ANALYTICS FOR HOSPITAL'S HEALTHCARE DATA

A PROJECT BASED LEARNING REPORT

SUBMITTED BY

V. SRIVARDHAN	**910619104087**
T.K. SIVAKUMAR	**910619104081**
R.C. SHREE SURYA PRASAD	**910619104077**
M. SIVAKUMAR	**910619104080**

TEAM ID: PNT2022TMID11392

INTRODUCTION

1.1 Project Overview

Recent Covid-19 Pandemic has raised alarms over one of the most overlooked areas to focus Healthcare Management. While healthcare management has various use cases for using data science, patient lengthof 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.

1.2 Purpose

The purpose of the project is to accurately predict the Length of Stay for each patient on case by case basis so that the Hospitals can use this information for optimal resource allocation and better functioning by creating the meaningful visualizations and exploring the available data.

LITERATURE SURVEY

2.1 Existing Problem

1) Data Modeling, Confidence interval with Bootstrap, Graph Modeling, Building graphs from MTS, this technique is used to analyze the data for exploring the potential of data network. Analyzing the HER and to gain knowledge about the COVID-19 patients.

Pros:

The new way to understand and model the information handled. Analyzing the pair wise correlation without making any assessment.

Cons:

The no.of patients is not large and they were treated in same hospital so that over fitting may exit and caution when generalizing the conclusion.

2) Predictive Analysis, Artificial Intelligence, DT Algorithm, In this study, multivariate analysis to identify the key variables using the DT algorithm.

Pros:

DT model shows an intriguing role for dexamethasone in saving lives,ranging from zero risk of death.

Cons:

The DT model was further validated by unsupervised learning methods showing similar separation pattern, and ROC suggest a stable and robust DT Model.

3) Big Data Analytics and Data-driven method, in this study Medical facilities are working on both structured and unstructured which comes from database. It clearly shown that the decision made are largely data driven.

Pros:

It increased the analytics of diagnosis, preventing the public health issuessince the accurate prediction is involved.

Cons:

It is necessary to examine use of structured and unstructured data in vastarea of medical field.

4) Survival Analysis, MFT data preparation, AFT Model, AFT survival model and Truncation Corrected method both will underlying Weibull distribution, were fitted to the data to estimate LOS from hospital.

Pros:

Three different estimations of LOS of patients is used.

Cons:

Missing of large dataset which may lead in bias of estimation. Delay inupdate and delay in reporting.

2.2 References

1) **Data and Network Analytics for COVID-19 Patients** – Sergio Martinez, Antonio G marques, Cristina Soguero-Rui. 2021

2) **Prediction of COVID-19 Hospital Length of Stay and Risk of Death using AI based Modelling —** Bassam Mahboub, Hussam Alshrideh, Laila Salameh. 2021

3) Big Data Analytics in Healthcare – Kornelia Batko, Andrzej Slezak. 2022

4) **Hospital Length of Stay for COVID-19 patients: Data Driven method for forward planning** – Bindu vekaria, Christopher Overton, Arkadiusz wisniowski, Neil A Hanley and Mark J Elliot. 2021

2.3 Problem Statement

Recent Covid-19 Pandemic has raised alarms over one of the most overlooked areas to focus: Healthcare Management. While healthcare management has various use cases for using data science, patient lengthof stay is one critical parameter to observe and predict if one wants to improve the efficiency of the healthcare management in a hospital.

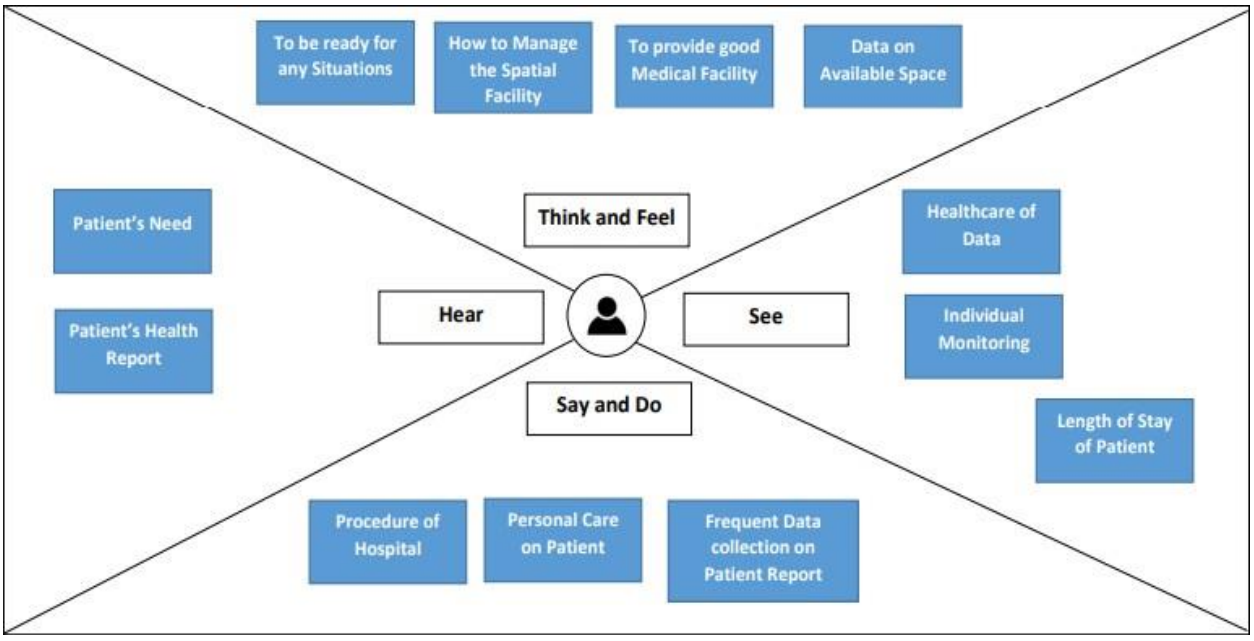
I am	I'm trying to	But	Because	Which makes me feel
Hospital Management	Assured treatment in any kind of situation and ensuring the spatial facility for patients	Proper allocation of resources become tough challenge in hospital	The number of affected people becomes high and couldn't predict the arriving cases and to allocate he resources and admission	● Loss of Confidence ● Helpless ● Tensed
Hospital Staff	Personal care on admitted patients and to monitor the health condition of patients	It is not possible all time	The flue and virus may affect the health of monitoring staffs	● Tensed ● Over conscious
Patient	Get good treatment and getcure from COVID-19	Difficult to reach the hospitals	Lack of treatment facilities and space due to stayof other COVID patients.	● Frustration ● Being helpless ● Tensed

IDEATION AND PROPOSED SOLUTION

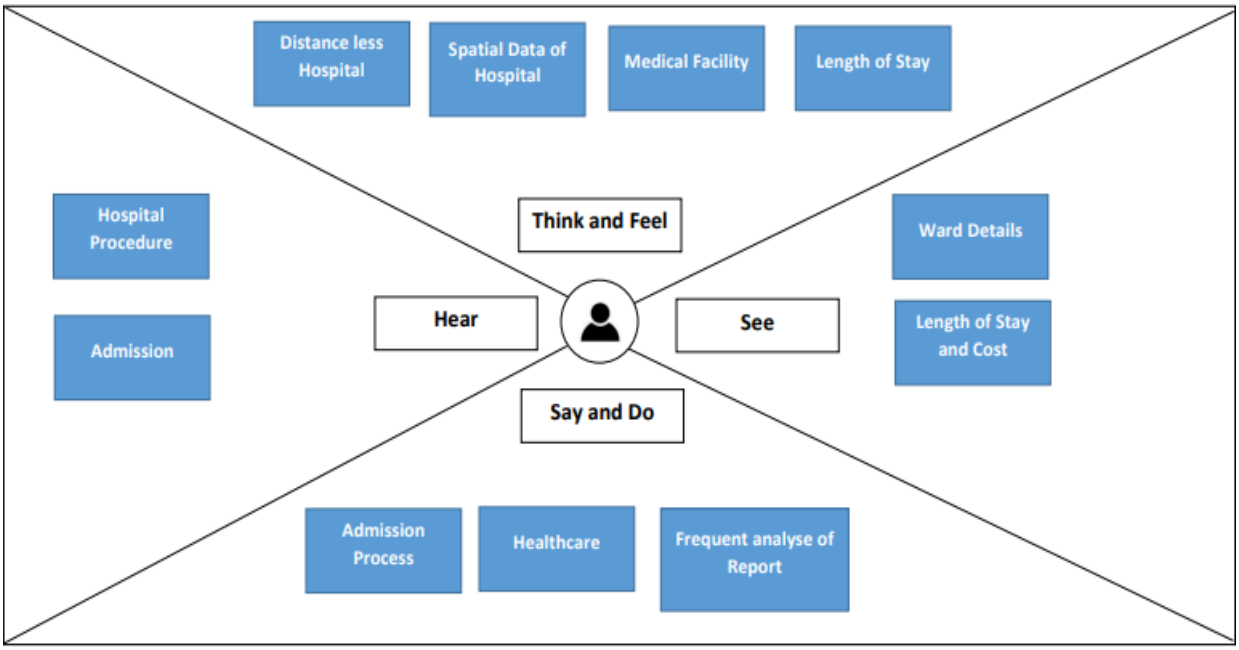
3.1Empathy Map

Empathy map helps is simple and easy to digest visually that captures knowledge about a user's behavior and attitudes.

