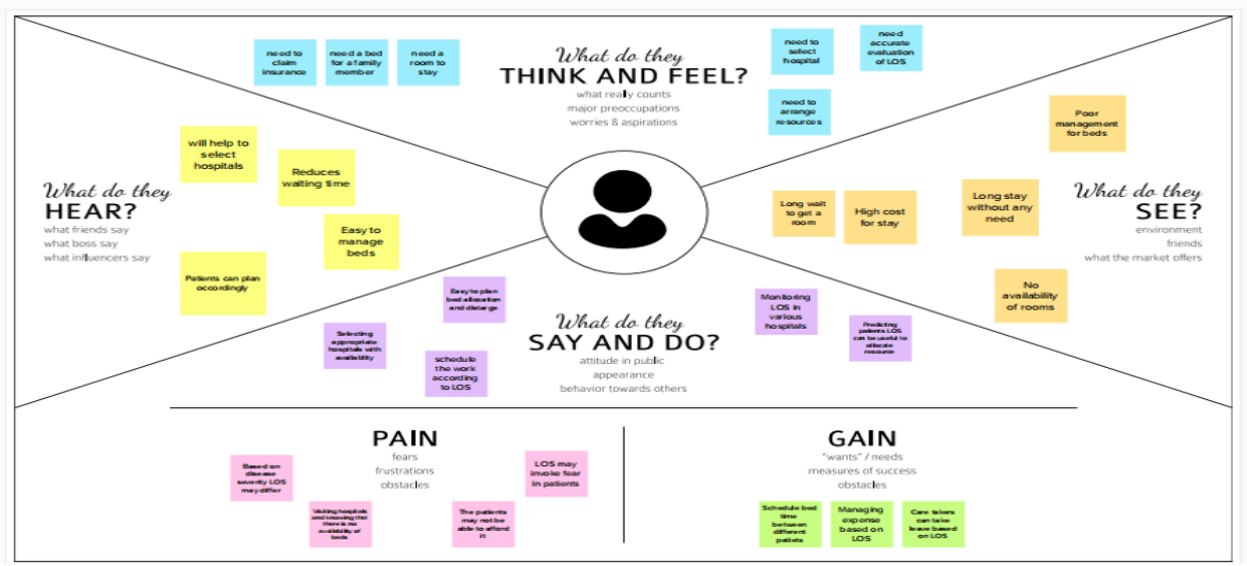
3.1 Research Paper:

Journal	IEEE
Title	Data analytics in healthcare: promise and potential
Authors	Wullianallur Raghupathi And Viju Raghupathi
Volume/ Issue Year	Volume: 8, Issue: 1, January 2021
Description	The nascent field of big data analytics in healthcare, discusses the benefits, outlines an architectural framework and methodology, describes examples reported in the literature, briefly discusses the challenges, and offers conclusions.

Journal	IEEE
Title	Big data analytics in healthcare
Authors	Ashwin Belle, Raghuram Thiagarajan, Fatemeh Navidi and Kayvan Najarian
Volume/ Issue Year	Volume: 8, Issue: 1, Apr 2020
Description	The rapidly expanding field of big data analytics has started to play a pivotal role in the evolution of healthcare practices and research. It has provided tools to accumulate, manage, analyze, and assimilate large volumes of disparate, structured, and unstructured data produced by current healthcare systems. Big data analytics has been recently applied towards aiding the process of care delivery and disease exploration volumes of disparate, structured, and unstructured data produced by current healthcare systems. Big data analytics has been recently applied towards aiding the process of care delivery and disease exploration

