NALAIYA THIRAN - IBM PROJECT REPORT

(19EC406T - Professional Readiness for Innovation, Employability and Entrepreneurship)

ON

ANALYTICS FOR HOSPITAL'S HEALTH-CARE DATA

Submitted by

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in partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

1.INTRODUCTION

1.1 Project Overview

The data analysis results are visualized through display charts/graphs that make it easier for users to understand the data analysis results and interpretation. This dashboard is useful to facilitate decision making so that stakeholders can find out more quickly to be able to respond appropriately and also improve the quality of health services so as to improve the degree of public health. At the time of admission, it helps the 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. It gives us a full-fledged analysis on the hospital data regarding the patient health conditions and case study analysis, which can result in the enormous amount of growth in the health-care industry to analyze the health-care data **.**

1.2 Purpose

It gives us a full-fledged analysis on the hospital data regarding the patient health conditions and case study analysis, which can result in the enormous amount of growth in the health-care industry to analyze the health-care data. IBM Cognos analytical tool has been used to make the analysis and create an interactive dashboard to make the real-time analysis on the incoming data from the database. The scope of this project is to make an intuitive dashboard, report and story to present it to the user's perspective to make them understand in a better manner. Apart from the length of stay for each patient, it is used to analyze the various fields related to health using various visualization plots.

2. LITERATURE SURVEY

2.1 Existing Problems

In the existing system of analytics in hospital management it was unable to maintain a large amount of data.The data that needed to be store in the dataset may arrive at a low speed.There is less data privacy in the informations that are stored in the datasets.Inaccuracies in the data lead to poor decision-making. One of the major drawbacks in the application of big data in the healthcare industry is the issue of lack of privacy. As with just about every computer network these days, EHR systems are vulnerable to hacking, which means sensitive patient data could fall into the wrong hands. A drawback of clinical trials is that they are highly controlled and highly monitored to ensure strict adherence to protocol; however, that's not how people take drugs in the real world. Variables used in the clinical prediction model were not clearly reported, or unavailable in routine clinical practice.

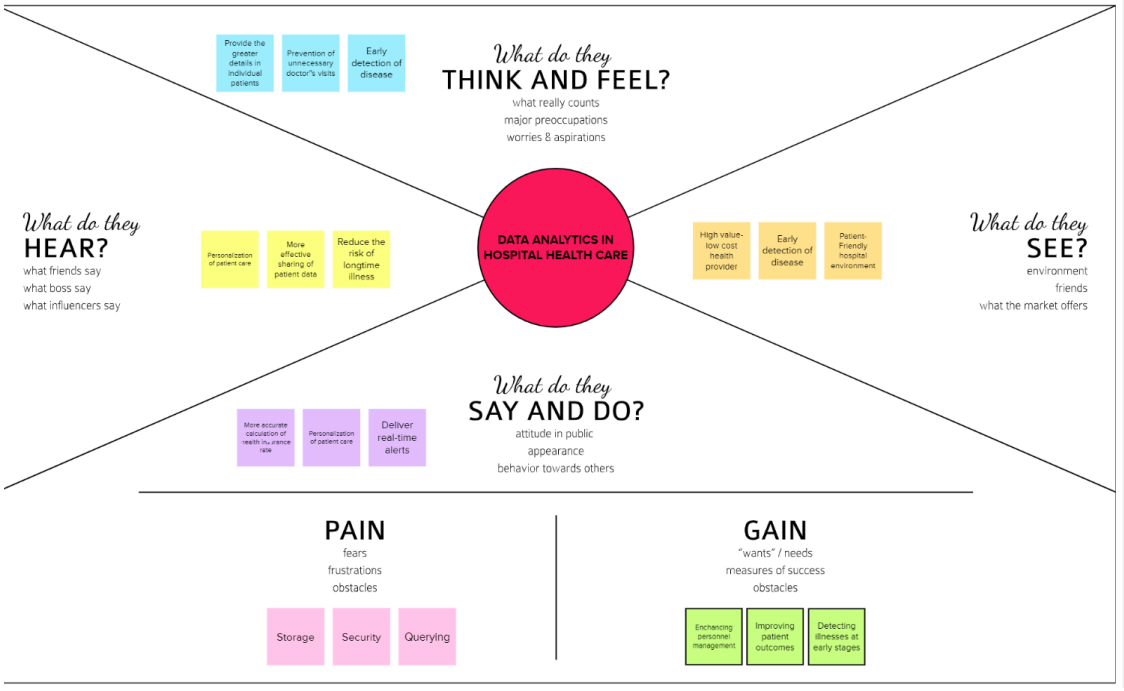
2.2 Problem Statement Definition

The healthcare costs have been constantly rising, the quality of care provided to the patients in the many states have not seen considerable improvements. Recently, several researchers have conducted studies which showed that by incorporating the current healthcare technologies, they are able to reduce mortality rates, healthcare costs and medical complications at various hospitals. The recent advances in information technology have led to an increasing ease in the ability to collect various forms of healthcare data. Data analytics, in particular, forms a critical component of these computing technologies. Healthcare is a multi-dimensional system established with the sole aim for the prevention, diagnosis, and treatment of health-related issues or impairments in human beings. The combined pool of data from healthcare organizations and biomedical researchers has resulted in a better outlook, determination, and treatment of various diseases. This has also helped in building a better and healthier personalized healthcare framework.

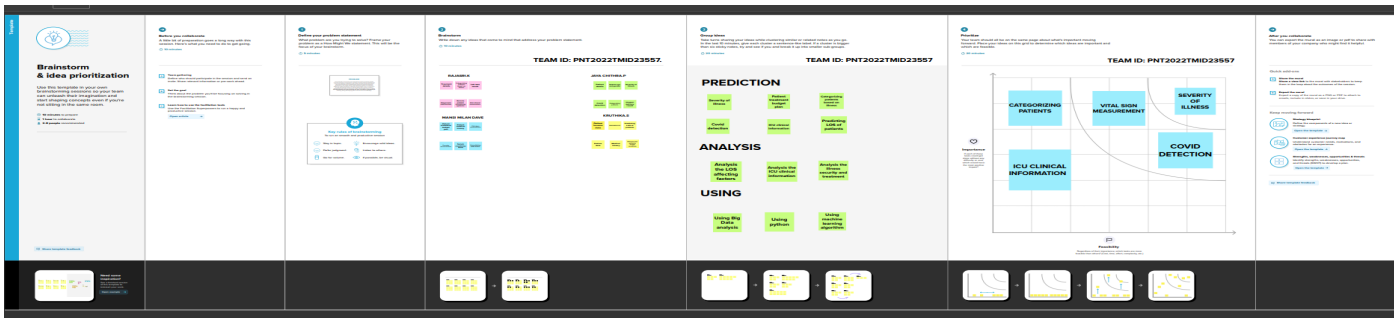
Modern healthcare fraternity has realized the potential of big data and therefore, have implemented big data analytics in healthcare and clinical practices.Drug discovery is related to big data analytics as the process may require the collection, processing and analysis of extremely large volume of structured and unstructured biomedical data stemming from a wide range of experiments and surveys collected by hospitals, laboratories, pharmaceutical companies or even social media.