1) Empathy map on Hospital Management



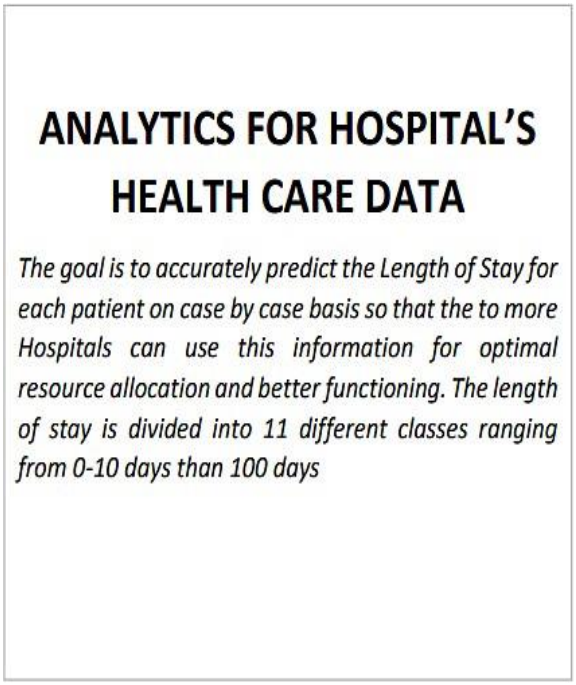
2) Empathy map on Patients

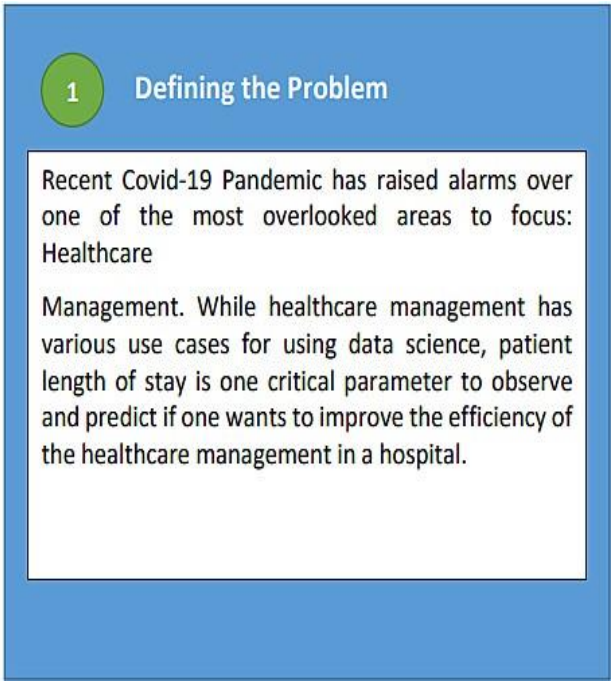


3.2 Ideation and Brainstorming

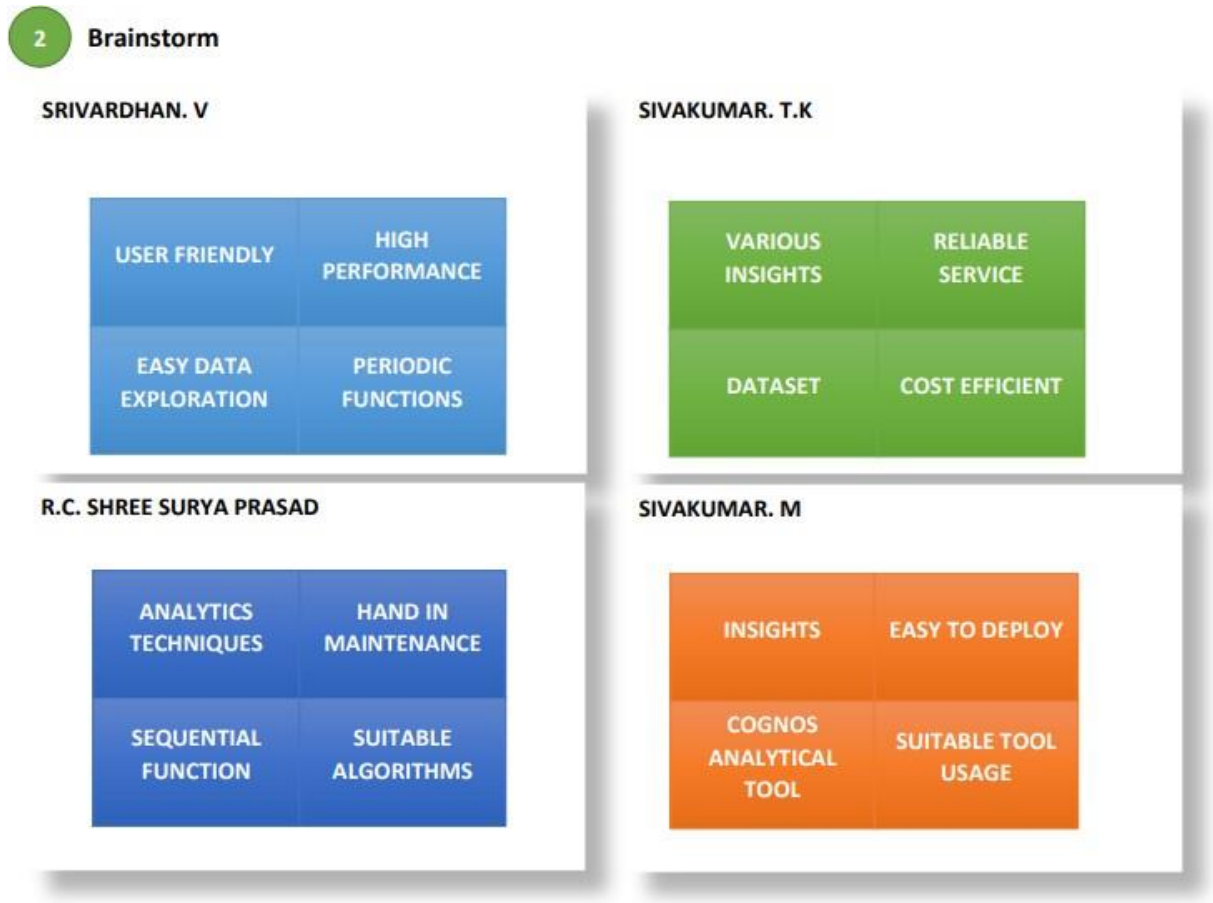
Brainstorming provides a free and open environment that encourages everyone within a team to participate in creative thinking process that leads to problem solving. Prioritizing volume over value, out-of-the-box ideas are welcome and built upon, and all participants are encouraged to collaborate, helping each other develop a rich amount of creative solutions.

3.2.1 Defining the Problem





3.2.2Brainstorming



3.3 Proposed solution

S.No	Parameters	Description
1.	Problem Statement	The goal is to accurately predict the Length of Stay for each patient on case by case basis so that the Hospitals can use this information for optimal resource allocation and better functioning. The length ofstay is divided into 11 different classes ranging from 0-10 days to more than 100 days.
2.	Idea / Solution	Predictive Analysis.
3.	Novelty / Uniqueness	Predictive analytics with AI Solution.
4.	Social Impact	Access to primary healthcare, Less Casualty.
5.	Business Model	Pharmacy companies will sell their Medical products to generate more revenue. Insurance companies will sell their health policies to needed People.
6.	Scalability of Solution	• Easy access of PatientsData • User friendly analytics • Accurate results

3.4 Problem Solution Fit

The Problem-Solution Fit simply means that you have found a problem with your customer and the solution that you have realized for it actually solves the customer's problem. It helps entrepreneurs, marketers and corporate innovators identify behavioral patterns and recognize what would work and why.

<table>
<tr><td>1. Customer Segments
Hospital Management
Patients</td><td>6. Customer Limitation
Can’t assure the effective utilization and allocation of resources</td><td>5. Available Solution
Text mining
Information retrieval</td></tr>
<tr><td>2. Problems/Pains
Proper allocation of resources
Predicting the length of stay of COVID patients
Proper utilization and treatment to patients</td><td>9. Problem
Efficient less calculation and prediction of occurring situations</td><td>7. Behaviour
Data tracking with available methodologies such as text mining and information retrieval</td></tr>
<tr><td>3. Triggers to Act
Prevailing emergency situations and Pandemic period</td><td rowspan="2">10. Your Solution
Using predictive analysis powered by the Artificial intelligence which is used in analytics technique</td><td>8. Channels of Behaviour
1. Online: Usage of data exploration</td></tr>
<tr><td>4. Emotions
Tensed and perplexed mind set to get rectified from the pandemic period</td><td>2. Offline: Preparing the dataset on the COVID patients.</td></tr>
</table>

REQUIREMENT ANALYSIS

4.1Functional Requirements

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	**User Registration**	The User has his/her own ID to get registered in the portal or Dashboard
FR-2	**User Confirmation**	Confirmation via OTP (if necessary)
FR-3	**Dashboard**	The collected data are found in visualized format and the prior data are analyzed
FR-4	**Dataset**	The patients record and staff records are collected and consolidated as dataset
FR-5	**Report Generator**	The periodic reports of patients and the LoS are reported
FR-6	**Exploration**	The data exploration on available dataset