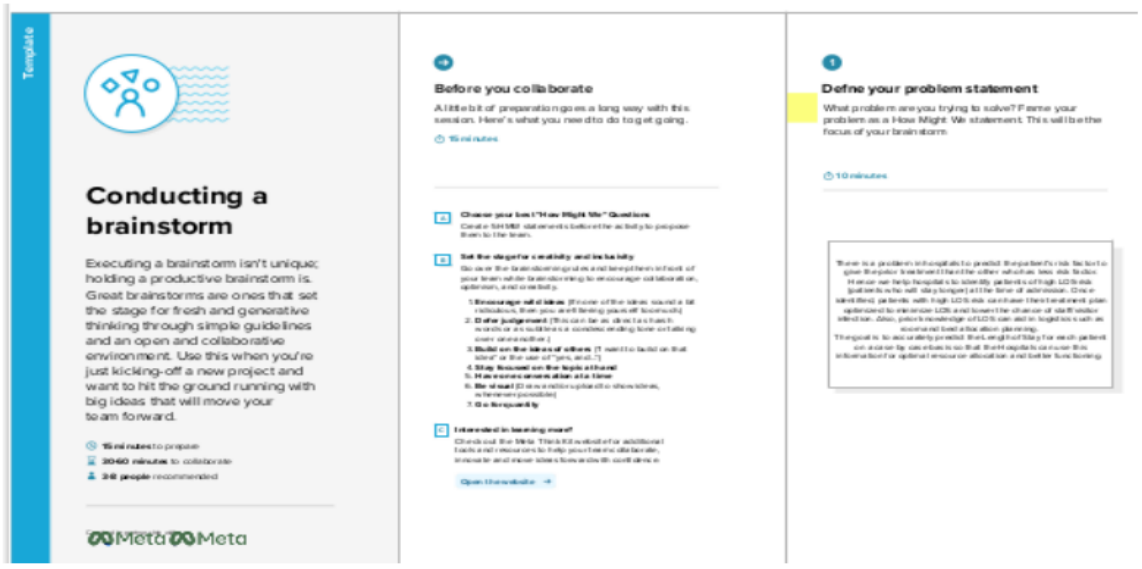
4. IDEATION AND PROPOSED SOLUTION

4.1 Empathy Map



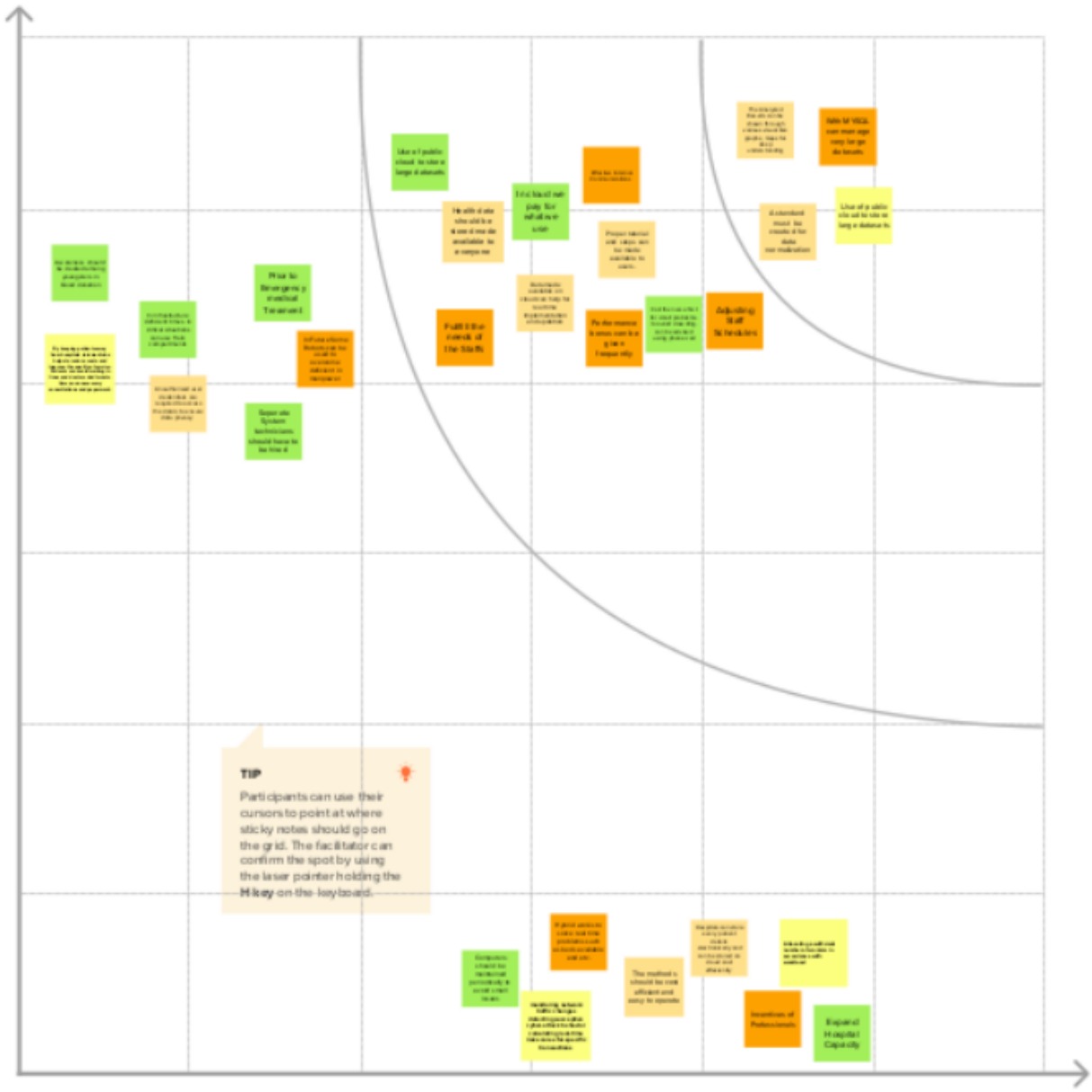
4.2 Brainstorming & Idea Prioritization

Step-1: Team Gathering, Colloboration and Problem statement Selection



Step-2: Brainstorming

Step-3: Idea Prioritization



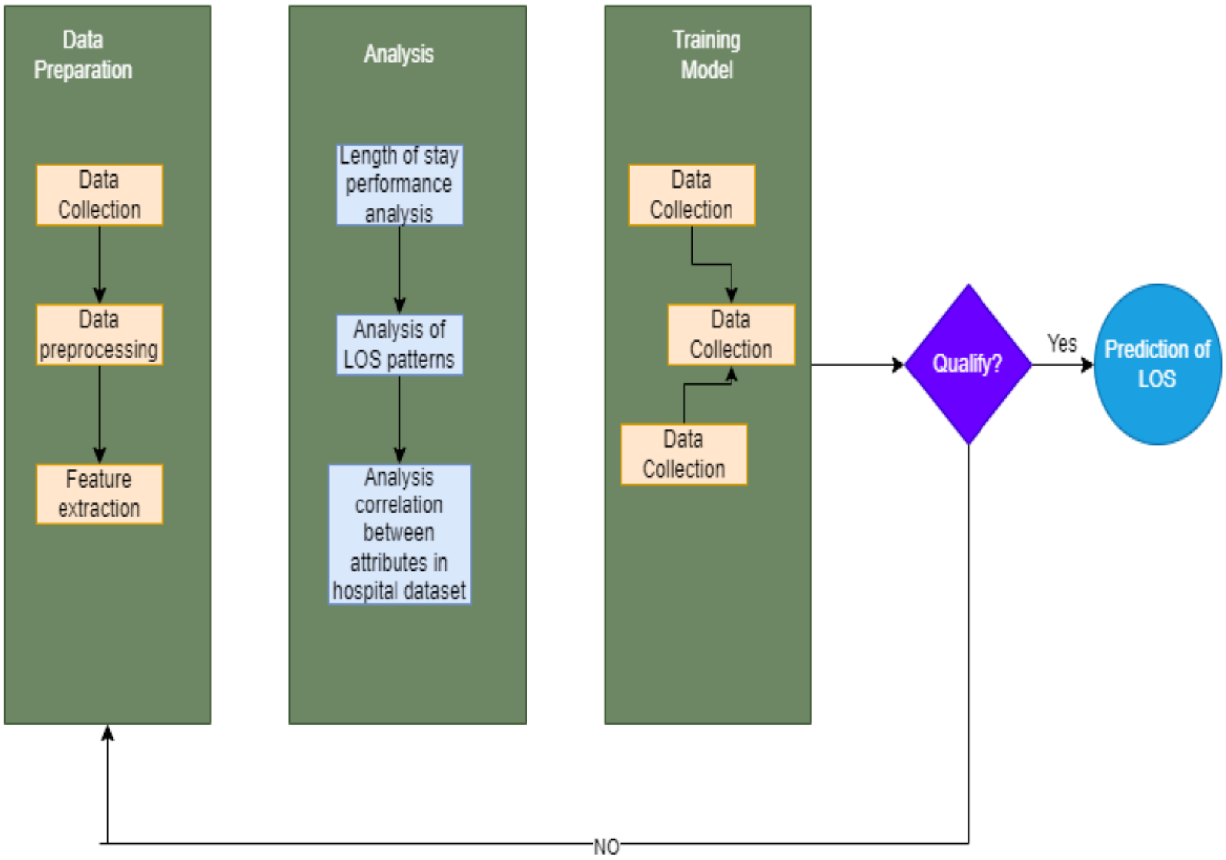
Step-4: Requirements

4.3 Proposed Solution

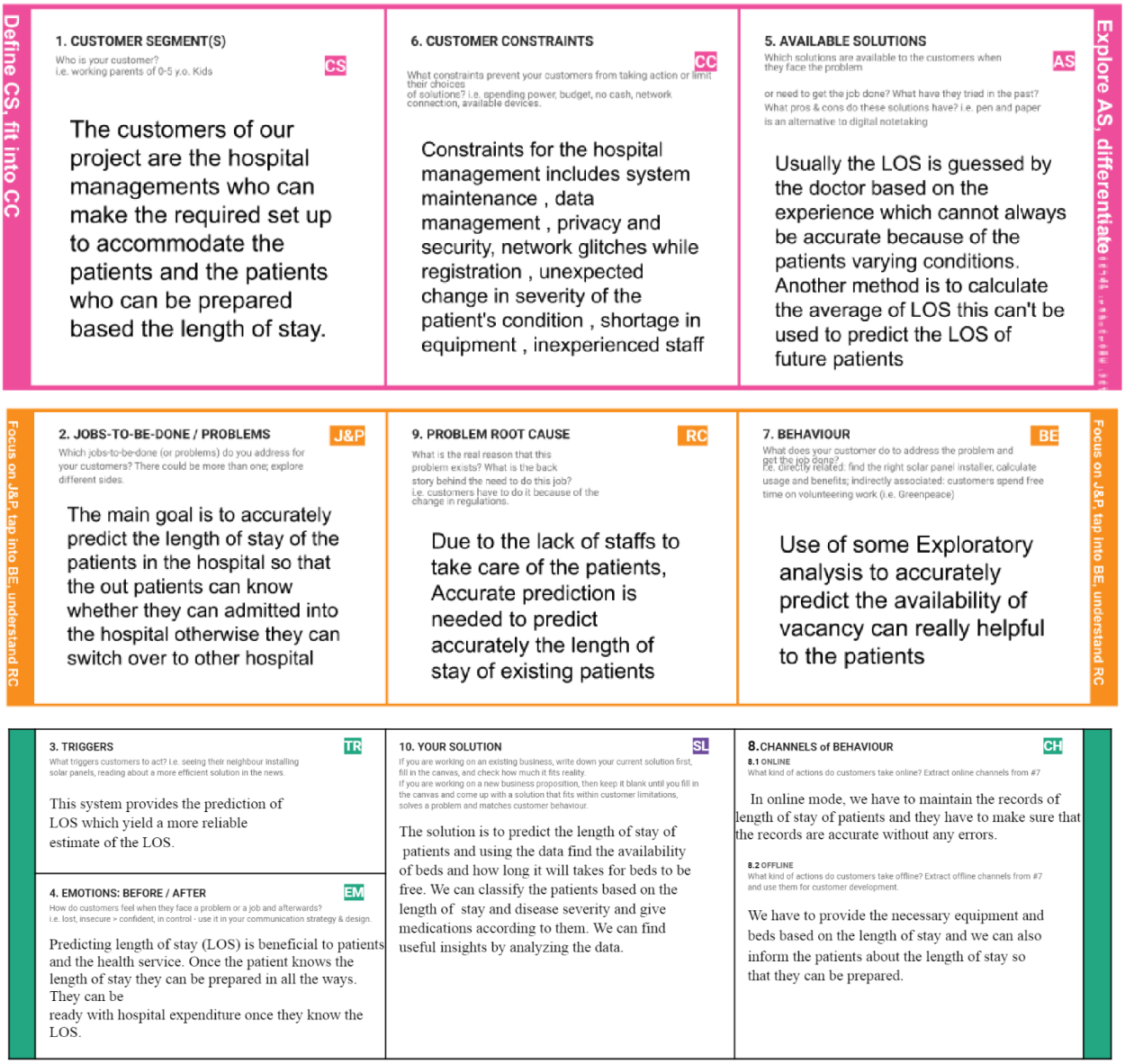
S.No	Parameter	Description
1.	Problem Statement	There is a problem in hospitals to predict the patient's risk factor to give the prior treatment than the other who has less risk factor. Hence we help hospitals to identify patients of high LOS-risk (patients who will stay longer) at the time of admission. Once identified, patients with high LOS risk can have their treatment plan optimized to minimize LOS and lower the chance of staff/visitor infection. Also, prior knowledge of LOS can aid in logistics such as room and bed allocation planning. The goal is to accurately predict the Length of Stay for each patient on a case by case basis so that the Hospitals can use this information for optimal resource allocation and better functioning.
2.	Idea / Solution description	We are able to predict the length of stay of patients with data from the movement they entered the hospital and are diagnosed with an accuracy of ~70%. Such a model has the ability to profoundly improve hospital management and patient well-being. Also we can predict the LOS with big data analytic tools within a Python interface such as Spark, AWS clusters, SQL query optimization, and dimensionality reduction techniques

3.	Novelty / Uniqueness	Length of stay in the hospital differs based upon the critical in their health situation it can range between 2 to 3 days or even upto 10- 20 days so based on the exploratory analysis of various patients we can accurately predict the length of stay of patients and can allocate optimum resource allocation
4.	Social Impact / Customer satisfaction	With Exploratory analysis using different methods to predict the length of stay creates a way to out patients to know the vacancy of beds in the hospitals and also paved a way in their critical times to secure their better life