3.IDEATION AND PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation and Brainstorming



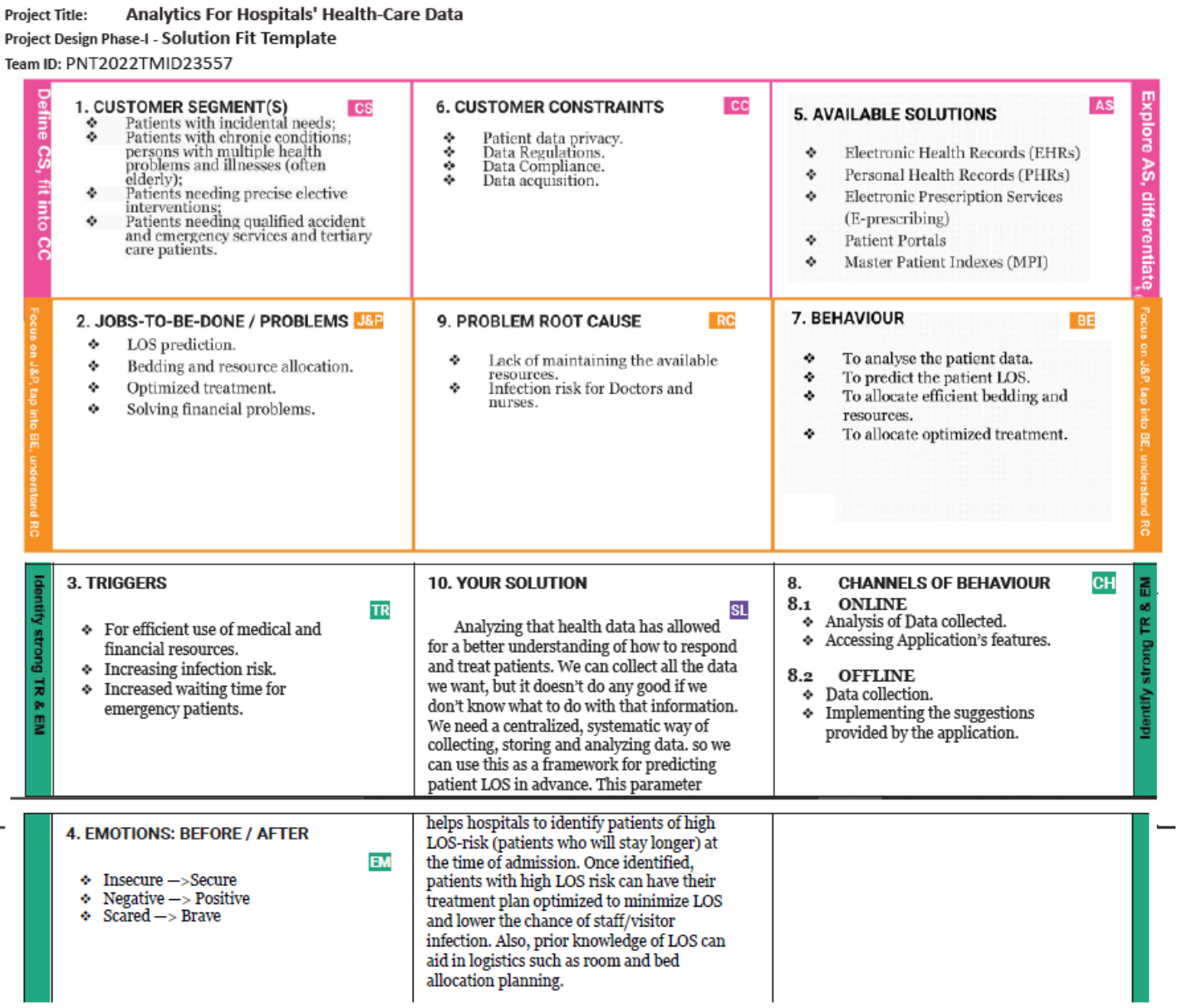
3.3 Proposed Solution

S.No.	Parameter	Description
1	Problem Statement (Problem to be solved)	Accurate prediction of patient LOS may aid the healthcare specialists to take medical decisions and allocate medical team and resources.
2	Idea / Solution description	Here we are Analyzing that health data has allowed for a better understanding of how to respond and treat patients. We can collect all the data we want, but it doesn't do any good if we don't know what to do with that information. We need a centralized, systematic way of collecting, storing and analyzing data. so we can use this as a framework for predicting patient LOS in advance.

3	Novelty / Uniqueness	There is a need for an accurate LOS prediction system to estimate patient LOS in the ICU. we in advance used, a centralized, systematic way of collecting, storing and analyzing data .
4	Social Impact / Customer Satisfaction	For predicting patient LOS, Because of its effectiveness and equity, LOS is used to evaluate the efficiency of both the medical and the financial sections .The patient and insurance companies may use this prediction to manage their budget as well.
5	Business Model (Revenue Model)	ICU is considered one of the most resource-consuming departments in the medical sections. Most elderly ICU patients are exposed to aggressive medical procedures to keep them alive, and about 33% of them die after a prolonged LOS. Moreover, the time after discharging a prolonged LOS patient is critical as 55% of patients died within six months of being discharged . In addition, the average cost for patients who have a prolonged ICU LOS is seven times the cost of the patients who do not have a prolonged LOS . Therefore, we satisfy the need for an accurate LOS prediction system to estimate patient LOS in the ICU in advance.
6	Scalability of the Solution	Here LOS is used to evaluate the efficiency of both the medical and the financial sections. By analyzing the

		health data we will fulfill the need for an accurate LOS prediction system to estimate patient LOS in the ICU in advance.

3.4 Proposed Solution



4. REQUIREMENT ANALYSIS

4.1 Functional Requirements

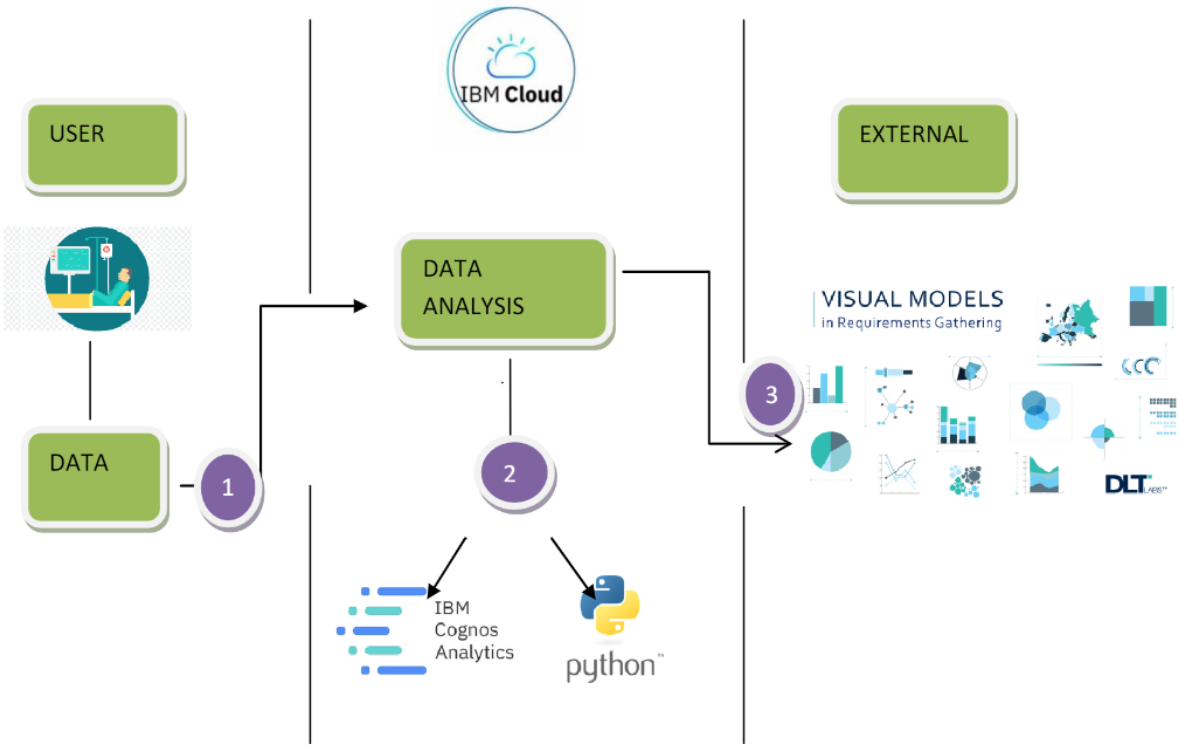
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through the form
FR-2	Check availability	Checking the availability of rooms and beds in the hospital for allocating the rooms and bed for a new patient
FR-3	Analyzing the user data	Analyzing through a registered form by a user and providing the LOS
FR-4	Display the data	Using a dashboard displaying a patient progress and also updating the LOS