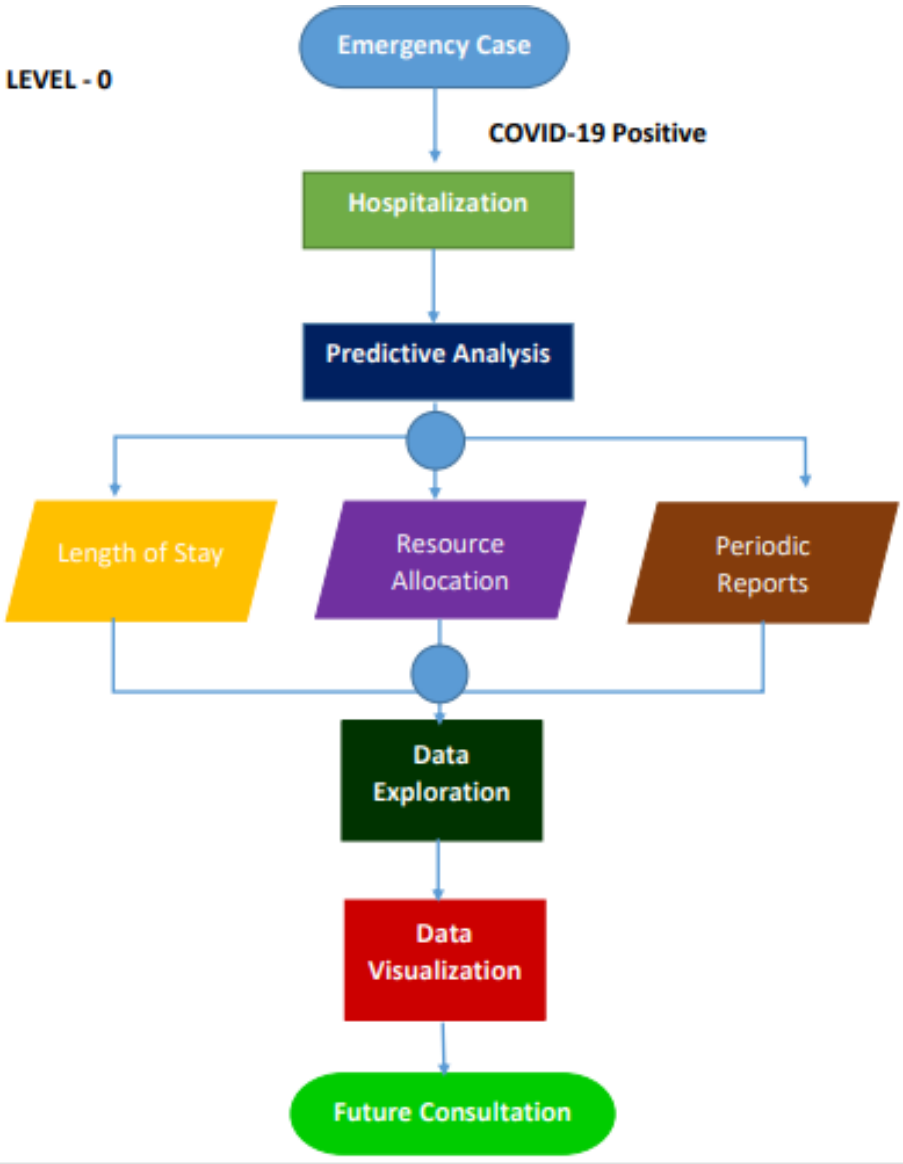
4.2 Non-Functional Requirements

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The user can analyze about the Patients detail and their Length of Stay
NFR-2	**Security**	The data are confidential so Hospital Staff conscious about it
NFR-3	**Reliability**	The Analytics system ensures the reliability
NFR-4	**Performance**	The accurate result of patients LoS can be identified.
NFR-5	**Availability**	The availability of dataset must be constrained for accurate data
NFR-6	**Scalability**	Any kind of data can be explored and the system is quiet expandable

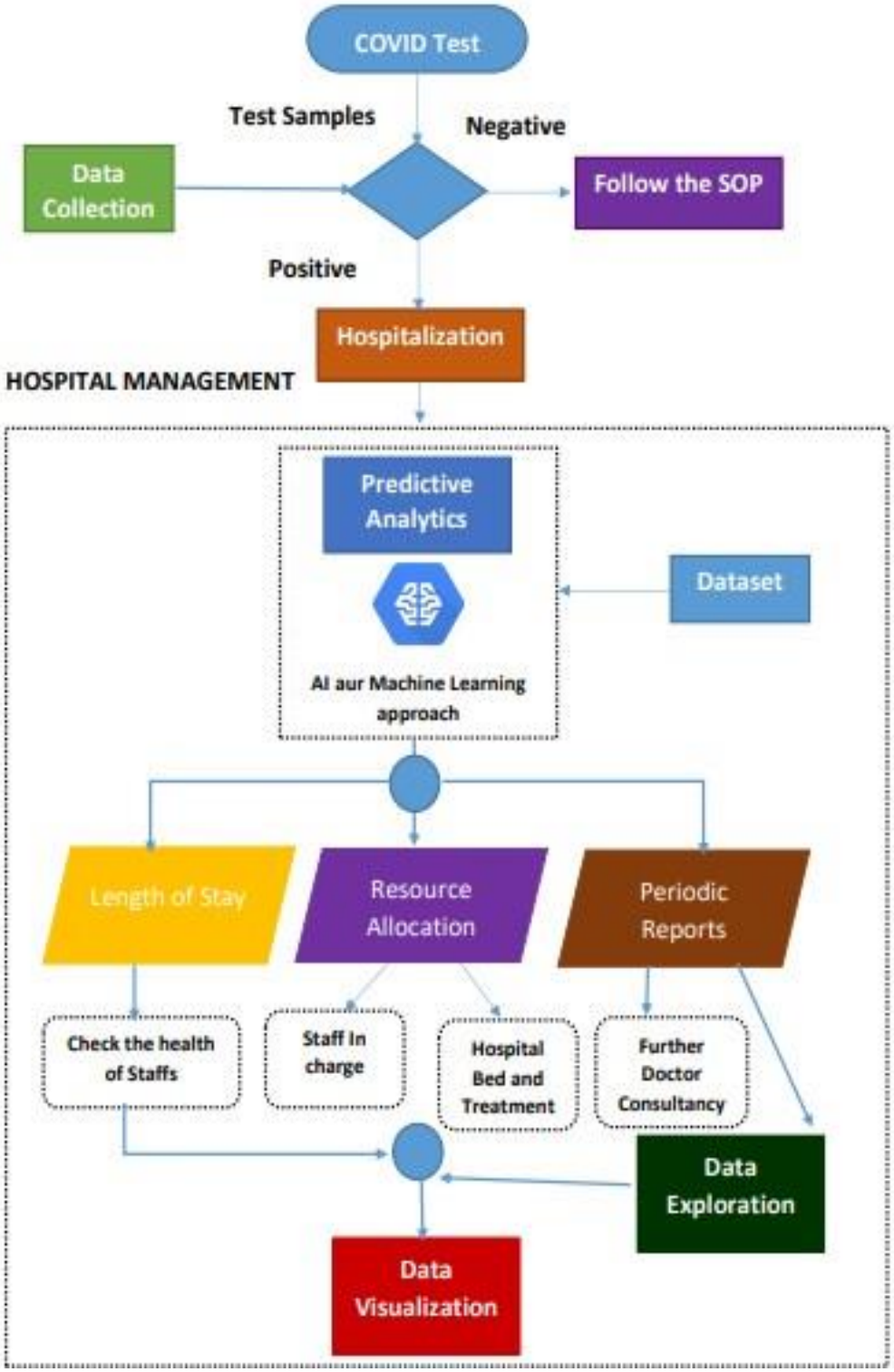
PROJECT DESIGN

5.1 Data Flow Diagram

Data Flow Diagram is the traditional visual representation of the information flow within the system. A neat and clear DFD can depict the right amount ofthe system requirements graphically.



Level - 1

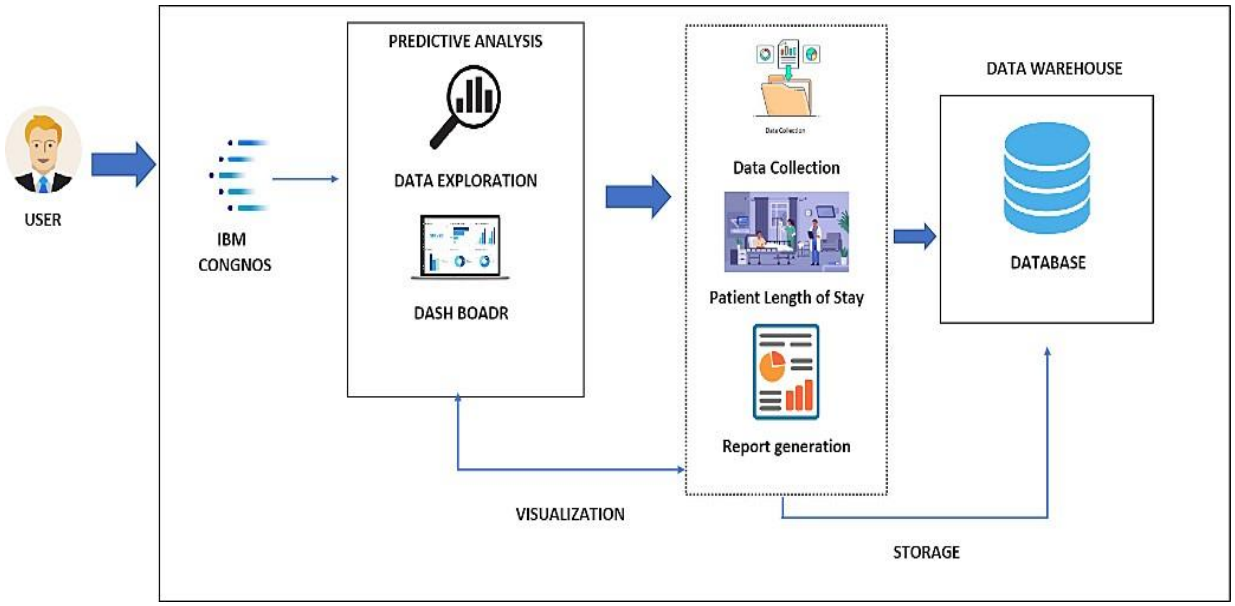

COVID Test
Test Samples
Negative
Data Collection
Follow the SOP
Positive
Hospitalization
HOSPITAL MANAGEMENT
Predictive Analytics
Dataset
AI aur Machine Learning approach
Length of Stay
Resource Allocation
Periodic Reports
Check the health of Staffs
Staff In charge
Hospital Bed and Treatment
Further Doctor Consultancy
Data Exploration
Data Visualization