5.	Business Model	Using this model The usage of length of stay of patients in the hospitals has increased among the people and it is free of cost to get the details about the vacancy. It doesn't affect the revenue model. .
6.	Scalability of the Solution	It is a easily scalable method using dataset of previous patients we can able to predict the LOS ● Increased productivity among the users ● Decreased stress level ● Possibility of getting the detailed list of vacancy

4.4 Solution Architecture



4.5 Solution Fit



5. REQUIREMENT ANALYSIS

5.1 Functional Requirement

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Analysing and Visualizing Hospital health care data	Visualizing Analysis result on application dashboard. Analyze the relationship between various attributes in the dataset and Length of stay. Interactive dashboard that users can easily understand the insights.
FR-2	Prediction of LOS	Predict the Length of Stay using the user's hospital data like Severity of disease, hospital type, hospital location, hospital name, emergency or not , etc. System should predict the LOS with any number of given attributes.
FR-3	Obtaining User Response for prediction	Get the user's response after the prediction. This helps us to find how accurate our prediction is from the user's point of view. Bad user experience can be noted by doing this, So that we can improve the prediction accuracy.
FR-4	Monitoring user response and satisfaction	Real Time monitoring of user response. Monitoring user satisfaction through various visualizations like barchart, pie chart etc.
FR-5	Monitoring System accuracy	The accuracy of the prediction should be monitored every time there is a change in dataset. If the accuracy becomes low the model should be redesigned for higher accuracy. This way the predictions will be up to date.

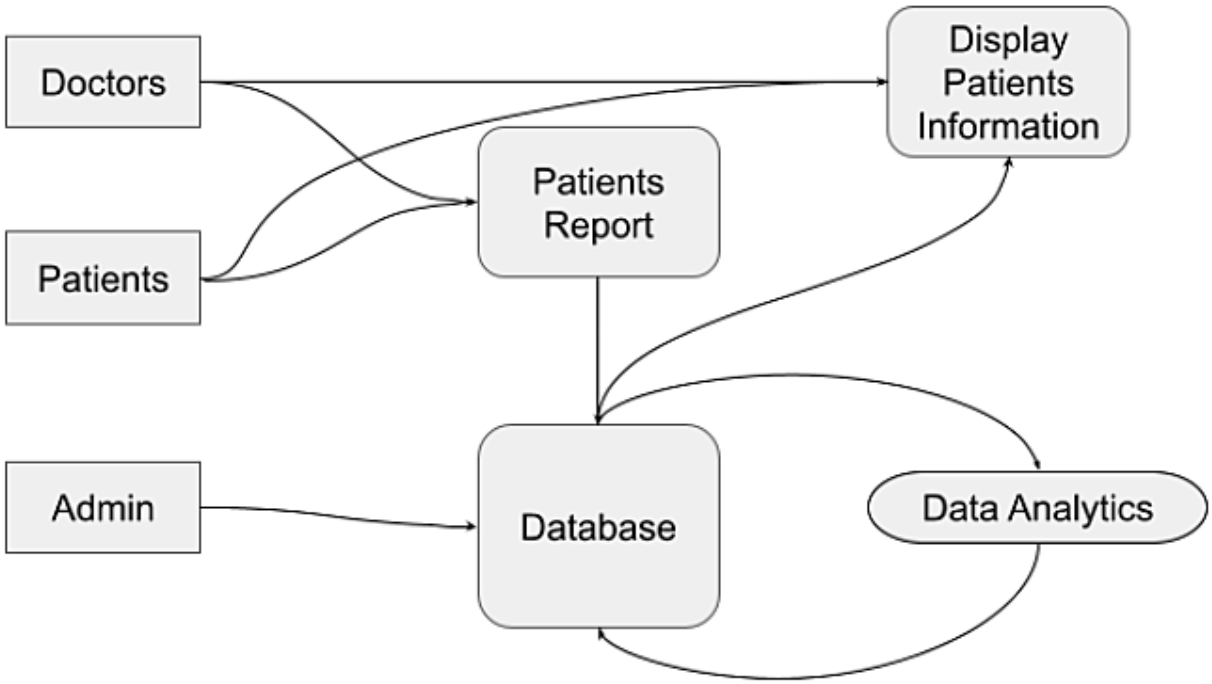
5.2 Non-Functional Requirement

Following are the non-functional requirements of the proposed solution.