4.2 Non Functional Requirements

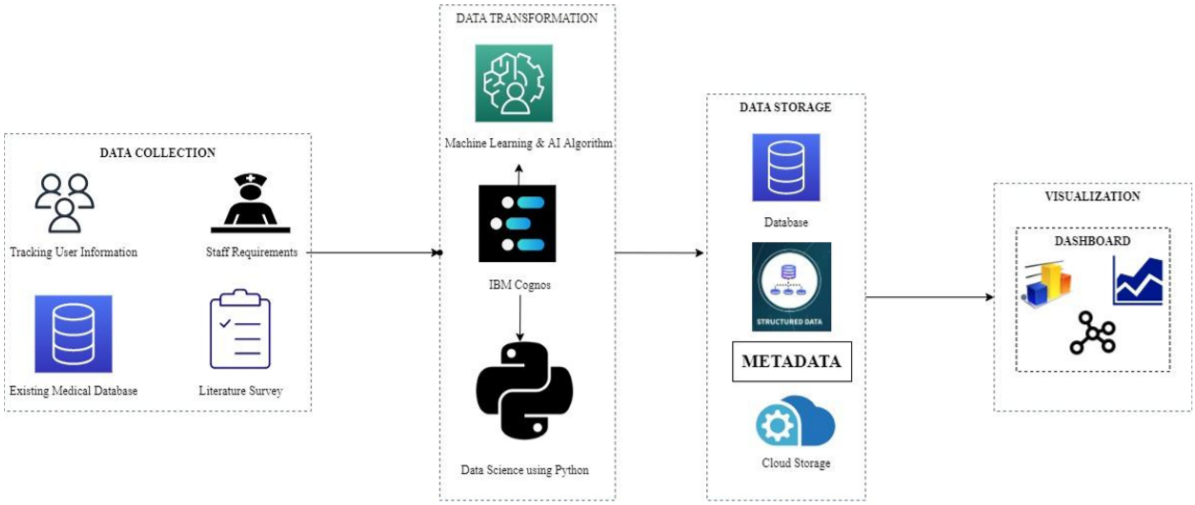
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	It is a very user friendly application as we are using the visualizations techniques for easy understanding of the LOS.
NFR-2	Security	We can secure the patients data with appropriate caution and take smart decisions . Restrict access to data and applications.
NFR-3	Reliability	It provides consistency in quality and safety of health care systems or processes performed over a required period of time .it is trustable since it has a lower risk of errors and processes failures that can cause patients harm.
NFR-4	Performance	It is a high performance application because doctors can easily find the available LOS.

5. PROJECT DESIGN

5.1 Data Flow Diagram



5.2 Solution & Technical Architecture



5.3 User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer	Retrieve data	USN-1	As a user I should get clearer clinical context for cancer patient's unique case	Oncologists provided with tools to help them personalize their patient's treatments	High	Sprint-1
Customer	Improve treatment of disease	USN-2	As a user, I got improved techniques for prevention of disease and identify members who are at risk.	Got precise ways of treating disease	High	Sprint-1
Customer	Reduced wait time	USN-3	As a user I got reduced patient wait time via improved scheduling and staffing	Wait time of patients reduced	High	Sprint-2
Customer	Detailed EHRs of patient	USN-4	Provided greater detail in the EHRs of individual patient	EHRS provided in detail	Medium	Sprint-1
Customer	Track of patient's visit to hospitals	USN-5	Tracking a patient's healthcare over years of visits and screening.	Patient visit at hospital recorded periodically	High	Sprint-2

6. PROJECT PLANNING & SCHEDULING

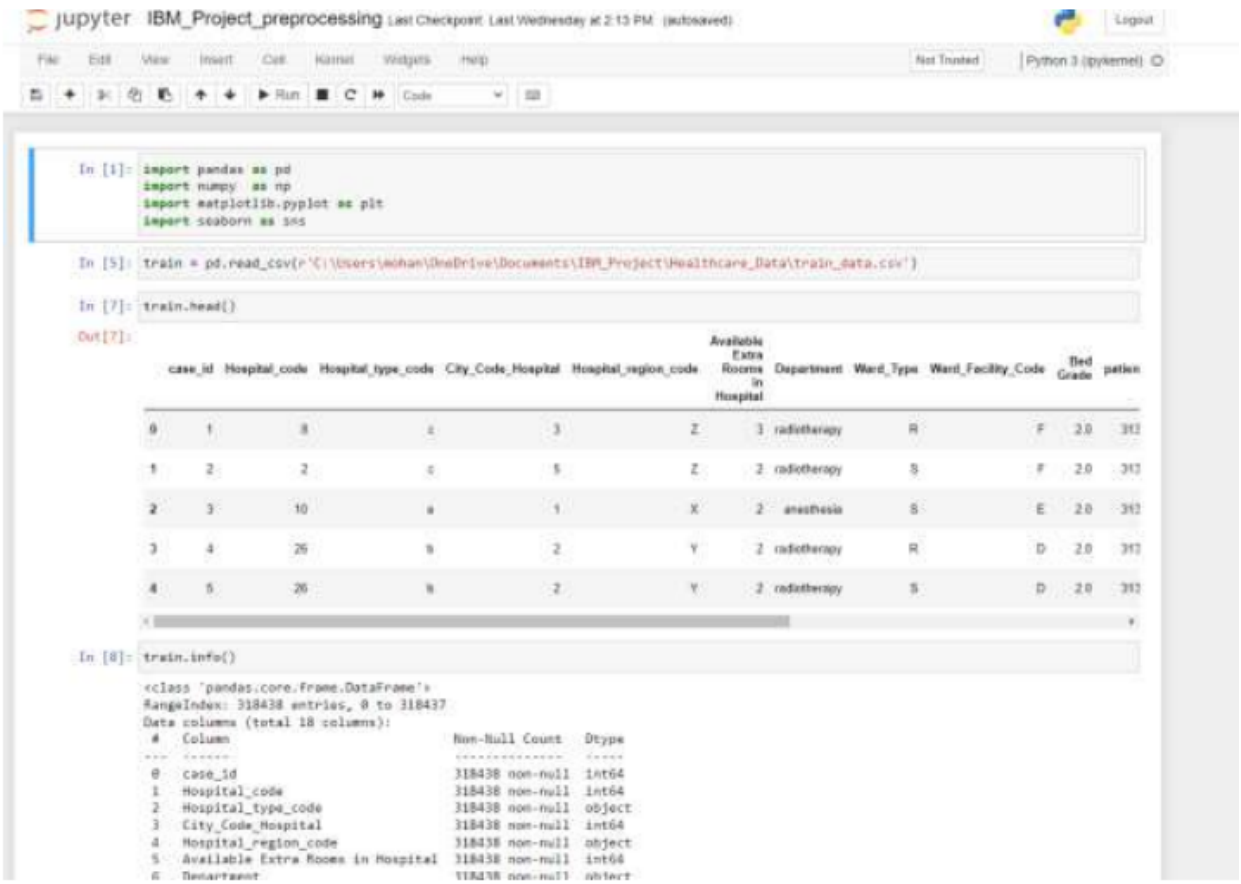
6.1 Sprint Planning & Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	10	High	MansiMilanDave, Rajasri, Jaya chithra,kruthika
Sprint-1	Data uploading	USN-2	As a user, I will be uploading my data into the cognos analytics	10	High	MansiMilanDave, Rajasri, Jaya chithra,kruthika
Sprint-2	Data Analysis	USN-3	As a user, I will be performing analysis on the data for making predictions	5	High	MansiMilanDave, Rajasri, Jaya chithra, kruthika
Sprint-2	Dashboards	USN-4	As a user, I will be making visualizations and interactive dashboards from the data	10	High	MansiMilanDave, Rajasri, Jaya chithra,kruthika
Sprint-3	Story	USN-5	As a user, I will be making stories from the data and the dashboards	20	High	MansiMilanDave, Rajasri, Jaya chithra,kruthika
Sprint-4	Report	USN-6	As a user, I will be making a report from the analysis and dashboards	20	High	MansiMilanDave ,Rajasri, Jaya chithra, kruthika