5.2 Solution and Technical Architecture

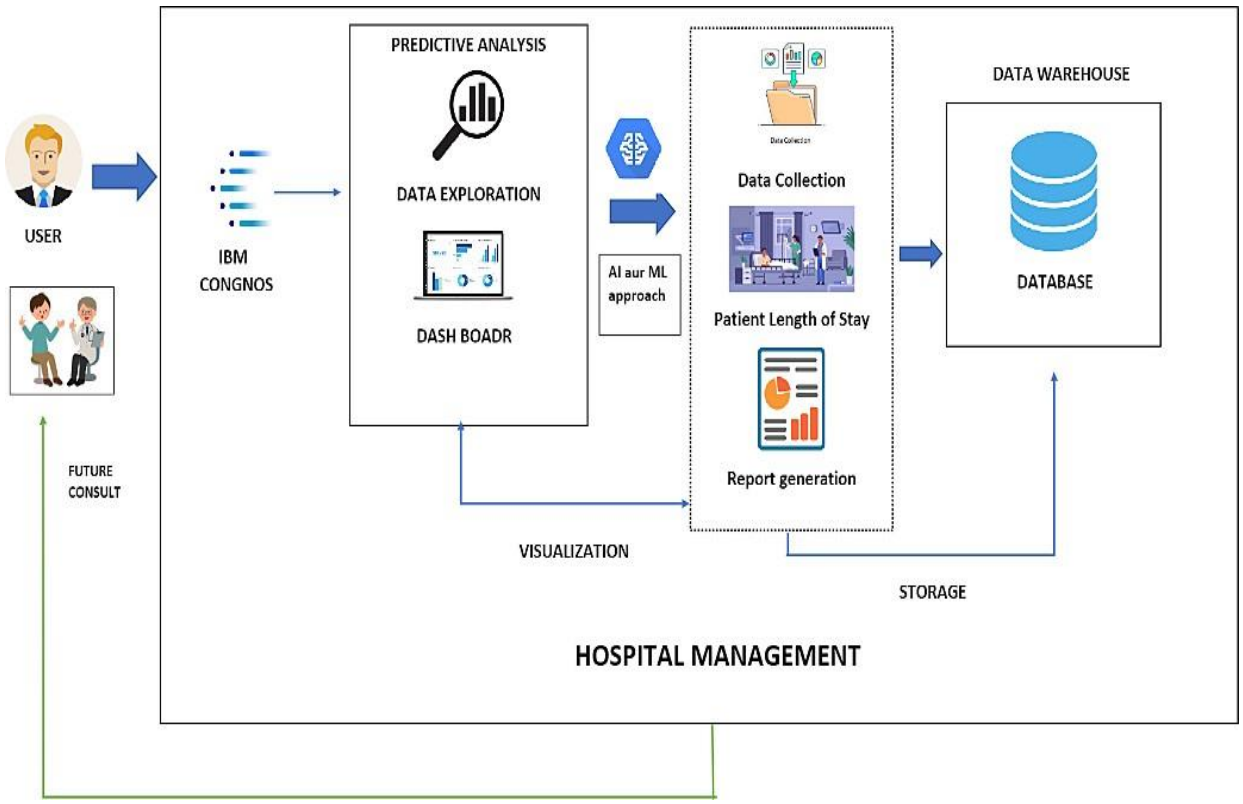
5.2.1 Solution Architecture

Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

- Find the best tech solution to solve existing business problems.
- Describe the structure, characteristics, behavior, and other aspects of the software to project stakeholders.
- Define features, development phases, and solution requirements.
- Provide specifications according to which the solution is defined, managed, and delivered.



5.2.2 Technical Architecture



Components and Technologies

S.No	Component	Description	Technology
1.	User Interface	The Users will be interactingwith the site through their convenient devices	IBM cognos or IBM cloud
2.	Application Logic-1	The Collecting the data	CSV File
3.	Application Logic-2	Exploring and visualizing The data	IBM Cognos analytics
4.	Application Logig-3	Data model on the Available data	AI or ML
5.	Cloud Database	Storing the patients data In cloud environment	IBM cloud
6.	Machine Learning Model	Predictive Analysis on The data model	Python, IBM Cognos
7.	Infrastructure Service	Cloud environment For analytics	IBM Cloud and Cognos Analytics

Application Characteristics

S.No	Characteristics	Description	Technology
1.	Open Source Framework	Pandas and Numpy	Python
2.	Security Implementations	Admin and User or Management Authorization	e.g. SHA-256, Encryptions, IAM Controls, OWASP etc.
3.	Availability	The data exploration andvisualization is a timely work hence the system should be more available	Cognos analytics
4.	Performance	The accurate calculation of data is the well-known performance of this system	Predictive Analyticsusing AI or ML Model

5.3 User Stories

User Type	Functional Requirements	User Story	User Task	Acceptance Criteria	Priority
Patient	Hospitalization	USN-1	Patients are required to get Hospitalize if they have COVID +ve	Direct Hospitalization	High
	Treatment Report	USN-2	Patients should collect their treatment report and get future doctor consult	They can receive the report from Hospital	Medium
Hospital Management	Resource Allocation	USN-3	Hospital Management should allocate necessary resources	Should be ready for any circumstance	High
	Predicting Length of Stay	USN-4	The Doctors should be awareof Patient's condition to predict the LOS	Exploring and Predicting Patients LOS	High
	Resource Available	USN-5	The Hospital staffs should be aware of available resources	Visualizing the resource availability	High
	Staff Welfare	USN-6	The working staff should stay safe from COVID-19		High

PROJECT PLANNING AND SCHEDULING

6.1 Sprint Planning and Estimation

Sprint	Functional Requirements (Epic)	User Story. No	User Story / Task	Story Pts	Priority	Team Members
Sprint -1	Dataset	USN-1	User needs to collect data about patients and prepare the dataset	2	High	Sivakumar. M
Sprint -1	Data Exploration	USN-2	Data exploration is the first step in data analysis to explore and visualize data and uncover insights from start	2	High	R.C. Shree Surya Prasad
Sprint -1	Secondary Exploration	USN-3	Identifying the secondary relationship of data	1	Low	R.C. Shree Surya Prasad
Sprint -2	Data Visualization	USN-4	Patients data are visualized graphically for data verification and to know available resources	2	High	Sivakumar. T.K
Sprint -3	Dashboard, Report, Story	USN-5	The explored and visualized data are viewed in dashboard	2	High	Srivardhan. V
Sprint -4	PredictiveModel	USN-6	Predictive analysis is performed by creating predictive model	2	High	Srivardhan. V

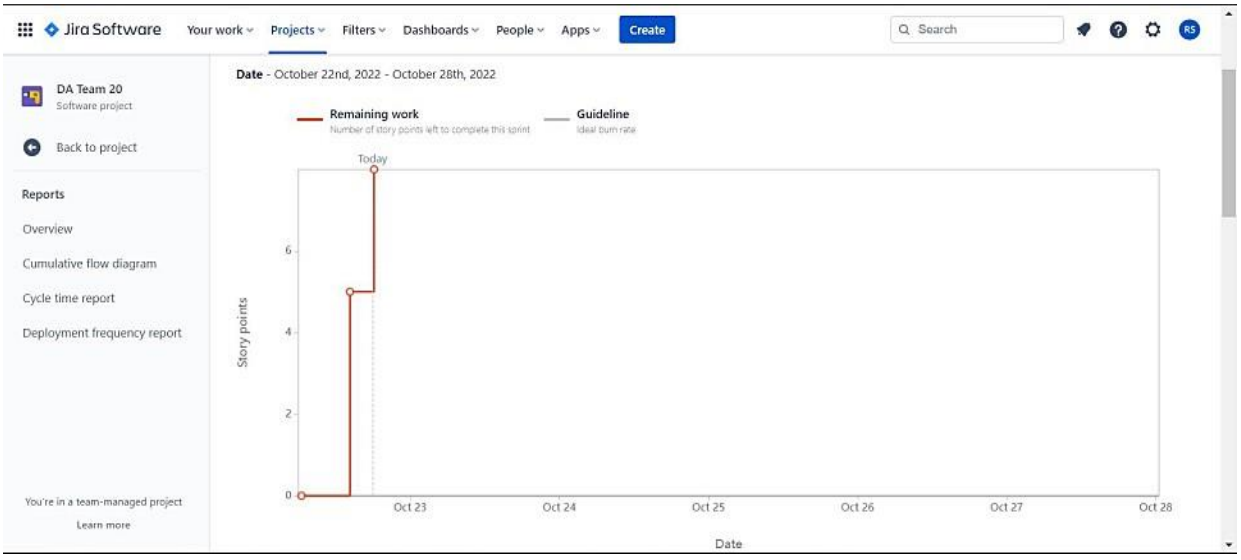
Sprint Delivery Schedule

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed	Sprint Release Date
Sprint-1	20	4 days	24 Oct 2022	27 Oct 2022	20	27 Oct 2022
Sprint-2	20	6 days	29 Oct 2022	03 Nov 2022	20	03 Nov 2022
Sprint-3	20	6 days	04 Nov 2022	09 Nov 2022	20	09 Nov 2022
Sprint-4	20	8 days	10 Nov 2022	18 Nov 2022	20	19 Nov 2022

6.2 Reports from Jira

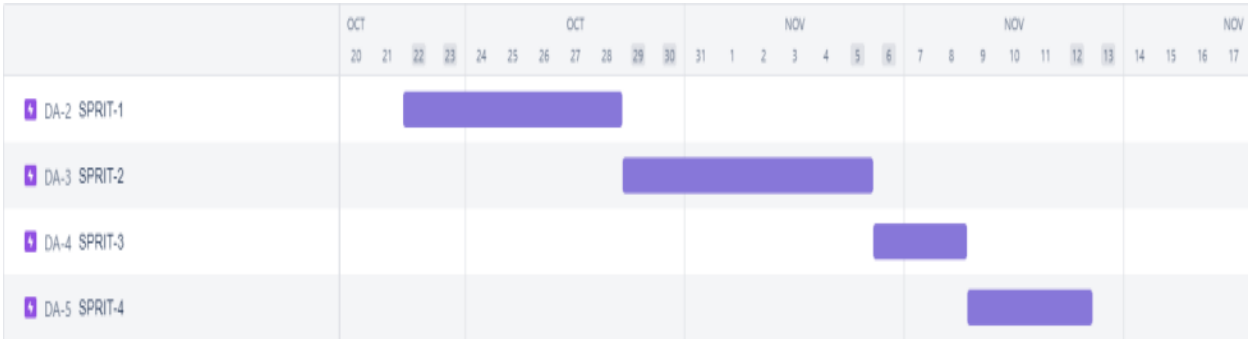
6.2.1 Burn down Charts:

A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.