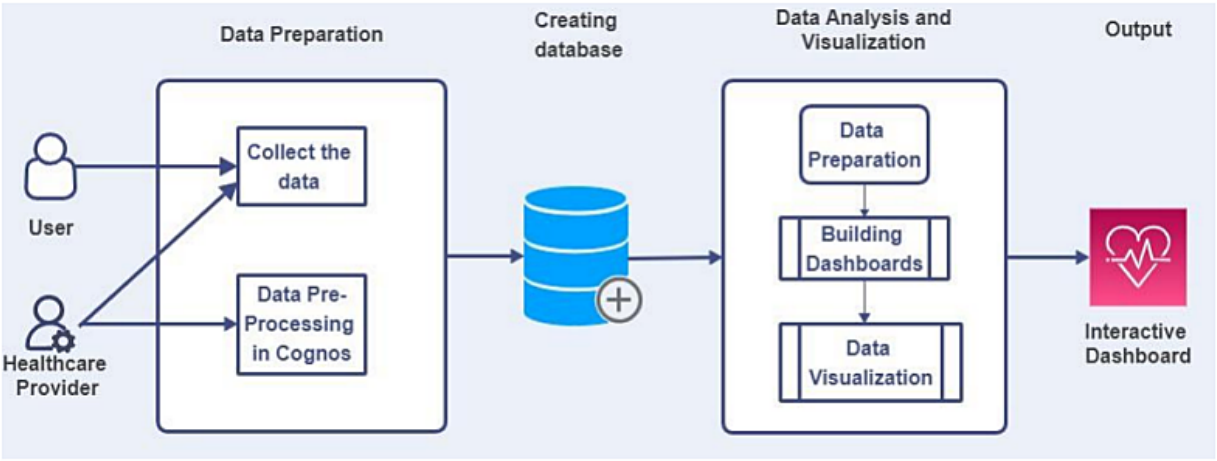
FR No	Non-Functional Requirement	Description
NFR-1	Usability	These Dashboards are designed to offer a comprehensive overview of a patient's LOS, and do so through the use of data visualization tools like charts and graphs.
NFR-2	Security	The dataset is accessed only by the administrators and the user's input is encrypted and it is protected.
NFR-3	Reliability	This dashboard will be consistent and reliable to the users and helps the user to use in effective ,efficient and reliable manner .
NFR-4	Performance	This dashboard can scan the backend users and analyzing the frequency in which they visit the dashboard helps understand how useful and helpful the data displayed is for tasks.
NFR-5	Availability	The dashboard can available to meet user’s demand in timely manner and it is also helps to provide necessary information to the user’s dataset
NFR-6	Scalability	The layers used in the dashboard are a hosted feature layer, feature layer view, or hosted tile layer.

6. PROJECT DESIGN

6.1 Data Flow Diagrams



6.2 Solution and Technology Architecture



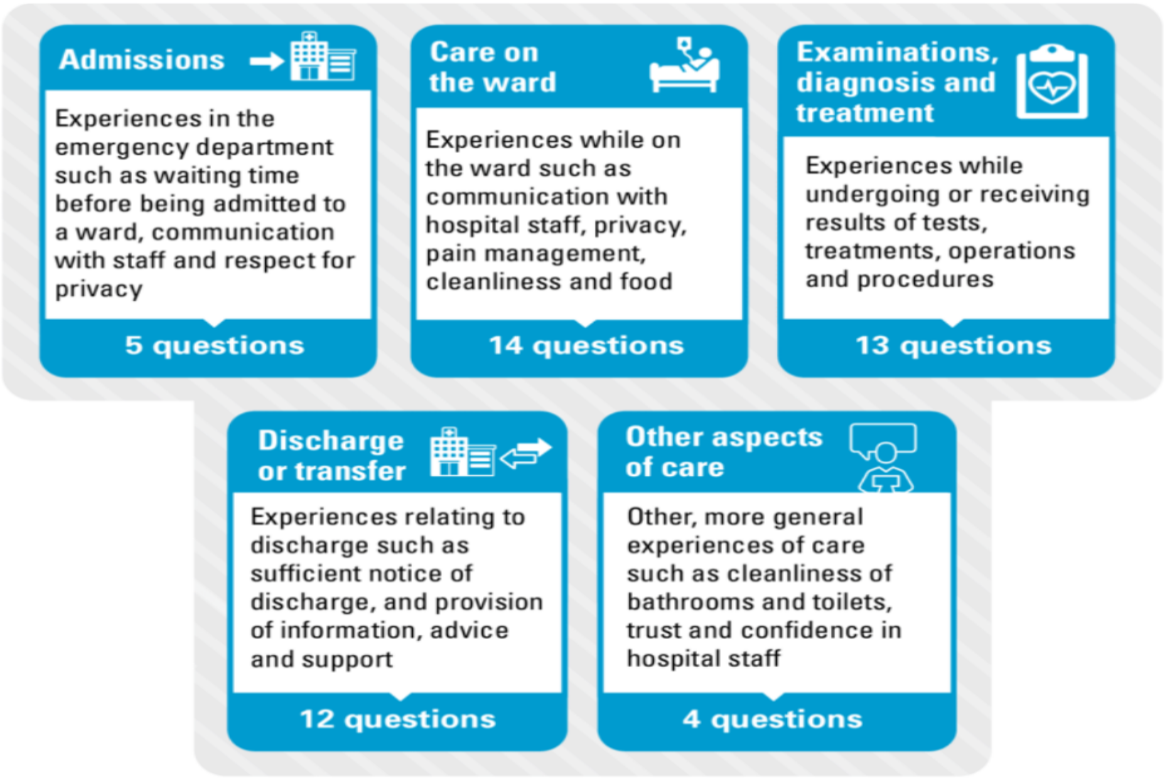
01. Component and Technologies			
S.No	**Component**	**Description**	**Technology**
1.	User Interface	How the user interacts with application e.g. Web UI, Mobile App, Chatbot etc.	HTML, CSS, JavaScript / Angular Js etc.
2.	Data Visualization	The data from the dataset is pre-processed	IBM Cognos Analytics
3.	Data Classification	Data is classified using classification algorithms to classify the data into 10 classifications	IBM Watson , colab
4.	Data Prediction	Prediction of the Length Of Stay (LOS)	IBM Cognos Analytics and python
5.	Database	Database Service on IBM Cloudl	IBM Cloud.
6.	File Storage	File storage requirements	IBM Block Storage or Other Storage Service or Local Filesystem
7.	Uploading Dataset	Uploading dataset to the IBM Cognos	IBM Cognos Analytics and python

2.Application Characteristics			
S.No	**Characteristics**	**Description**	**Technology**
1	Open-Source Frameworks	Dashboard frameworks in the form of charts, graphs and more	IBM Cognos
2	Scalable Architecture	The application is done 3 tier architecture	Presentation layer-HTML/CSS javascript Business Logic Layer-colab, IBM cognos Database layer-IBM db2
3	Availability	The application is available for all the users at anytime	IBM Cognos
4	Performance	The application provides various visualization types in the dashboard	IBM Cognos

6.3 User Story

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Doctor)	Login	USN-1	As a Doctor i want to login to view Patients Data	I can access my account	Medium	Sprint -1
	Patients Dashboard	USN-2	As a Doctor i want to see patients dashboard to take treatment to patients	I can access patients dashboard	High	Sprint -1
Customer (Patients)	Login	USN-3	As a patient i want to login to see my dashboard	I can access my account	Medium	Sprint -1
	Patients Dashboard	USN-4	As a patient i want to see my medical report	I can access my dashboard	High	Sprint -2
Admin	Login	USN-5	As a admin i want to login to maintain the database	I can access my account	High	Sprint -1
	Add / Edit / Update Data	USN-6	As a admin i want to add, edit,, update the data	I can access the database	High	Sprint -1