Sprint 1

Data preprocessing

Using Jupyter notebook to remove the null values:



In [17]:
```
train.isnull().sum()
```

Out[17]:
```
case_id                            0
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
patientid                          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
```

In [18]:
```
train = train.to_csv('final_train_data.csv', index=False)
```

In [19]:
```
test = pd.read_csv(r'C:\Users\mohan\OneDrive\Documents\IBM_Project\Healthcare_Data\test_data.csv')
```

In [20]:
```
test.head()
```

Out[20]:

	case_id	Hospital_code	Hospital_type_code	City_Code_Hospital	Hospital_region_code	Available Extra Rooms in Hospital	Department	Ward_Type	Ward_Facility_Code	Bed Grade	patien
0	318439	21	c	3	Z	3	gynecology	S	A	2.0	170
1	318440	29	a	4	X	2	gynecology	S	F	2.0	170

```
Stay                               0
dtype: int64
```

In [11]:
```
train['Bed Grade'].value_counts()
```

Out[11]:
```
2.0    123671
3.0    110583
4.0     57566
1.0     26505
Name: Bed Grade, dtype: int64
```

In [12]:
```
train['Bed Grade'].unique()
```

Out[12]:
```
array([ 2.,  3.,  4.,  1., nan])
```

In [13]:
```
train.shape
```

Out[13]:
```
(318438, 18)
```

In [14]:
```
train.dropna(inplace=True)
```

In [15]:
```
train.shape
```

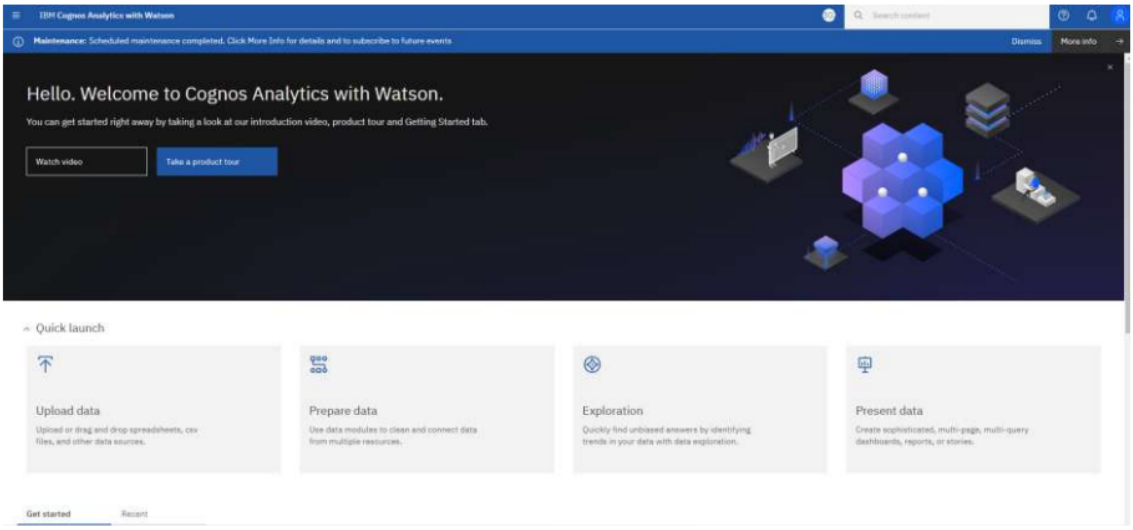
Out[15]:
```
(313793, 18)
```

In [16]:
```
train.head()
```

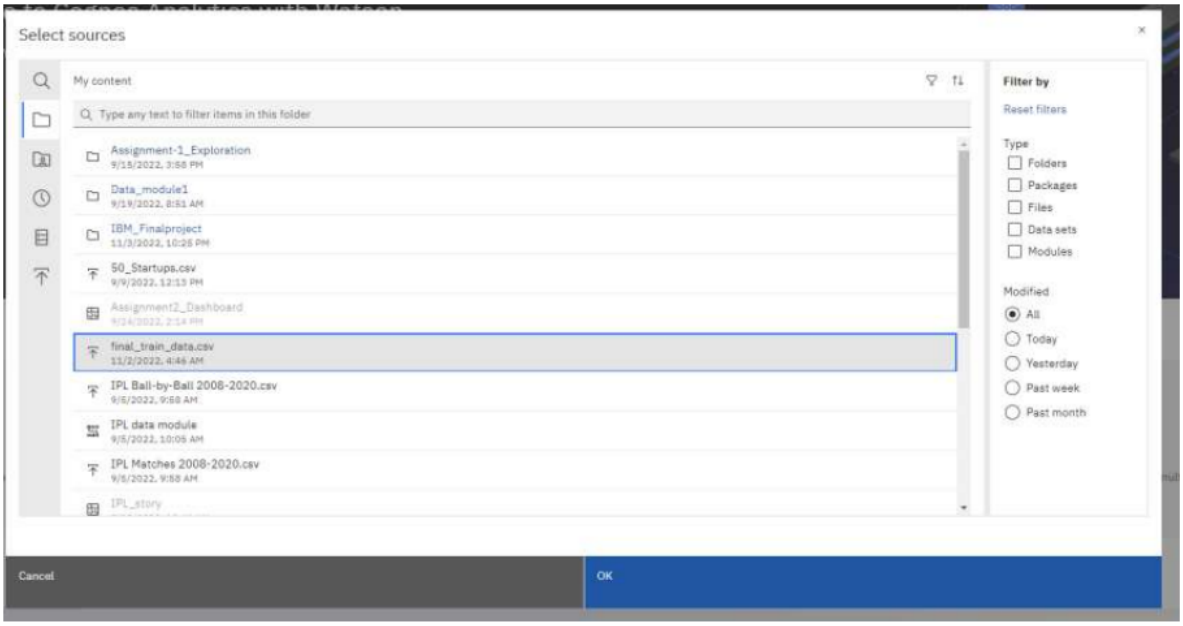
Out[16]:

	case_id	Hospital_code	Hospital_type_code	City_Code_Hospital	Hospital_region_code	Available Extra Rooms in Hospital	Department	Ward_Type	Ward_Facility_Code	Bed Grade	patien
0	1	8	c	3	Z	3	radiotherapy	R	F	2.0	313
1	2	2	c	5	Z	2	radiotherapy	S	F	2.0	313
2	3	10	e	1	X	2	anesthesia	S	E	2.0	313
3	4	26	b	2	Y	2	radiotherapy	R	D	2.0	313

Signing in to the IBM Cognos tool:



Selecting the dataset to upload into the Cognos:

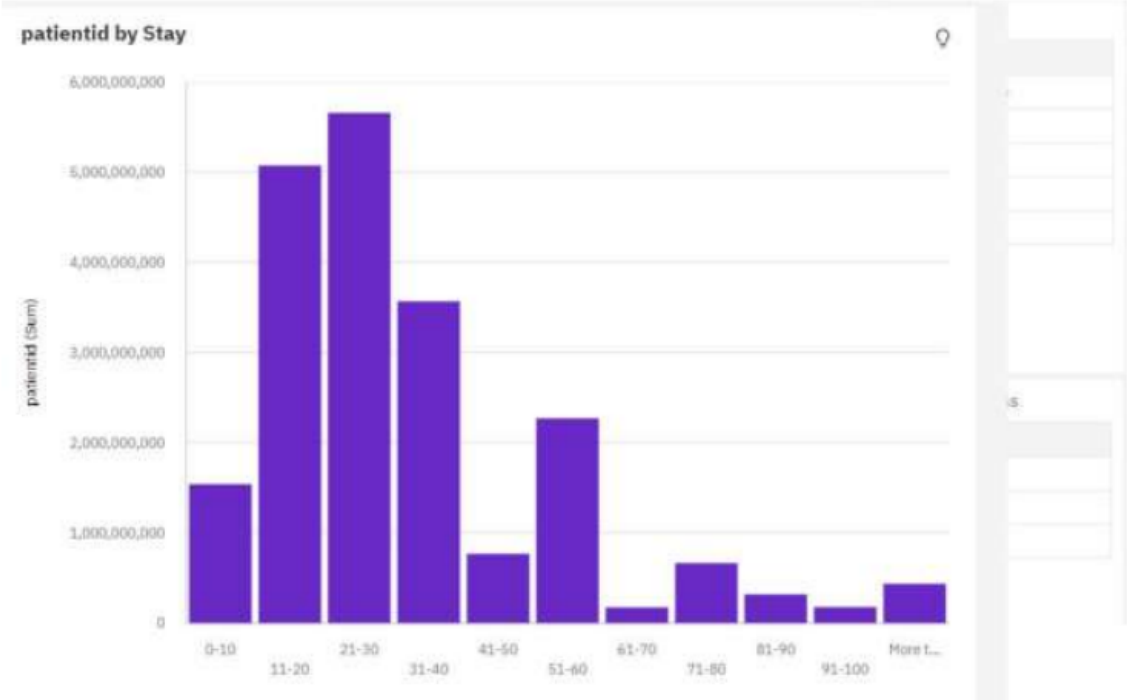


Sprint 2

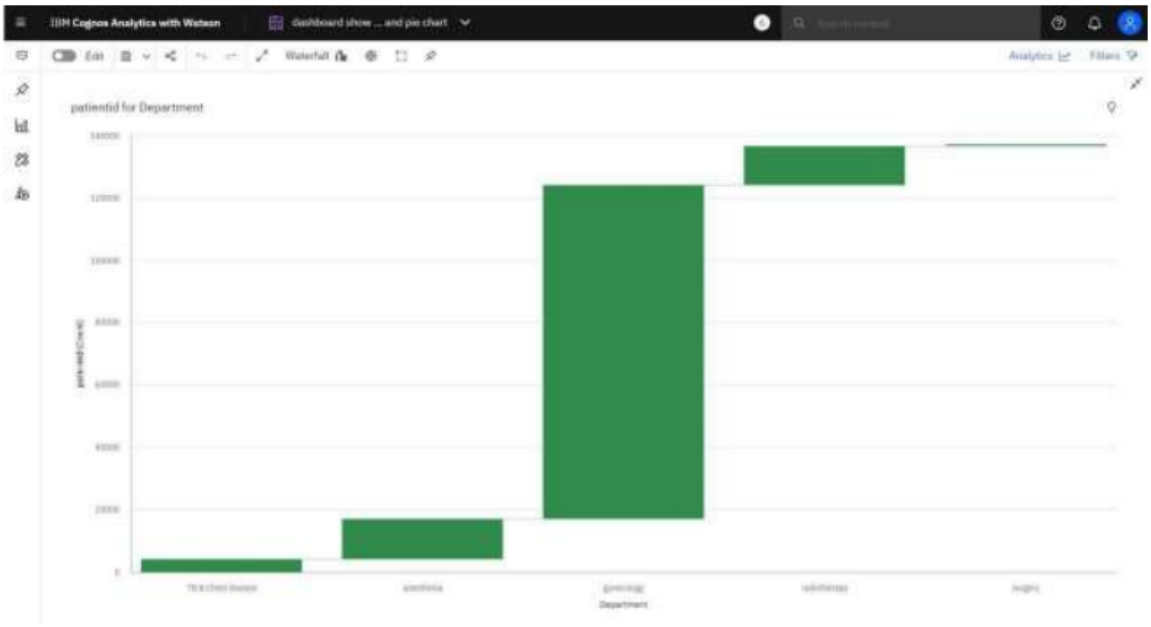
- Data Exploration

- Patient id by stay
- Patient id for department
- Severity of Illness by Age colored by City Code Hospital
- Case id by Ward Type
- Case id by Department
- Bed Grade by Department
- Case id by Severity of Illness
- Patient by Ward Type
- Available Extra Rooms in Hospital by Ward type
- Stay by Department
- Admission count for Department

Patient id by stay:

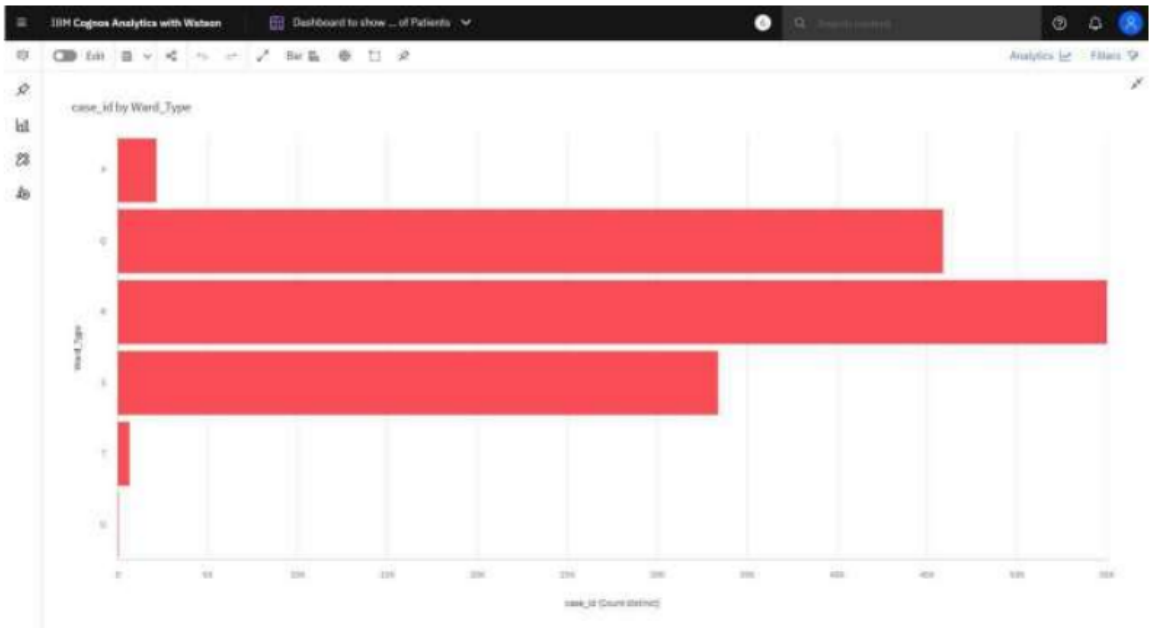


Patient id for department:

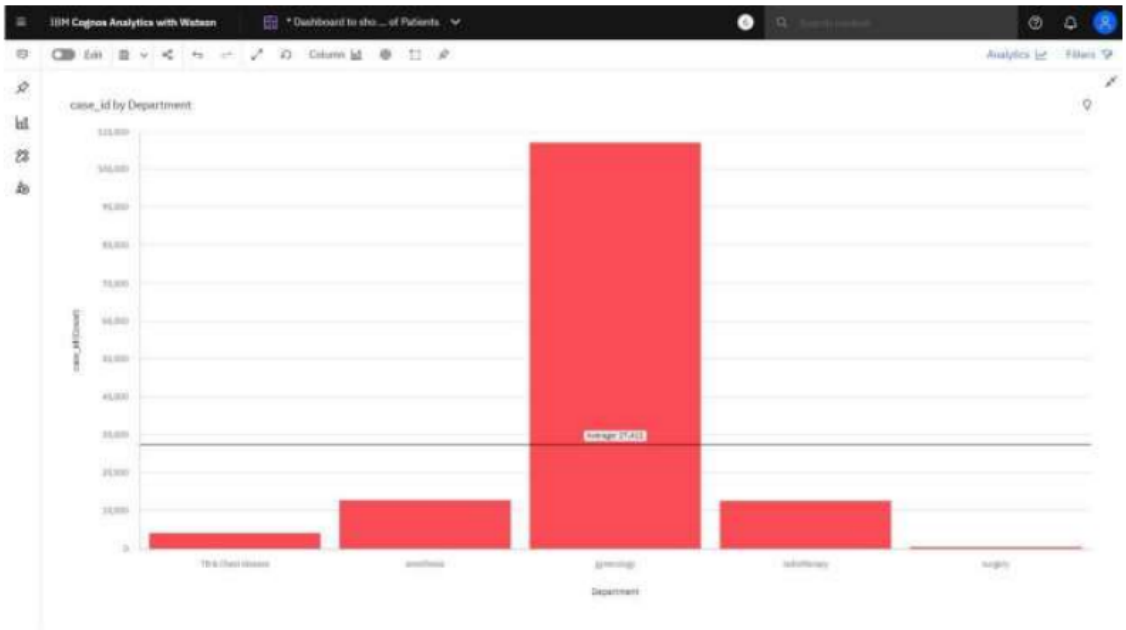


Severity of illness by Age colored by city code Hospital:

Case id by ward type:

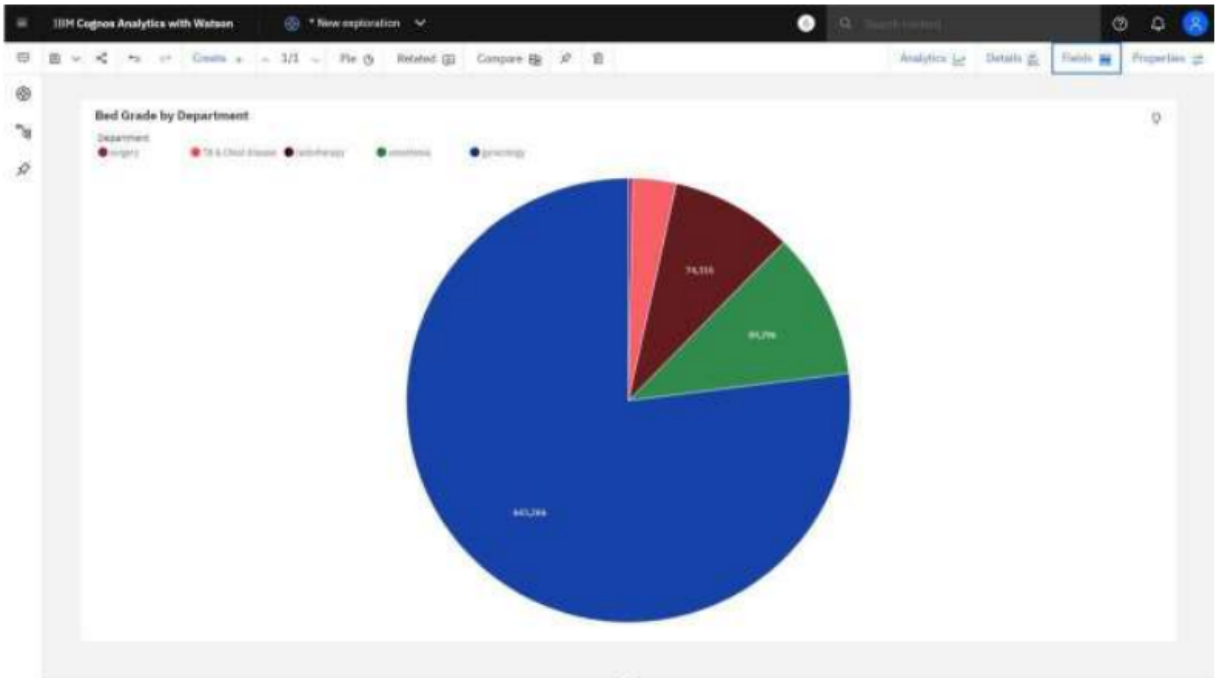


Case id by department:



Bed Grade by Department:

Bed Grade by Department:



Case Id by severity of illness:

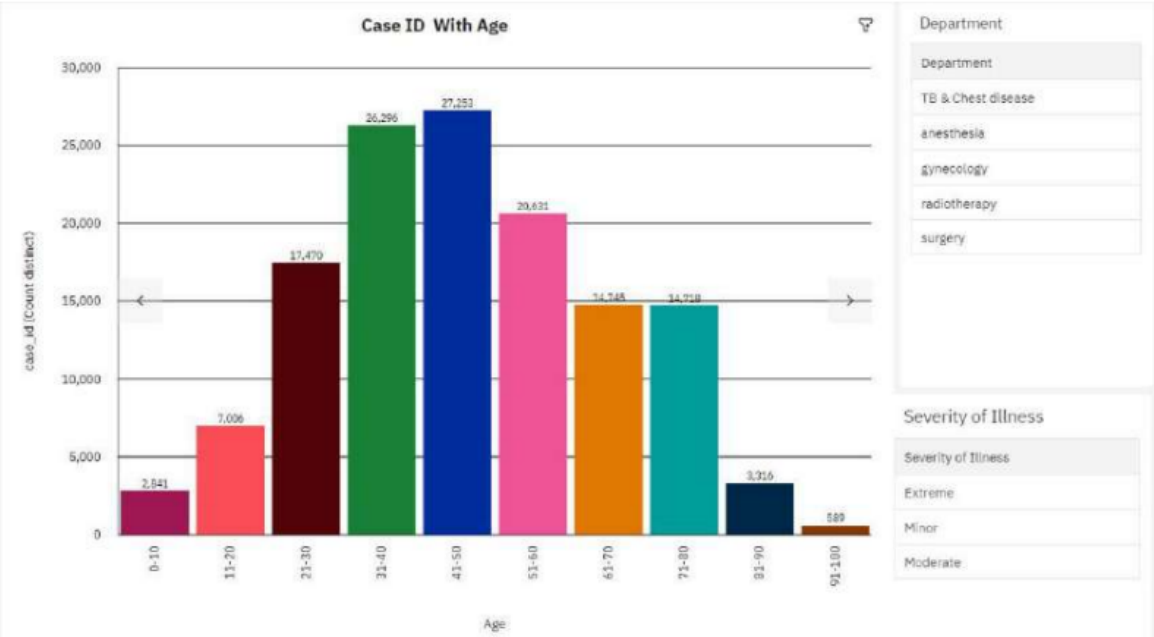
Patient id by ward type:

Sprint 3

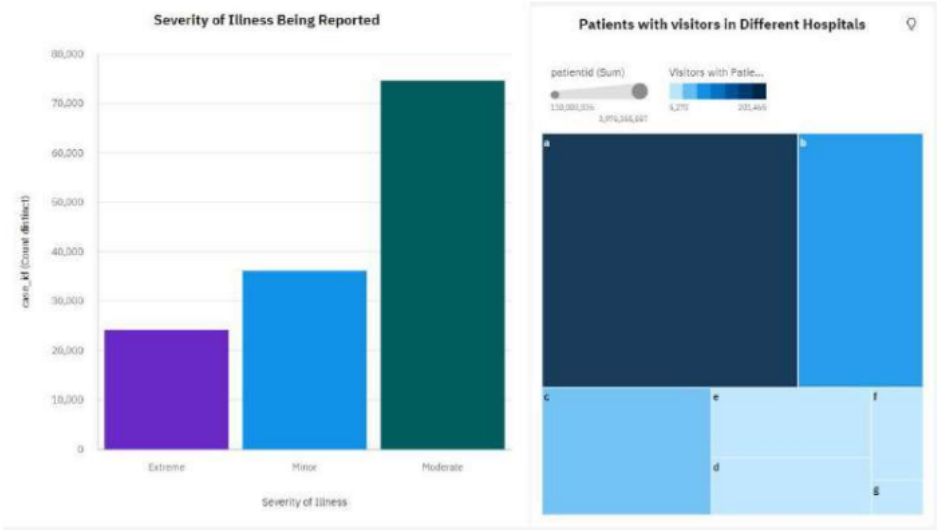
Dashboard

DASHBOARD:

AGE OF PATIENTS WITH CASE ID AND FILTERS OF DEPARTMENTS AND SEVERITY OF ILLNESS:



SEVERITY OF ILLNESS AND VISITORS IN HOSPITALS:



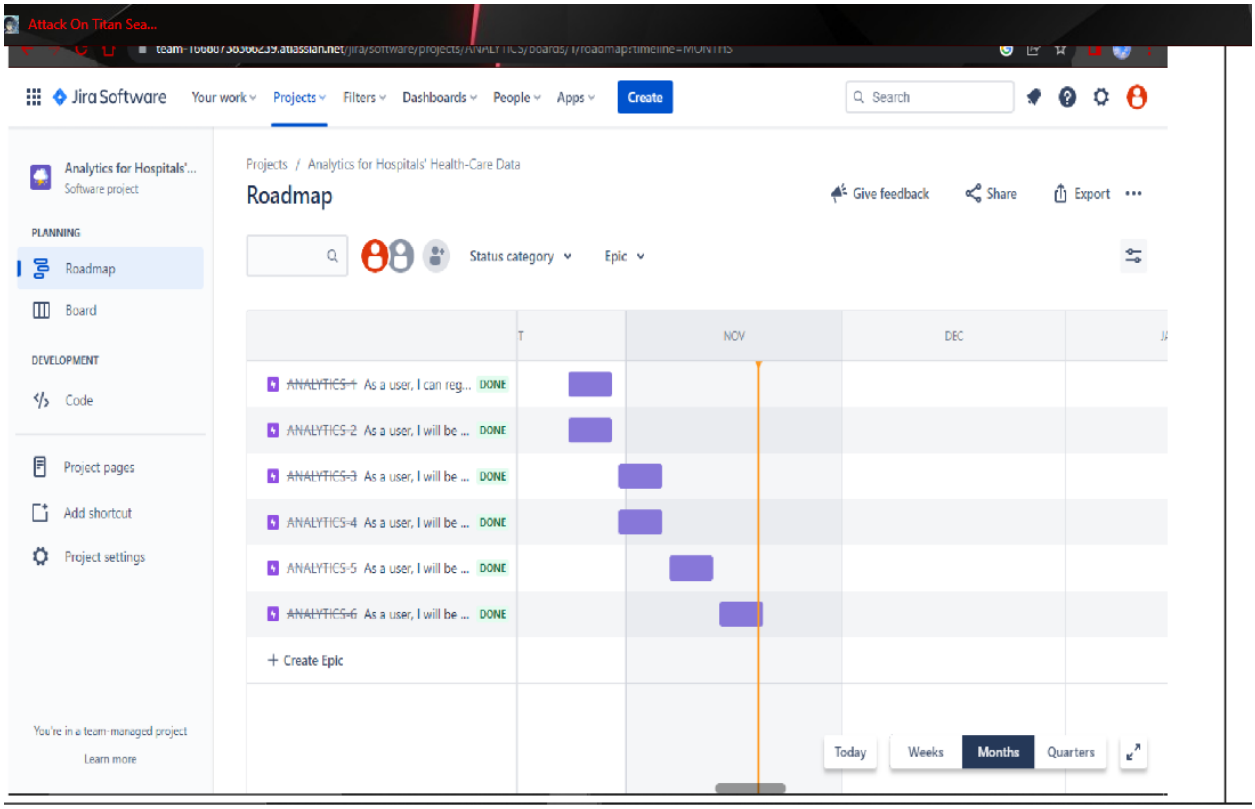
6.2 Sprint Delivery Schedule

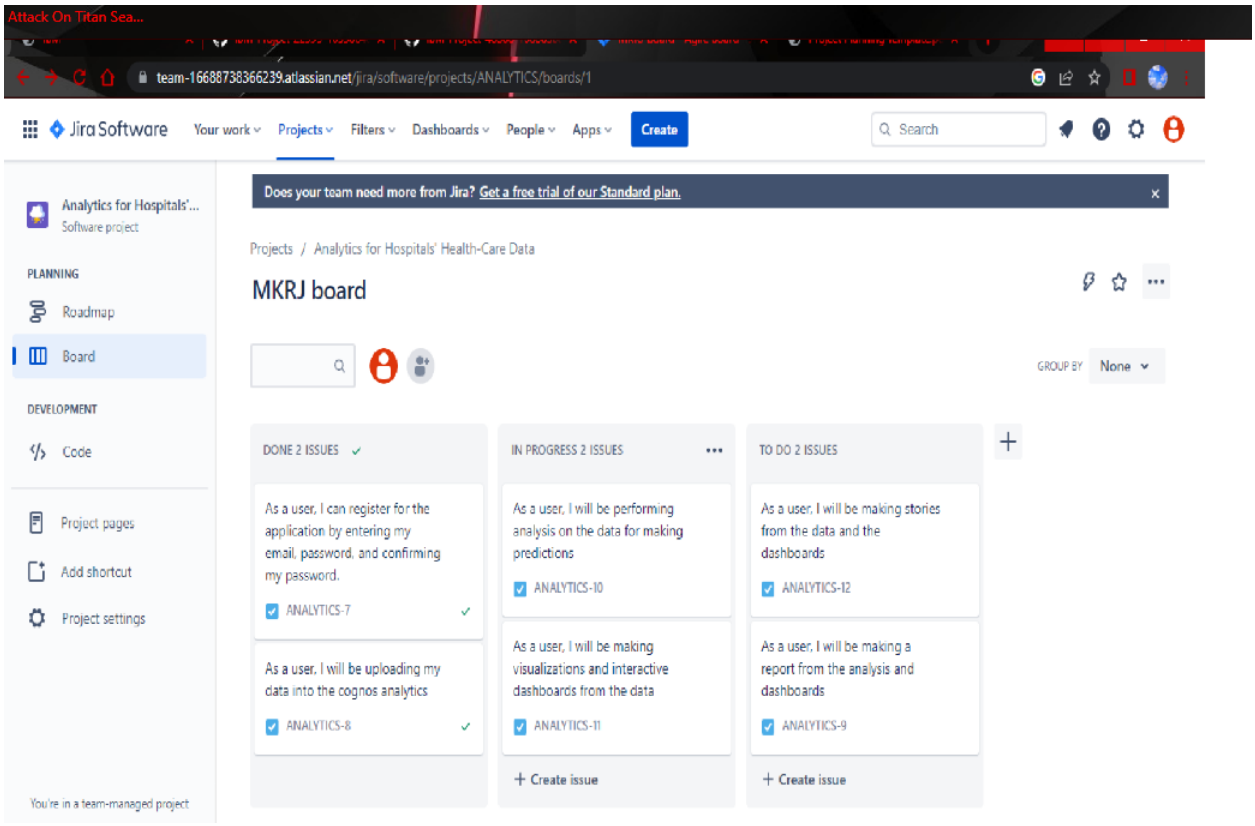
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