6.2.2 Jira Progress Chart

- Jira is an open-source software tool used for managing project tasks,issue tracking and other issues
- It is a platform-independent tool; that can be worked with differenttypes of operating systems.
- As we know, Jira is an issue tracking platform, so it is used by development and technical support teams to get work.



CODING AND SOLUTIONING

7.1 Feature 1

7.1.1 Data Exploration and Visualization:

Data exploration is the first step of data analysis used to explore and visualize data to uncover insights from the start or identify areas or patterns to dig into more. Using interactive dashboards and point-and-click data exploration, users can better understand the bigger picture and get to insights faster.

Steps:

1. Variable Identification
2. Univariate Analysis
3. Bi-Variable Analysis
4. Detecting / Treating missing values
5. Detecting / Treating outliers
6. Feature Engineering

Data visualization is the graphical representation of information and data. By using visual elements like charts, graphs, and maps, data visualization tools provide an accessible way to see and understand trends, outliers, and patterns in data. Additionally, it provides an excellent way for employees or business owners to present data to non-technical audiences without confusion.

It can be employed as;

- Dashboards
- Story
- Reports

Code:

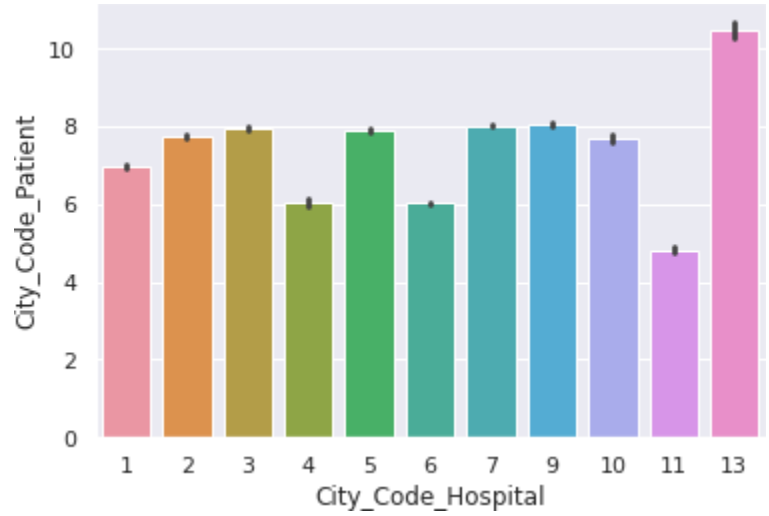
Data Exploration on Healthcare dataset#

Import packages

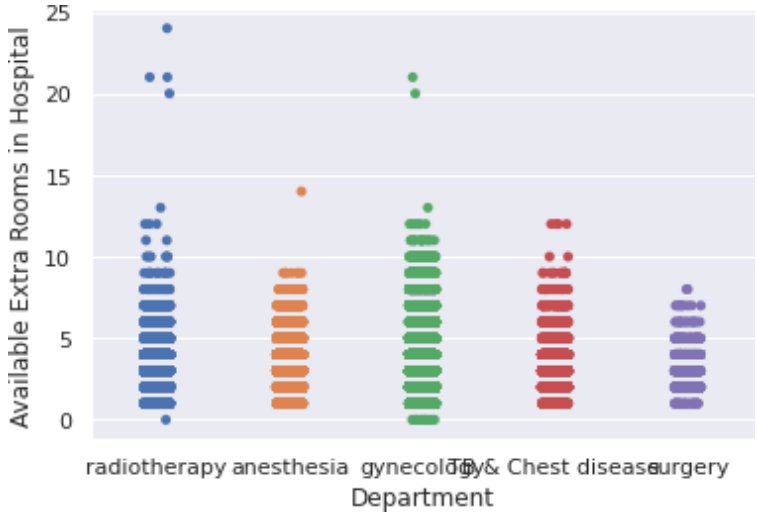
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt

# Reading the Dataset
data = pd.read_csv("/content/drive/My Drive/MachineLearning/train_data.csv")
data.head()
data.tail()
data.info()
data.nunique() /  finding unique and null value
data.isnull().sum() (data.isnull()).sum()/(len(data))* 100

# Data Reduction data.drop(columns=['City_Code_Patient'],
inplace = True)data.describe()  / finding the mean value
```

Data Visualization on Healthcare Data:

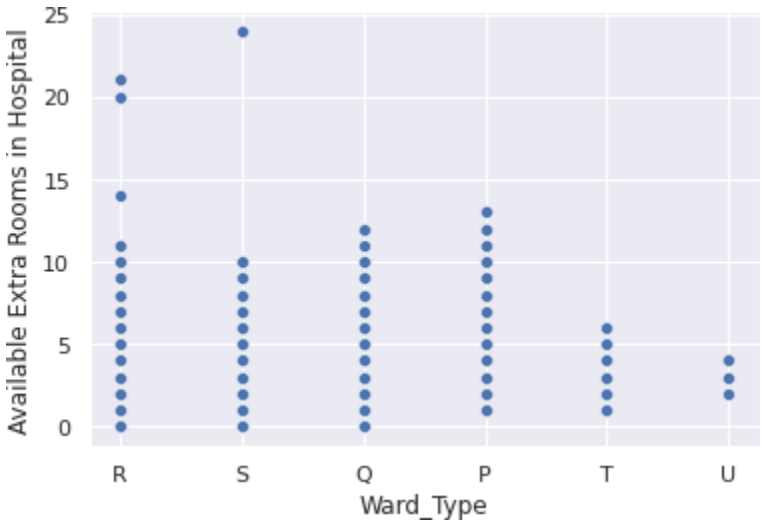
```
import numpy as np import
pandas as pd import seaborn
as sns
sns.set(color_codes=True)
from matplotlib import pyplot as plt

data = pd.read_csv("/content/drive/My Drive/Machine Learning/train_data.csv")

sns.barplot(data['City_Code_Hospital'], data['City_Code_Patient'])
```



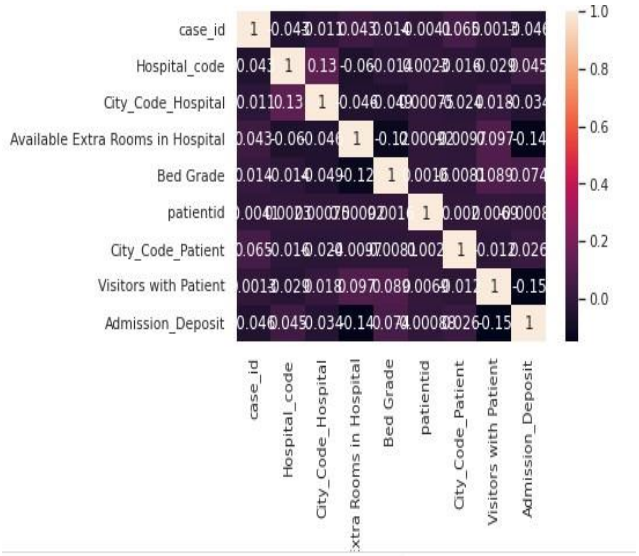

```
sns.stripplot(data['Department'], data['Available Extra Rooms in Hospital'])
```



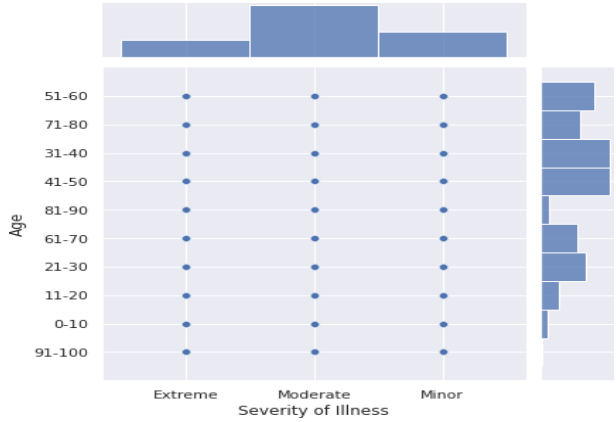
```
sns.scatterplot(data['Ward_Type'], data['Available Extra Rooms in Hospital'])
```



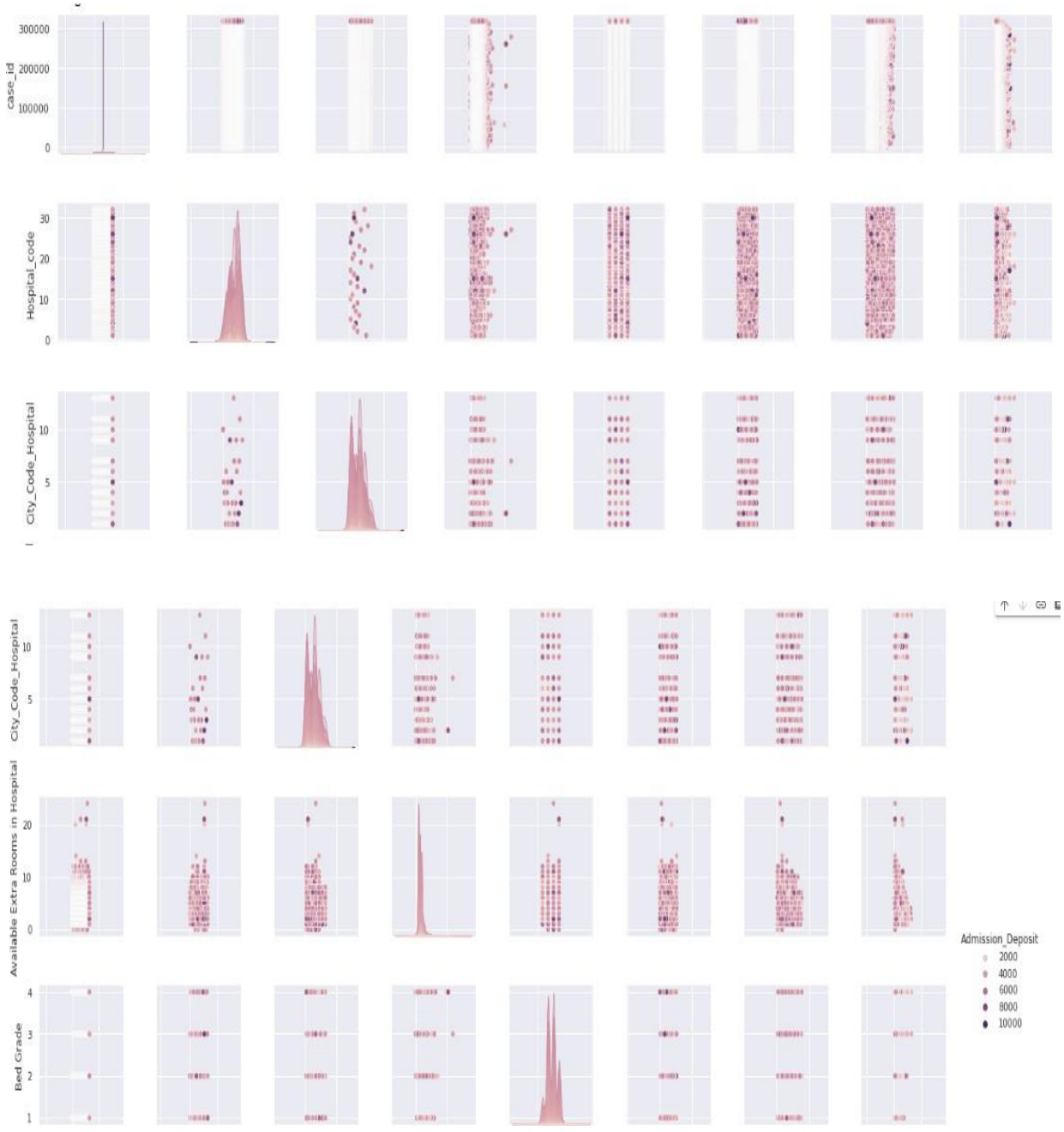