6.3 Customer Journey



7. PROJECT PLANNING AND SCHEDULING

7.1 Sprint Delivery Schedule

Sprint	Functional Requirement (Epic)	User Stories Numbers	User Story / Task	Story Points	Priority	Team Members
Sprint 1	Analyzing , Visualizing , and Data Preparation	USN-1	As an user, I want to visualize the hospital health care data	10	Medium	JagaGanesh D, Lokkeswaran S, Sanjay M, Velmurugan M
Sprint 1	Prediction of LOS	USN-2	As a user, I want to predict length of stay in different hospitals so that I can plan accordingly	5	High	JagaGanesh D, Lokkeswaran S, Sanjay M, Velmurugan M
Sprint 2	Doctor Login	USN-3	As a Doctor i want to login to view Patients Data	2	Easy	JagaGanesh D, Lokkeswan S
Sprint 2	Doctor Dashboard	USN-4	As a Doctor i want to see patients dashboard to take treatment to patients	5	Medium	Velmurugan M, Sanjay M
Sprint 3	Patient Login	USN-5	As a patient i want to login to see my dashboard	2	Easy	JagaGanesh D, Velmurugan M
Sprint 3	Patient Dashboard	USN-6	As patient i want to see my medical report	5	Medium	Lokkeswaran S, Sanjay M
Sprint 4	Admin Login	USN-7	As a admin i want to login to maintain the database	2	Easy	JagaGanesh D, Sanjay M
Sprint 4	Admin Dashboard	USN-8	As a admin i want to CRUD the data	5	Medium	Velmurugan M, Lokkeswaran S

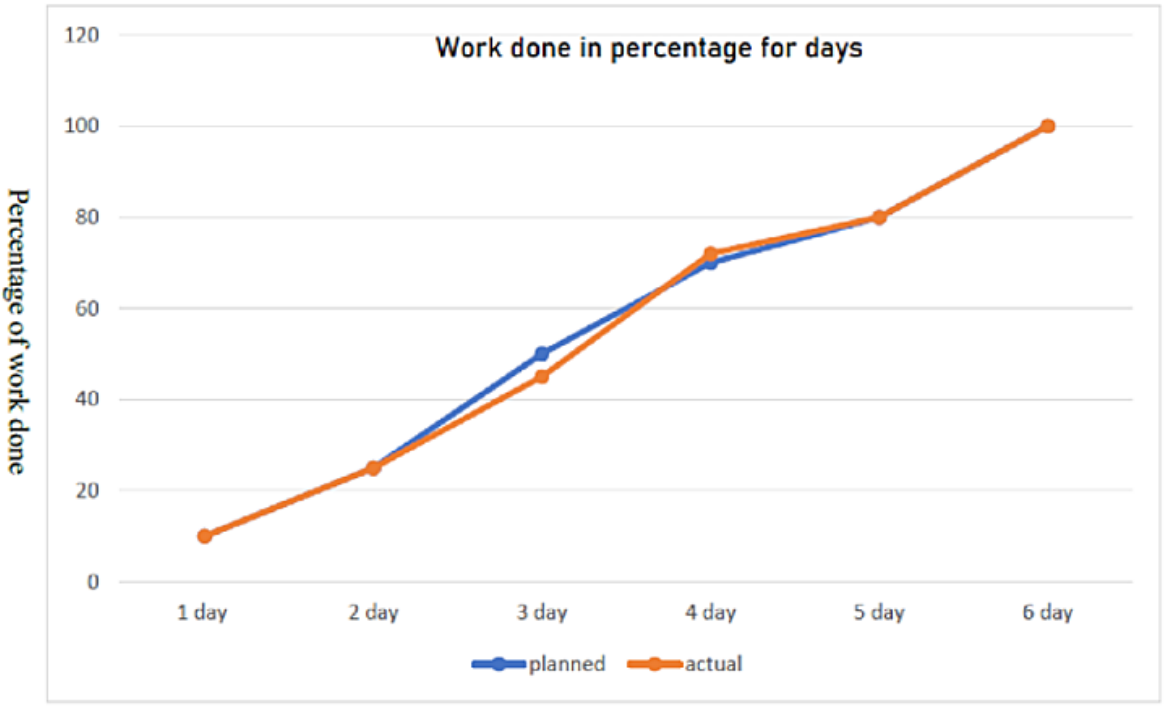
7.2 Project Tracker

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint 1	15	6 Days	24 Oct 2022	29 Oct 2022	15	29 Oct 2022
Sprint 2	7	6 Days	31 Oct 2022	05 Nov 2022	10	05 Nov 2022
Sprint 3	7	6 Days	07 Nov 2022	12 Nov 2022	13	12 Nov 2022
Sprint 4	7	6 Days	14 Nov 2022	19 Nov 2022	15	19 Nov 2022

7.3 Velocity:

Sprint	Total Story Points	Sprint Duration	Average Velocity
Sprint 1	15	6 Days	15 / 6 = 2.5
Sprint 2	7	6 Days	7 / 6 = 1.16
Sprint 3	7	6 Days	7 / 6 = 1.16
Sprint 4	7	6 Days	7 / 6 = 1.16

7.4 Burndown Charts



8. IMPLEMENTATION AND OUTPUT SCREENSHOTS

Data Cleaning and Preprocessing

In [13]:
```
df["Bed Grade"].value_counts()
```

Out[13]:
```
2.0    123671
3.0    110583
4.0     57566
1.0     26505
Name: Bed Grade, dtype: int64
```

In [14]:
```
df["Bed Grade"].fillna(2.0, inplace=True)
```

In [15]:
```
df["Bed Grade"].isna().sum()
```

Out[15]:
```
0
```

In [16]:
```
df["City_Code_Hospital"].value_counts()
```

Out[16]:
```
1     55351
2     51809
6     46991
7     35463
3     31569
5     31105
9     26277
11    17137
4     13857
10     5249
13     3630
Name: City_Code_Hospital, dtype: int64
```

In [17]:
```
df["City_Code_Patient"].fillna(1, inplace=True)
```

In [18]:
```
df["City_Code_Patient"].isna().sum()
```

Out[18]:
```
0
```

In [19]:
```
df.isna().sum()
```

Out[19]:
```
Hospital_code                      0
Hospital_type_code                 0
City_Code_Hospital                 0
Hospital_region_code               0
Available Extra Rooms in Hospital  0
Department                         0
Ward_Type                          0
Ward_Facility_Code                 0
Bed Grade                          0
City_Code_Patient                  0
Type of Admission                  0
Severity of Illness                0
Visitors with Patient              0
Age                                0
Admission_Deposit                  0
Stay                               0
dtype: int64
```

Correlations in Dataset

In [10]:
```
df.corr()
```

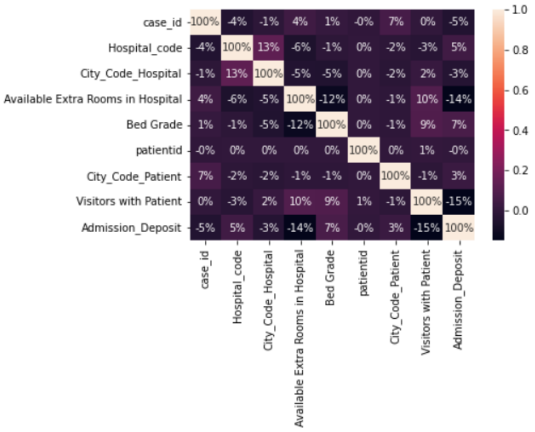
Out[10]:

	case_id	Hospital_code	City_Code_Hospital	Available Extra Rooms in Hospital	Bed Grade	patientid	City_Code_Patient	Visitors with Patient	Admission_Deposit
case_id	1.000000	-0.043023	-0.011352	0.042580	0.013702	-0.004150	0.065196	0.001309	-0.045972
Hospital_code	-0.043023	1.000000	0.128294	-0.059638	-0.013739	0.002291	-0.015530	-0.028500	0.045446
City_Code_Hospital	-0.011352	0.128294	1.000000	-0.045771	-0.049309	0.000750	-0.023988	0.018184	-0.034455
Available Extra Rooms in Hospital	0.042580	-0.059638	-0.045771	1.000000	-0.115868	0.000921	-0.009681	0.096714	-0.143739
Bed Grade	0.013702	-0.013739	-0.049309	-0.115868	1.000000	0.001645	-0.008105	0.088945	0.073833
patientid	-0.004150	0.002291	0.000750	0.000921	0.001645	1.000000	0.002002	0.006889	-0.000877
City_Code_Patient	0.065196	-0.015530	-0.023988	-0.009681	-0.008105	0.002002	1.000000	-0.012074	0.025837
Visitors with Patient	0.001309	-0.028500	0.018184	0.096714	0.088945	0.006889	-0.012074	1.000000	-0.150358
Admission_Deposit	-0.045972	0.045446	-0.034455	-0.143739	0.073833	-0.000877	0.025837	-0.150358	1.000000

In [11]:
```
import seaborn

seaborn.heatmap(df.corr(), annot=True, fmt='.0%')
```

Out[11]:



Data Transformation

In [20]:
```
from sklearn import preprocessing
```

In [21]:
```
le = preprocessing.LabelEncoder()
```

In [22]:
```
le.fit(df["Stay"])
```

Out[22]:
```
LabelEncoder()
```

In [23]:
```
transformed = le.transform(df["Stay"])
```

In [24]:
```
df["Stay"] = transformed
```

In [25]:
```
le.fit(df["Age"])
```

Out[25]:
```
LabelEncoder()
```

In [26]:
```
age_transformed = le.transform(df["Age"])
```

In [27]:
```
df["Age"] = age_transformed
```

In [28]:
```
le.fit(df["Hospital_region_code"])
hrc_transformed = le.transform(df["Hospital_region_code"])
df["Hospital_region_code"] = hrc_transformed
```

In [29]:
```
le.fit(df["Department"])
dept_transformed = le.transform(df["Department"])
df["Department"] = dept_transformed
```

In [30]:
```
le.fit(df["Ward_Type"])
wt_transformed = le.transform(df["Ward_Type"])
df["Ward_Type"] = wt_transformed
```

In [31]:
```
le.fit(df["Ward_Facility_Code"])
wfc_transformed = le.transform(df["Ward_Facility_Code"])
df["Ward_Facility_Code"] = wfc_transformed
```

Transformed Data

In [35]:
```
df.head()
```

Out[35]:

	Hospital_code	Hospital_type_code	City_Code_Hospital	Hospital_region_code	Available Extra Rooms in Hospital	Department	Ward_Type	Ward_Facility_Code	Bed Grade	City_Code_Patient	Type of Admission	Seve
0	8	2	3	2	3	3	2	5	2.0	7.0	0	
1	2	2	5	2	2	3	3	5	2.0	7.0	1	
2	10	4	1	0	2	1	3	4	2.0	7.0	1	
3	26	1	2	1	2	3	2	3	2.0	7.0	1	
4	26	1	2	1	2	3	3	3	2.0	7.0	1	

ALGORITHMS USED:--

1.Random Forest

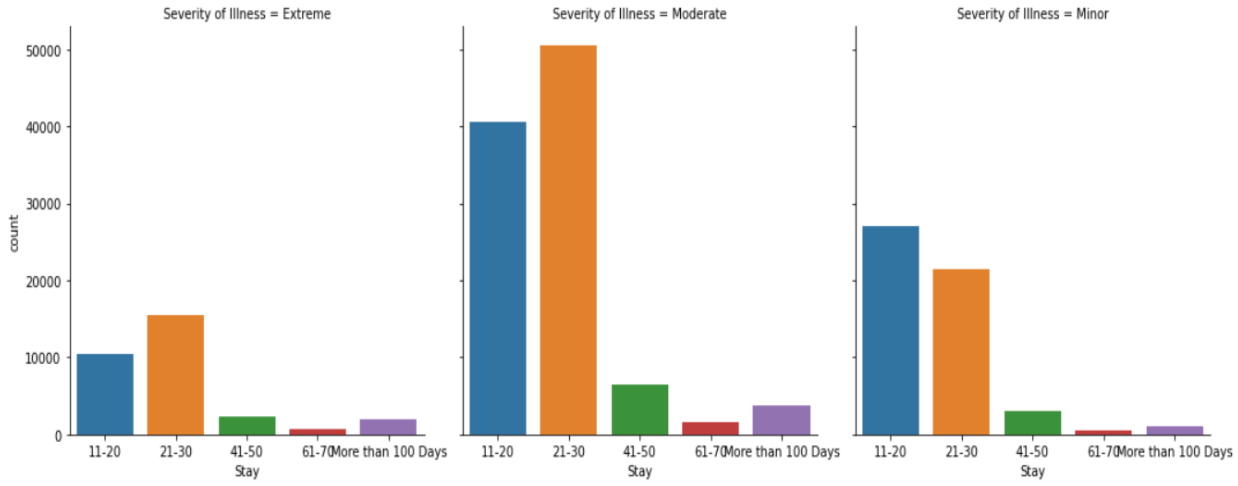
- Random Forest is a popular machine learning algorithm that belongs to the supervised learning technique.
- It can be used for both Classification and Regression problems in ML.
- It is based on the concept of ensemble learning, which is a process of combining multiple classifiers to solve a complex problem and to improve the

performance of the model.

In [29]:
```
df.corr().style.background_gradient(cmap='coolwarm').set_precision(2)
```

Out[29]:

	case_id	Hospital_code	City_Code_Hospital	Available Extra Rooms in Hospital	Bed Grade	patientid	City_Code_Patient	Visitors with Patient	Admission_Deposit
case_id	1.00	-0.04	-0.01	0.04	0.01	-0.00	0.07	0.00	-0.05
Hospital_code	-0.04	1.00	0.13	-0.06	-0.01	0.00	-0.02	-0.03	0.05
City_Code_Hospital	-0.01	0.13	1.00	-0.05	-0.05	0.00	-0.02	0.02	-0.03
Available Extra Rooms in Hospital	0.04	-0.06	-0.05	1.00	-0.12	0.00	-0.01	0.10	-0.14
Bed Grade	0.01	-0.01	-0.05	-0.12	1.00	0.00	-0.01	0.09	0.07
patientid	-0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.01	-0.00
City_Code_Patient	0.07	-0.02	-0.02	-0.01	-0.01	0.00	1.00	-0.01	0.03
Visitors with Patient	0.00	-0.03	0.02	0.10	0.09	0.01	-0.01	1.00	-0.15
Admission_Deposit	-0.05	0.05	-0.03	-0.14	0.07	-0.00	0.03	-0.15	1.00