```
sns.heatmap(data.corr(),annot=True)
```




```
sns.jointplot(data['Severity of Illness'], data['Age'])
```



```
sns.pairplot(data,hue="Admission_Deposit")#multivariate
```



7.2 Feature 2

Predictive Model

Predictive analytics is a branch of advanced analytics that makes predictions about future outcomes using historical data combined with statistical modeling, data mining techniques and machine learning. Companies employ predictive analytics to find patterns in this data to identify risks and opportunities.

Flexible Platforms to build;

1. Scalability
2. Speed
3. Simplicity

Code:

```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as pltplt.style.use('classic')
# Preparing the data
data['Bed Grade'].fillna(data['Bed Grade'].mode()[0], inplace = True)test['Bed
Grade'].fillna(test['Bed Grade'].mode()[0], inplace = True)

data['City_Code_Patient'].fillna(data['City_Code_Patient'].mode()[0], inplace = True)
test['City_Code_Patient'].fillna(test['City_Code_Patient'].mode()[0], inplace = True)

from sklearn.preprocessing import LabelEncoderle =
LabelEncoder()
data['Stay'] = le.fit_transform(data['Stay'].astype('str'))

test['Stay'] = -1
df = pd.concat([data, test])
df.shape
```

 # Label Encoding all the columns in Train and test datasets

```
for i in ['Hospital_type_code', 'Hospital_region_code', 'Department',
        'Ward_Type', 'Ward_Facility_Code', 'Type of Admission', 'Severity of Illness', 'Age']: le =
    LabelEncoder()
    df[i] = le.fit_transform(df[i].astype(str))#
```

Spearating Train and Test Datasets data =

```
df[df['Stay']!=-1]
test = df[df['Stay']==-1]
```

 # Feature Engineering

```
def get_countid_enocde(data, test, cols, name):
  temp = data.groupby(cols)['case_id'].count().reset_index().rename(columns = {'case_id': name})temp2 =
  test.groupby(cols)['case_id'].count().reset_index().rename(columns = {'case_id':
name})
  data = pd.merge(data, temp, how='left', on= cols)test =
  pd.merge(test,temp2, how='left', on= cols)data[name] =
  data[name].astype('float') test[name] =
  test[name].astype('float')
  data[name].fillna(np.median(temp[name]),    inplace    =    True)
  test[name].fillna(np.median(temp2[name]), inplace = True)return
  data, test
data, test = get_countid_enocde(data, test, ['patientid'], name = 'count_id_patient') data, test
= get_countid_enocde(data, test,
                     ['patientid', 'Hospital_region_code'], name = 'count_id_patient_hospitalCode')data, test =
get_countid_enocde(data, test,
                     ['patientid', 'Ward_Facility_Code'], name = 'count_id_patient_wardfacilityCode')
```

 # Droping duplicate columns

```
test1 = test.drop(['Stay', 'patientid', 'Hospital_region_code', 'Ward_Facility_Code'], axis =1) train1 =
data.drop(['case_id', 'patientid', 'Hospital_region_code', 'Ward_Facility_Code'], axis =1) # Splitting
```

train data for Naive Bayes and XGBoost

```
X1 = train1.drop('Stay', axis =1)y1 =
train1['Stay']
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X1, y1, test_size =0.20, random_state =100)
```

 # Model

```
from sklearn.naive_bayes import GaussianNB
target = y_train.values
features = X_train.values
classifier_nb = GaussianNB()
model_nb = classifier_nb.fit(features, target)
prediction_nb = model_nb.predict(X_test) from
sklearn.metrics import accuracy_score
acc_score_nb = accuracy_score(prediction_nb,y_test)
print("Acurracy:", acc_score_nb*100)
```

 # Segregation of features and target variable

```
X = data.drop('Stay', axis =1)y
= data['Stay'] print(X.columns)
z = test.drop('Stay', axis = 1)
print(z.columns)
```

 # Data Scaling

```
from sklearn import preprocessingX_scale =
preprocessing.scale(X) X_scale.shape
X_train, X_test, y_train, y_test = train_test_split(X_scale, y, test_size =0.20, random_state =100) import
keras
from keras.models import Sequentialfrom
keras.layers import Dense import
tensorflow as tf
from keras.utils import to_categorical
```

#Sparse Matrix

```
a = to_categorical(y_train) b
=       to_categorical(y_test)
model = Sequential()
model.add(Dense(64, activation='relu', input_shape = (254750, 20)))
model.add(Dense(128, activation='relu'))
model.add(Dense(256, activation='relu'))
model.add(Dense(512,   activation='relu'))
```

```
model.add(Dense(512, activation='relu'))
model.add(Dense(11,  activation='softmax')) #
```

Prediction

 # Naive Bayes

```
pred_nb = classifier_nb.predict(test1.iloc[:,1:]) result_nb =
pd.DataFrame(pred_nb, columns=['Stay'])result_nb['case_id']
= test1['case_id']
result_nb = result_nb[['case_id', 'Stay']]
```

 # Neural Network

```
test_scale = preprocessing.scale(z)
test_scale.shape
```

 # Naive Bayes

```
print(result_nb.groupby('Stay')['case_id'].nunique())
```

```
Stay
0-10                   2598
11-20                 26827
21-30                 72206
31-40                 15639
41-50                   469
51-60                 13651
61-70                    92
71-80                   955
81-90                   296
91-100                    2
More than 100 Days     4322
Name: case_id, dtype: int64
```

Database Schema:

1. Case_id
2. Hospitla _code
3. Hospital_type_code
4. City_code_Hospital
5. Available Extra Rooms in Hospital
6. Department
7. Ward_type
8. Ward_Facility_code
9. BedGrade
10. Patient_id
11. City_code_Patient
12. Type of Admission
13. Severity of Illness
14. Visitors with Patient
15. Age
16. Admission_Deposit
17. Stay

TESTING

8.1 Test cases

Components	Test Scenario	Steps to Execute	Test data	Actual Working	Status
Home Page	Verify user is able to navigate to the homepage	Navigate to Hospital Healthcare analytics page and view the Homepage	https:/ us1.ca.analytics.ibm.com/bi/?perspective=dashboard&pathRef=.my_folders%2FAnalytics&action=view&mode=dashboard	Working as expected	Pass
Analytics Dashboard	Verify that users are able to view the responsive dashboard and view the data about the current scenario	1. Enter the Analytics Homepage 2. Choose the dashboard option 3. View the data	https:/ us1.ca.analytics.ibm.com/bi/?perspective=dashboard&pathRef=.my_folders%2FAnalytics&action=view&mode=dashboard	Working as expected	Pass
Story	Verify whether the story is functioned on the analytics dashboard	1. Enter the Analytics Homepage 2. Choose thestory option 3. View the story about the Hospitaldata	https://us1.ca.analytics.ibm.com/bi/?perspective=story&pathRef=.my_folders%2FANALYTICS%2BSTORY&action=view&mode=dashboard	Working as expected	Pass
Report	Verify user is able to view and run the reports	1. Enter the Analytics Homepage 2. Choose thereport option 3. View the story	https://us1.ca.analytics.ibm.com/bi/?pathRef=.my_folders%2FAnalytics%2Breport	Working as expected	Pass

8.1 User Acceptance Testing

1. Purpose of the Document:

The purpose of this document is to briefly explain the test coverage and open issues of the Analytics for Hospital's Healthcare Data project at the time of the release to User Acceptance Testing (UAT).

2. Defect Analysis:

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

Resolution	Severity1	Severity2	Severity3	Severity4	Subtotal
By Design	8	4	0	2	14
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	13	4	3	16	36
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	1	4	2	1	8
Totals	23	18	12	22	76

3. Test Case Analysis:

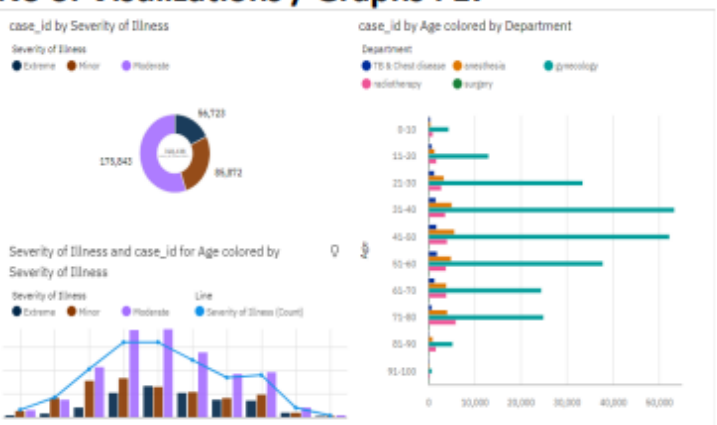
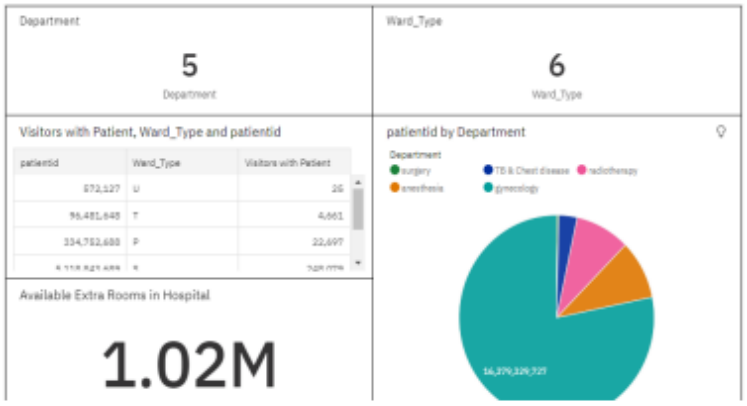
This report shows the number of test cases that have passed, failed, and untested.

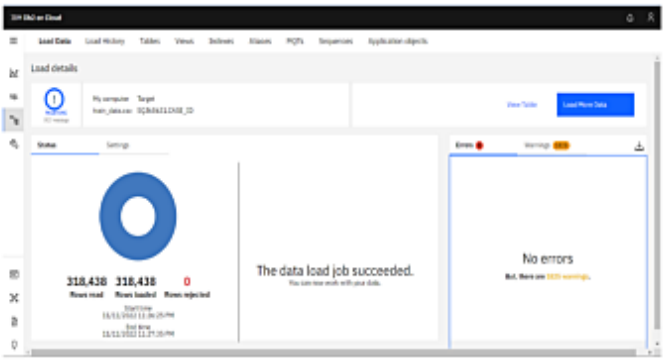
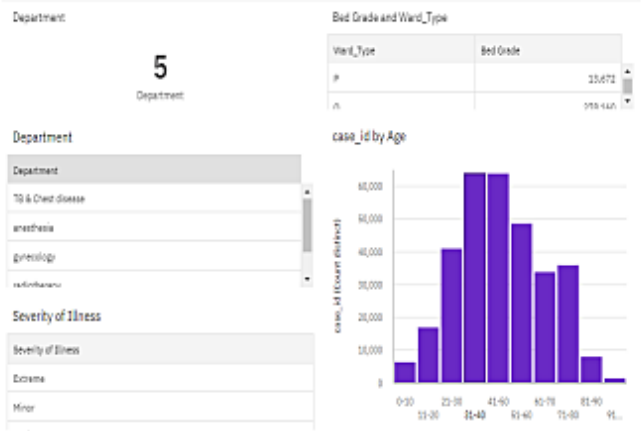
Section	Total Cases	Not Tested	Fail	Pass
Print Engine	9	0	0	9
Client Application	43	0	0	43
Security	1	0	0	1
Outsource Shipping	1	0	0	1
Exception Reporting	9	0	0	9
Final Report Output	10	0	0	10
Version Control	1	0	0	1

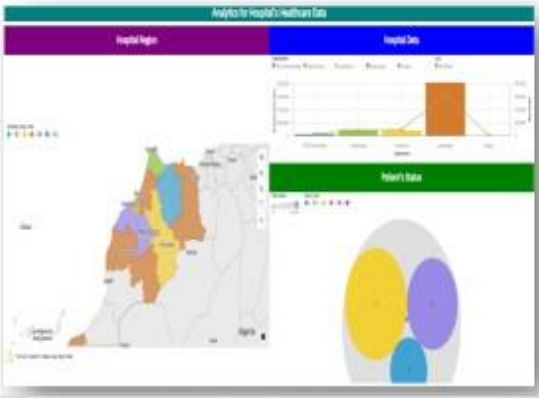
RESULTS

9.1 Performance Metrics

Model Performance Testing:

S.No.	Parameter	Screenshot / Values
1.	Dashboard design	**No of Visulizations / Graphs : 17** 
2.	Data Responsiveness	The visualizations are responsive enough to view the data and fit the screen 

3.	Amount Data to Rendered (DB2 Metrics)	**No.of Rows read: 318438** **No.of Rows loaded: 318438** 
4.	Utilization of Data Filters	The filters are used to see only the relevant data about the usecase 
5.	Effective User Story	No of Scene Added – 5

		 
6.	Descriptive Reports	No of Visulizations / Graphs – 6 

ADVANTAGES AND DISADVANTAGES

ADVANTAGES

1. Decision making and uncovering the insights are more easier
2. Presence of Visualizations make the users to understand the prevailing scenario and take necessary actions
3. The prediction of Length of stay of patient in Hospital is made easier
4. Strategically Planning
5. Improved Health Outcomes
6. The staffing procedure is defined easily
7. Presence of Predictive Model

DISADVANTAGES

1. Health regulatory changes
2. Shortage of Healthcare staffing
3. Frequent collection of data
4. Cyber security Risk
5. Implementation of Predictive model may be tedious
6. Identifying right dataset

CONCLUSION

Analytics for Hospital's Healthcare data employed to have a track on patient's healthcare and Hospital Data. It involves in staffing and resource allocation. Thus an analytical strategy is required to take the right decision on Healthcare sector. Analytics for Hospital's Healthcare data system provides the procedure to uncover the insights and make the qualified decision making by implementing the predictive analytics.

FUTURE SCOPE

In future the analytics strategy will be equipped and employed with the improved decision making procedure, thereby choosing the right way of activity planning and processes. The visualization methods will be easy tounderstand for the stakeholders. The Predictive analytics will be equipped with more special methods.

APPENDIX

Cognos Embeded Web Application:

Source Code:

Index.html

```
<!DOCTYPE html>
<html lang="en">
<head>
   <meta charset="UTF-8">
   <meta http-equiv="X-UA-Compatible" content="IE=edge">
   <meta name="viewport" content="width=device-width, initial-scale=1.0">
   <title>Analytics for Hospitals Healthcare Data</title>
   <link href="https:/ cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/css/bootstrap.min.css" rel="stylesheet"
integrity="sha384-
1BmE4kWBq78iYhFldvKuhfTAU6auU8tT94WrHftjDbrCEXSU1oBoqyl2QvZ6jIW3"
crossorigin="anonymous">
   <script src="https:/ cdn.jsdelivr.net/npm/@popperjs/core@2.10.2/dist/umd/popper.min.js"
integrity="sha384-
7+zCNj/IqJ95wo16oMtfsKbZ9ccEh31eOz1HGyDuCQ6wgnyJNSYdrPa03rtR1zdB"
crossorigin="anonymous"></script>
   <script src="https:/ cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/js/bootstrap.min.js"
integrity="sha384-
QJHtvGhmr9XOIpI6YVutG+2QOK9T+ZnN4kzFN1RtK3zEFEIsxhlmWl5/YESvpZ13"
crossorigin="anonymous"></script>
    <link rel="stylesheet" type="text/css" href="style.css">
</head>
<body>
   <div class="container-fluid" style="background-image: url(hospital.jpg); height: 500px;
background-repeat: no-repeat; background-size: cover; justify-content: center; align-items: center;
align-content: center;">
      <center>
         <div class="container">
            <h1>ANALYTICS ON HOSPITAL'S HEALTHCARE DATA</h1>
            <p style="color: white; font-weight:bolder">The visualized representation of the
```

```
Healthcare data and patient's Health status </p>
          </div>
          </center>
        <br>
        <center>
          <button type="button" class="btn btn-primary" style="width:300px; color:white; font-size: larger;
font-weight: bolder;">Explore</button>
        </center>
    </div><br>
    <div class="row row-cols-1 row-cols-md-3 g-4">
        <div class="col">
          <div class="card h-100" style="box-shadow: 5px 5px 5px grey;">
          <center><img src="dashboard.png" class="card-img-top" alt="..." style="width: 270px;
padding-top: 10px;"></center>
          <div class="card-body">
            <h5 class="card-title" style="text-align: center;">DASHBOARD</h5>
            <center><a href="Dashboard.html" class="btn btn-primary" style="width: 150px;">View</a></center>
          </div>
          </div>
        </div>
        <div class="col">
          <div class="card h-100" style="box-shadow: 5px 5px 5px grey;">
          <center><img src="report.jpg" class="card-img-top" alt="..."style="width:
230px;"></center>
          <div class="card-body">
            <h5 class="card-title"style="text-align: center;">REPORT</h5>
            <center><a href="Report.html" class="btn btn-primary" style="width: 150px;">View</a></center>
          </div>
          </div>
        </div>
        <div class="col">
          <div class="card h-100" style="box-shadow: 5px 5px 5px grey;">
```

```
          <center><img src="story.png" class="card-img-top" alt="..."style="width: 350px;"></center>
          <div class="card-body">
            <h5 class="card-title"style="text-align: center;">STORY</h5>
            <center><a href="story.html" class="btn btn-primary" style="width: 150px;">View</a></center>
          </div>
        </div>
      </div>
    </div>
    <br>
    <div class="container-fluid" style="display: flex; flex-wrap: wrap;">
      <div class="heading" style="background-color: yellow; padding: 20px; width: 50%;">
        <h2 style="font-family: 'Poppins',sans-seirf;text-align: center; margin-top: 50px;">Near by Hospitals</h2>
        <p style="font-size: larger;">The COVID patients can find their nearby Hospitals by visiting the
google map. Peoples can utilize the Hospitals services to test their COVID positivity.</p>