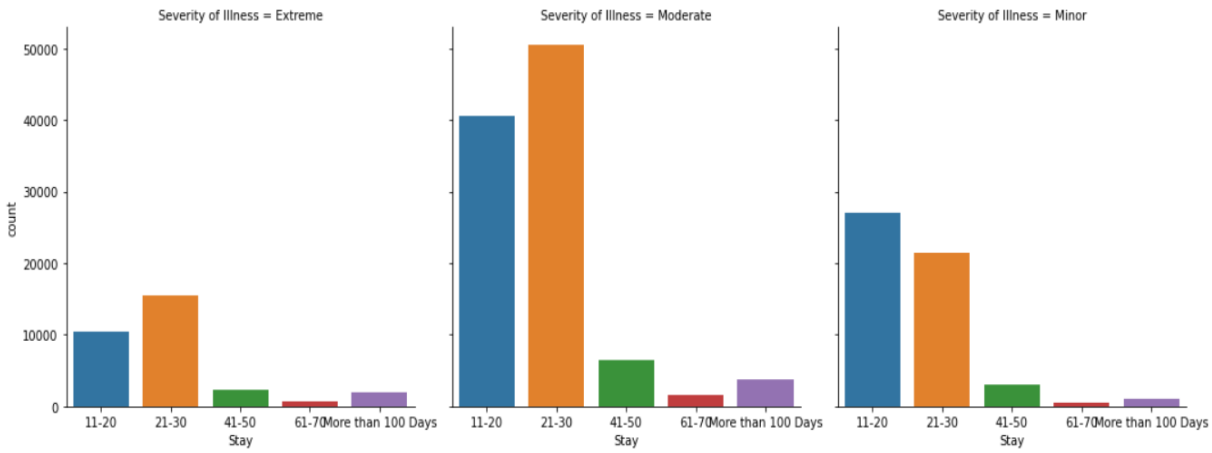


Decision Tree:--

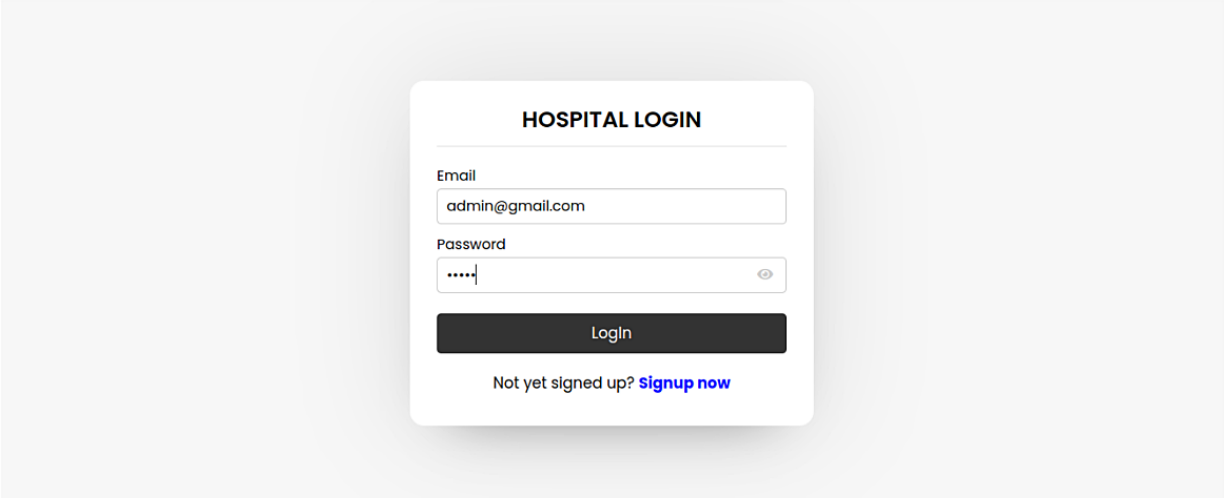
Decision tree is a non-parametric supervised learning algorithm, which is utilized for both classification and regression tasks.

It has a hierarchical, tree structure, which consists of a root node, branches, internal nodes and leaf nodes.

In [32]:
```
bivariate_analysis(df, "Stay", "Severity of Illness", selected_list)
```