      </div>
      <div class="map" style="width:50%;">
        <iframe
src="https:/ www.google.com/maps/embed?pb=!1m18!1m12!1m3!1d62880.5582204828!2d78.
09430301984648!3d9.931052435772585!2m3!1f0!2f0!3f0!3m2!1i1024!2i768!4f13.1!3m3!1m2!
1s0x3b00c572ffdcafa9%3A0xab4b16a274933755!2sApollo%20Hospitals!5e0!3m2!1sen!2sin!4
v1668337968054!5m2!1sen!2sin" width="650px" height="450" style="border:0;" allowfullscreen=""
loading="lazy" referrerpolicy="no-referrer-when-downgrade"></iframe>

      </div>
    </div>

</body>
</html>
```

Dashboard. html

```
<!DOCTYPE html>
<html lang="en">
<head>
   <meta charset="UTF-8">
   <meta http-equiv="X-UA-Compatible" content="IE=edge">
   <meta name="viewport" content="width=device-width, initial-scale=1.0">
   <title>DASHBOARD: Hospital Analytics</title>
            <link    href="https://cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/css/bootstrap.min.css"
rel="stylesheet"                                                                    integrity="sha384-
1BmE4kWBq78iYhFldvKuhfTAU6auU8tT94WrHftjDbrCEXSU1oBoqyl2QvZ6jIW3"crossorigin="anonymous">
       <script src="https://cdn.jsdelivr.net/npm/@popperjs/core@2.10.2/dist/umd/popper.min.js"
integrity="sha384- 7+zCNj/IqJ95wo16oMtfsKbZ9ccEh31eOz1HGyDuCQ6wgnyJNSYdrPa03rtR1zdB"
crossorigin="anonymous"></script>
                <script      src="https://cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/js/bootstrap.min.js"
integrity="sha384-
QJHtvGhmr9XOIpI6YVutG+2QOK9T+ZnN4kzFN1RtK3zEFEIsxhlmWl5/YESvpZ13"
crossorigin="anonymous"></script>
   <style>a{
      text-decoration: none;
     }
   </style>
</head>
<body>

  <nav class="navbar bg-light fixed-top">
   <div class="container-fluid">
                      <a     class="navbar-brand"        href="#"     style="font-size:      xx-large;     font-weight:
bolder;">DASHBOARD</a>
               <button class="navbar-toggler" type="button" data-bs-toggle="offcanvas" data-bs-
target="#offcanvasNavbar" aria-controls="offcanvasNavbar">
      <span class="navbar-toggler-icon"></span>
     </button>
              <div class="offcanvas offcanvas-end" tabindex="-1" id="offcanvasNavbar" aria-
labelledby="offcanvasNavbarLabel">
      <div class="offcanvas-header">
        <h5  class="offcanvas-title"  id="offcanvasNavbarLabel">OPTIONS</h5>
```

```
                    <button type="button" class="btn-close" data-bs-dismiss="offcanvas" aria-
label="Close"></button>
      </div>
      <div class="offcanvas-body">
        <ul class="navbar-nav justify-content-end flex-grow-1 pe-3">
          <li class="nav-item">
            <a class="nav-link active" aria-current="page" href="index.html">Home</a>
          </li>

          <li class="nav-item dropdown">
              <a class="nav-link dropdown-toggle" href="#" role="button" data-bs-toggle="dropdown" aria-
expanded="false">
              Dashboards
            </a>
            <ul class="dropdown-menu">
              <li><a class="dropdown-item" href="dashhome.html">Dash-Home</a></li>
                        <li><a class="dropdown-item" href="department.html">Departments and
Wards</a></li>
                    <li><a class="dropdown-item" href="severity.html">Patients Disease Severity
Status</a></li>
              <li>
                <hr class="dropdown-divider">
              </li>
              <li><a class="dropdown-item" href="Overall.html">Overall Analysis</a></li>
            </ul>
          </li>
        </ul>
      </div>
    </div>
  </div>
</nav><br><br>

  <center>
    <img src="Dashboards.png" class="img-fluid" width="60%" style="height: 430px;">
  </center>
  <div class="row row-cols-1 row-cols-md-2 g-4">
    <div class="col">
      <div class="card" style="box-shadow: 10px 10px 6px skyblue;">
        <center><img src="icon.jpg" class="card-img-top" alt="..." style="width: 250px;"></center>
        <div class="card-body" style="text-align: center;">
          <a href="dashhome.html"><h5 class="card-title">Home</h5></a>
```

```
            <p class="card-text">View the Hospital region and the summary of Admission in theHospitals</p>
          </div>
         </div>
       </div>
       <div class="col">
         <div class="card" style="box-shadow: 10px 10px 6px skyblue;">
                    <center><img src="departments.jpg" class="card-img-top" alt="..."style="width:
270px;"></center>
          <div class="card-body" style="text-align: center;">
           <a href="department.html"><h5 class="card-title">Departments and Wards</h5></a>
            <p class="card-text">Departments and Ward Data can be analyzed here and status isknown</p>
          </div>
         </div>
       </div>
       <div class="col">
         <div class="card" style="box-shadow: 10px 10px 6px skyblue;">
                        <center><img src="Patient.jpg" class="card-img-top" alt="..." style="width:
290px;"></center>
          <div class="card-body" style="text-align: center;">
           <a href="severity.html"><h5 class="card-title">Patients Disease Severity Status</h5></a>
           <p class="card-text">COVID Patients status on severity of illness</p>
          </div>
         </div>
       </div>
       <div class="col">
         <div class="card" style="box-shadow: 10px 10px 6px skyblue;">
                        <center><img src="analytics.jpg"  class="card-img-top"  alt="..."style="width:
290px;"></center>
          <div class="card-body" style="text-align: center;">
           <a href="Overall.html"><h5 class="card-title">Overall</h5></a>
           <p class="card-text">The Overall Scenario of the Hospital Visualizations</p>
          </div>
         </div>
       </div>
     </div>

</body>
</html>
```

report.html

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta http-equiv="X-UA-Compatible" content="IE=edge">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>Report</title>
        <link  href="https://cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/css/bootstrap.min.css"
rel="stylesheet"                                                    integrity="sha384-
1BmE4kWBq78iYhFldvKuhfTAU6auU8tT94WrHftjDbrCEXSU1oBoqyl2QvZ6jIW3"crossorigin="anonymous">
    <script src="https://cdn.jsdelivr.net/npm/@popperjs/core@2.10.2/dist/umd/popper.min.js"
integrity="sha384- 7+zCNj/IqJ95wo16oMtfsKbZ9ccEh31eOz1HGyDuCQ6wgnyJNSYdrPa03rtR1zdB"
crossorigin="anonymous"></script>
          <script   src="https://cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/js/bootstrap.min.js"
integrity="sha384-
QJHtvGhmr9XOIpI6YVutG+2QOK9T+ZnN4kzFN1RtK3zEFEIsxhlmWl5/YESvpZ13"
crossorigin="anonymous"></script>
</head>
<body>
  <nav class="navbar navbar-expand-lg navbar-dark bg-primary">
    <div class="container-fluid">
            <button class="navbar-toggler" type="button" data-bs-toggle="collapse" data-bs-target="#menu">
        <span class="navbar-toggler-icon"></span>
      </button>
      <div class="collapse navbar-collapse" id="menu">
        <ul class="navbar-nav ms-auto" style="font-weight: bolder; font-size: x-large;">
          <li class="nav-item">
            <a class="nav-link" href="index.html">Home</a>
          </li>
        </ul>
      </div>
    </div>
  </nav>
<center><iframe
src="https://us1.ca.analytics.ibm.com/bi/?pathRef=.my_folders%2FAnalytics%2Breport&amp;amp;cl
oseWindowOnLastView=true&amp;amp;ui_appbar=false&amp;amp;ui_navbar=false&amp;amp;shareMode=em
```

bedded&action=run&format=HTML&prompt=false" width="100%" height="600" frameborder="0" gesture="media" allow="encrypted-media" allowfullscreen=""></iframe>

</body>
</html>

Story.html

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta http-equiv="X-UA-Compatible" content="IE=edge">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>Story</title>
        <link  href="https://cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/css/bootstrap.min.css" rel="stylesheet" integrity="sha384-1BmE4kWBq78iYhFldvKuhfTAU6auU8tT94WrHftjDbrCEXSU1oBoqyl2QvZ6jIW3"crossorigin="anonymous">
    <script src="https://cdn.jsdelivr.net/npm/@popperjs/core@2.10.2/dist/umd/popper.min.js" integrity="sha384- 7+zCNj/IqJ95wo16oMtfsKbZ9ccEh31eOz1HGyDuCQ6wgnyJNSYdrPa03rtR1zdB" crossorigin="anonymous"></script>
        <script  src="https://cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/js/bootstrap.min.js" integrity="sha384-QJHtvGhmr9XOIpI6YVutG+2QOK9T+ZnN4kzFN1RtK3zEFEIsxhlmWl5/YESvpZ13" crossorigin="anonymous"></script>
</head>
<body>
  <nav class="navbar navbar-expand-lg navbar-dark bg-primary">
    <div class="container-fluid">
          <button class="navbar-toggler" type="button" data-bs-toggle="collapse" data-bs-target="#menu">
        <span class="navbar-toggler-icon"></span>
      </button>
      <div class="collapse navbar-collapse" id="menu">
        <ul class="navbar-nav ms-auto" style="font-weight: bolder; font-size: x-large;">
          <li class="nav-item">
            <a class="nav-link" href="index.html">Home</a>
```

```
            </li>

          </ul>
        </div>
      </div>

  </nav>
<center><iframe
src="https://us1.ca.analytics.ibm.com/bi/?perspective=story&amp;pathRef=.my_folders%2FANALYTICS%2BSTORY&amp;closeWindowOnLastView=true&amp;ui_appbar=false&amp;ui_navbar=false&amp;shareMode=embedded&amp;action=view&amp;sceneId=model0000018456067085_00000001&amp;sceneTime=0" width="100%" height="600" frameborder="0" gesture="media" allow="encrypted-media" allowfullscreen=""></iframe></center>

</body>
</html>
```

GITHUB PAGE:

https:// github.com/IBM-EPBL/IBM-Project-37579-1660312773

PROJECT DEMO:

https://drive.google.com/file/d/1tZKo8TmC3N_VpShhP2KjVX7A6WYYJ0oi/view?usp=sharing