Administration Login Page:--

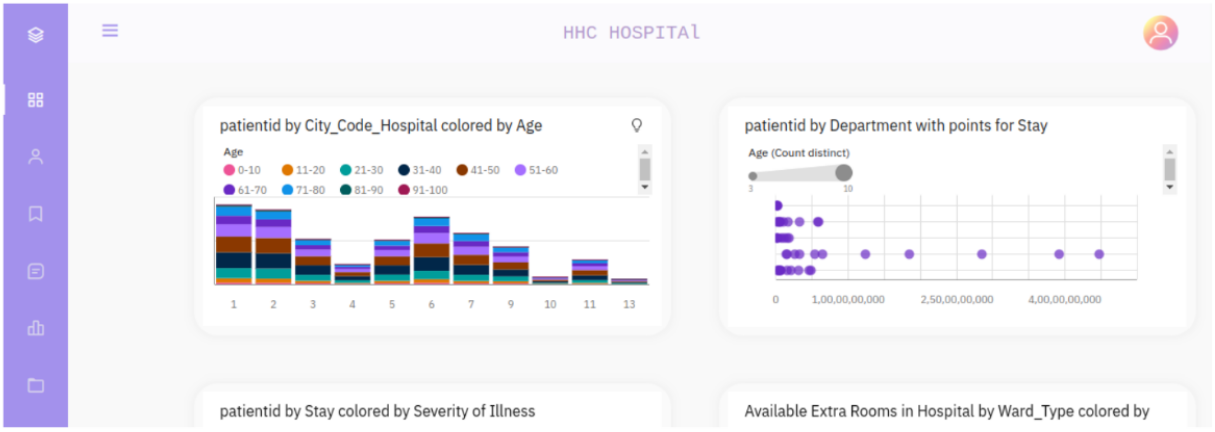


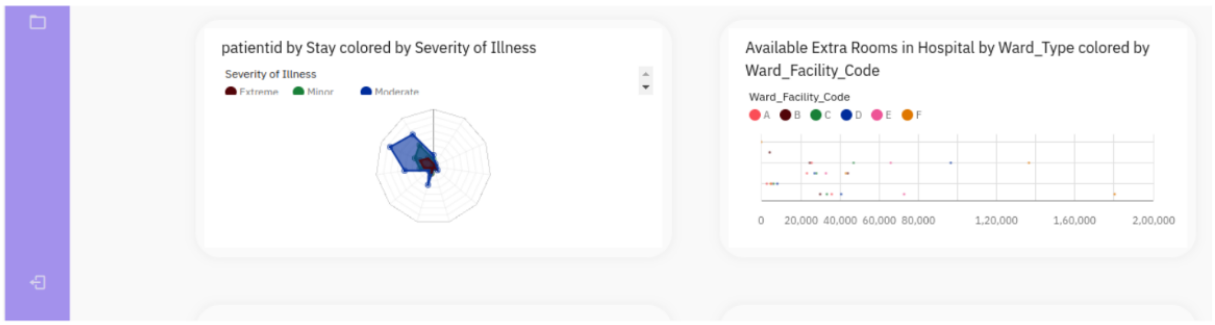
Administration Dashboard Page:--

ADMIN DASHBOARD Tools Used:--

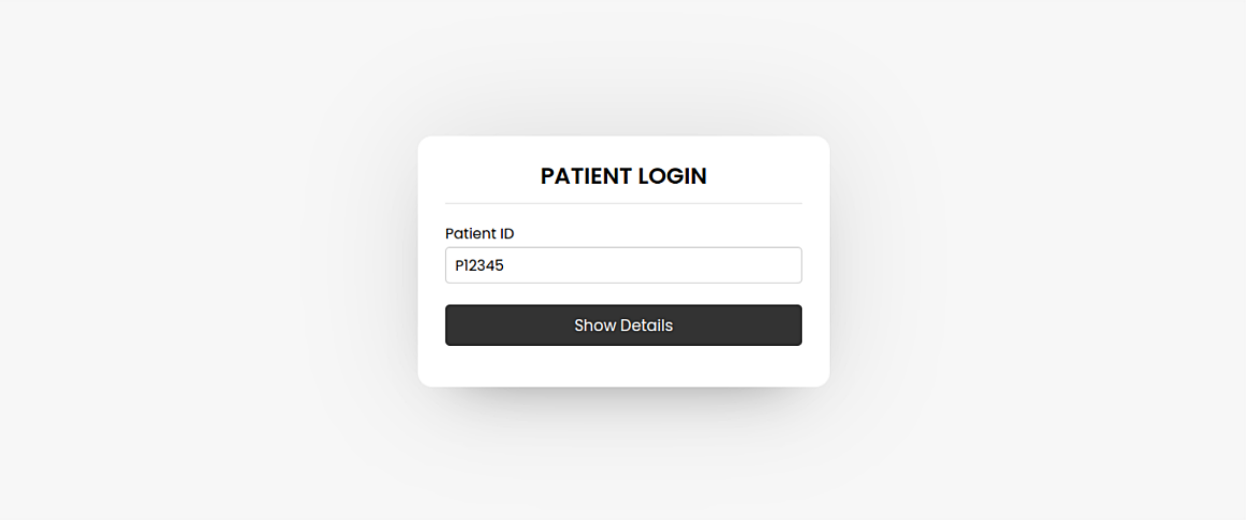
Firebase

- Firebase is a set of hosting services for any type of application.
- It offers NoSQL and real-time hosting of databases, content, social authentication, and notifications, or services, such as a real-time communication server.
- Firebase helps you develop high-quality apps, grow your user base, and earn more money. Each feature works independently, and they work even better

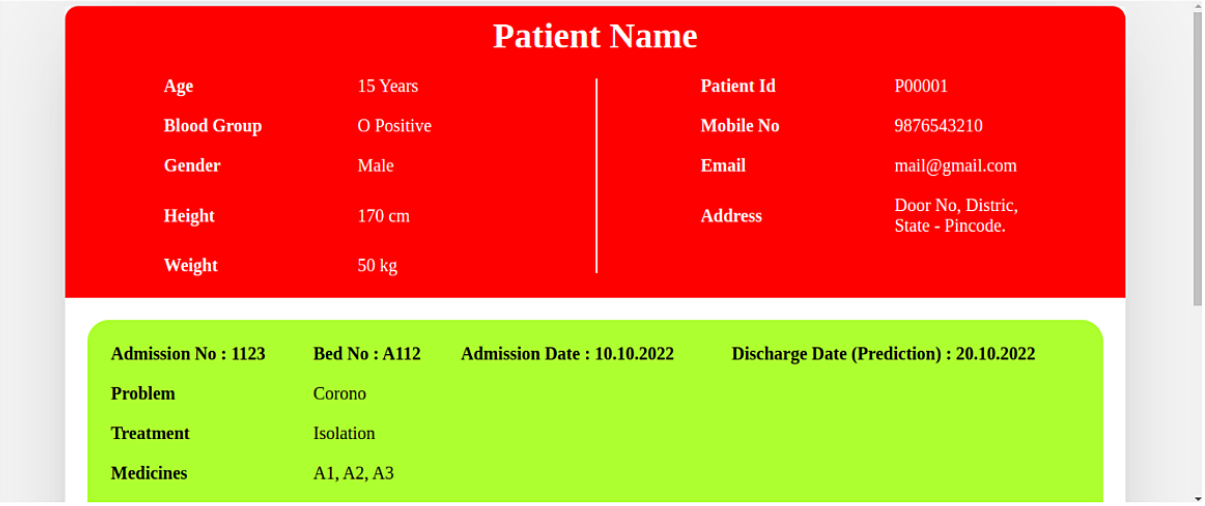


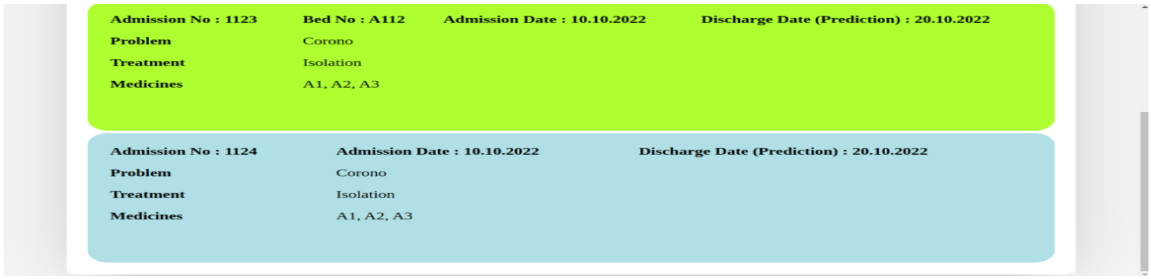


Patient's Login Page:--



Patient's Dashboard:--





9. TESTING

User Acceptance Testing:--

Purpose:

● The purpose of this document is to briefly explain the test coverage and open issues of the Analytics for Hospitals Health-Care data project at the time of the release to User Acceptance Testing (UAT).

● This document mainly covers the severity of each resolution in the system and contains the severity score of the resolution mentioned below in the table.

Defect Analysis:--

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved,

Section	Total Cases	Not Tested	Fail	Pass
Model	50	0	3	47
Client Application	37	0	3	34

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	5	1	2	3	11
Duplicate	0	0	3	0	3
External	0	3	0	1	4
Fixed	7	2	4	2	15
Not Reproduced	0	0	1	0	1
Skipped	0	0	0	3	3
Won't Fix	0	1	0	1	2
Totals	12	7	10	10	39

Test Case Analysis :--

This report shows the number of test cases that have passed, failed, and untested

Homepage	4	0	0	4
Insights	2	0	0	2
Classification	3	0	0	3
Login	2	0	0	2
Admin page	4	0	0	4

Github Repo Link : https://github.com/IBM-EPBL/IBM-Project-33246-1660217069

10. BENEFITS

● Accurate prediction of patient LOS may aid the healthcare specialists to take medical decisions and allocate medical team and resources.

● The patient and insurance companies may use this prediction to manage their budget.

● Patients with high LOS risk can have their treatment plan optimized to minimize LOS and lower the chance of getting a hospital-acquired condition such as staph infection.

● Prior knowledge of LOS can aid in logistics such as room and bed allocation planning.

11. CONCLUSION :--

Thus this project of Analytics for hospital health care data helps the patients in making plans of staying in the hospital and also it helps the other patients to know the capacity of bed available in hospitals during the pandemic times.

This study uses data visualization and analytics to show analytics for hospital and healthcare data.
This data is acquired from various health information systems and other technical tools used by government agencies, insurance providers, and healthcare professionals. Real-time analysis of the data being gathered allows for a better understanding of the virus's effects and the forecasting of future trends, which will help us contain the spread and stop further outbreaks.

If used appropriately, health care data management could result in better treatment.The collection and analysis of data from the healthcare industry with the aim of gaining insights and influencing decision-making can be referred to as healthcare analytics.

12. FUTURE SCOPE :--

The data analytics market in the healthcare space has only increased over the last few years.Decision-making is improved since guessing and manual duties are eliminated by data analytics. whether it be selecting the appropriate content, organizing marketing initiatives, or creating products. Organizations can use the data analytics insights they uncover to make wise decisions. resulting in improved results and customer satisfaction. After the Affordable Act was passed, the necessity for data analytics to meet business goals..

13. FUTURE SCOPE :--

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[2] M. Panda, S. M. Ali and S. K. Panda, "Big data in health care: A mobile based solution," 2017 International Conference on Big Data Analytics and Computational Intelligence (ICBDAC), 2017, pp. 149-152, doi: 10.1109/ICBDACI.2017.8070826.

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[5] Z. Yu et al., "Health Service Decision Toolbox (HSDT): Delivering the Right Treatment to the Right Patient with Health Information Technology and Data Analytics," 2018 15th International Conference on Service Systems and Service Management (ICSSSM), 2018, pp. 1-6, doi: 10.1109/ICSSSM.2018.8465110.