Velocity:
Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

6.3 Reports from JIRA



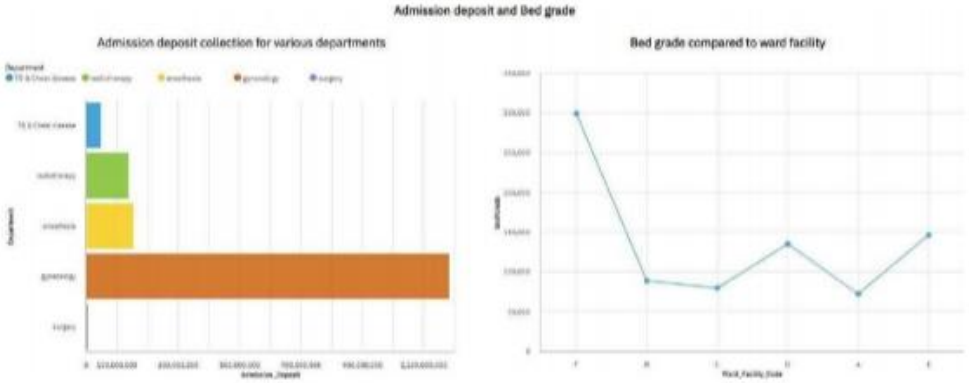

Attack On Titan Sea...
team-16688738366239.atlassian.net/jira/software/projects/ANALYTICS/boards/1
Jira Software
Your work
Projects
Filters
Dashboards
People
Apps
Create
Search
Analytics for Hospitals'...
Software project
PLANNING
Roadmap
Board
DEVELOPMENT
Code
Project pages
Add shortcut
Project settings
You're in a team-managed project
Does your team need more from Jira? Get a free trial of our Standard plan.
Projects / Analytics for Hospitals' Health-Care Data
MKRJ board
GROUP BY
None
DONE 2 ISSUES
As a user, I can register for the application by entering my email, password, and confirming my password.
ANALYTICS-7
As a user, I will be uploading my data into the cognos analytics
ANALYTICS-8
IN PROGRESS 2 ISSUES
As a user, I will be performing analysis on the data for making predictions
ANALYTICS-10
As a user, I will be making visualizations and interactive dashboards from the data
ANALYTICS-11
+ Create issue
TO DO 2 ISSUES
As a user, I will be making stories from the data and the dashboards
ANALYTICS-12
As a user, I will be making a report from the analysis and dashboards
ANALYTICS-9
+ Create issue

7. CODING & SOLUTIONING

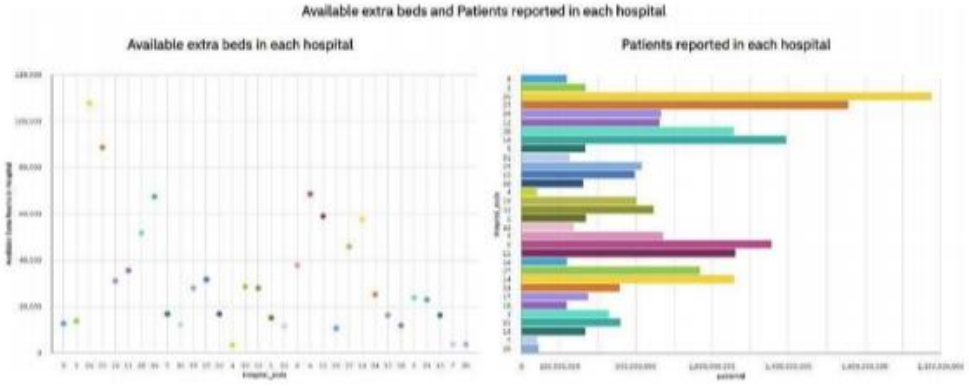
7.1 Feature 1

1. Fetched the data from DB2 database.
2. Creating a responsive dashboard.
3. Inserting filter for each chart
4. Creating report
5. Created reports using multiple graphs and charts

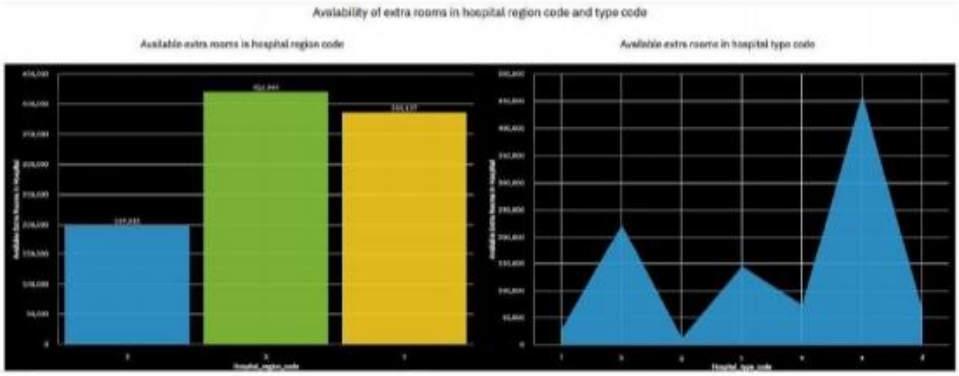
Patient's admission deposit and bed grade compared to ward facility:



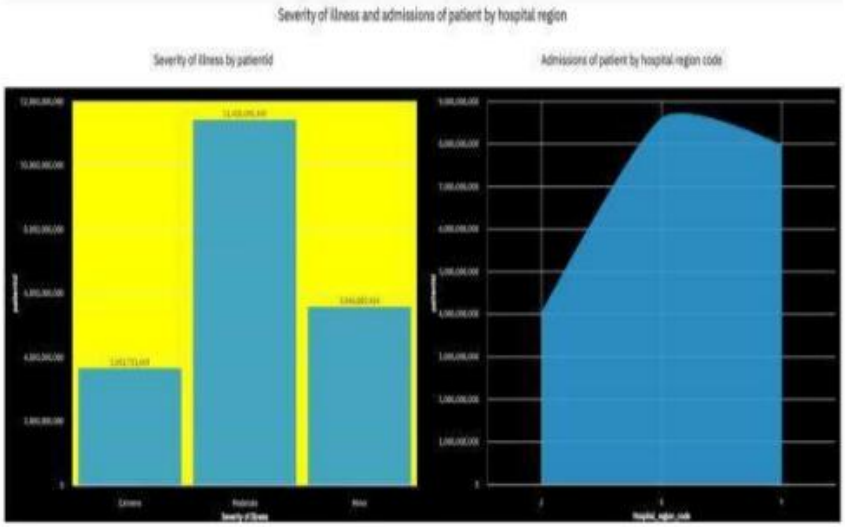
Available extra beds and Patients reported in each hospital:



Availability of extra rooms in hospital region code and type code:



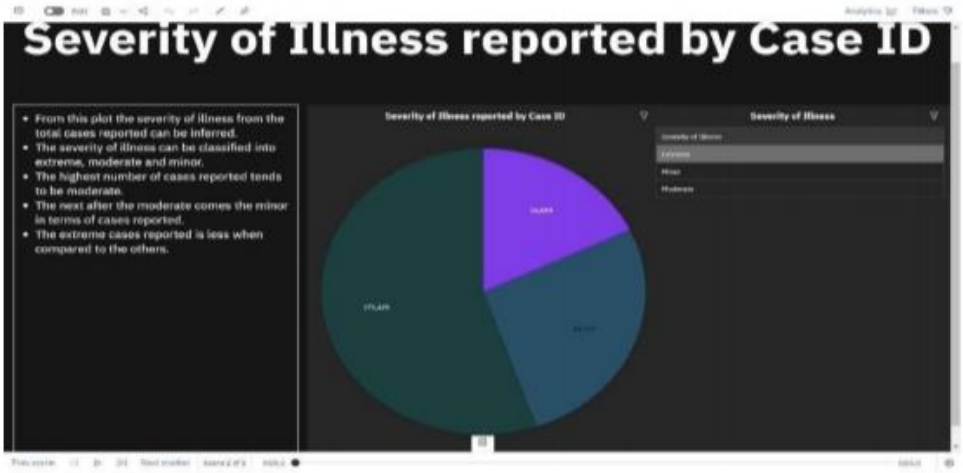
Severity of illness and admissions of patient by hospital region:



7.2 Feature 2

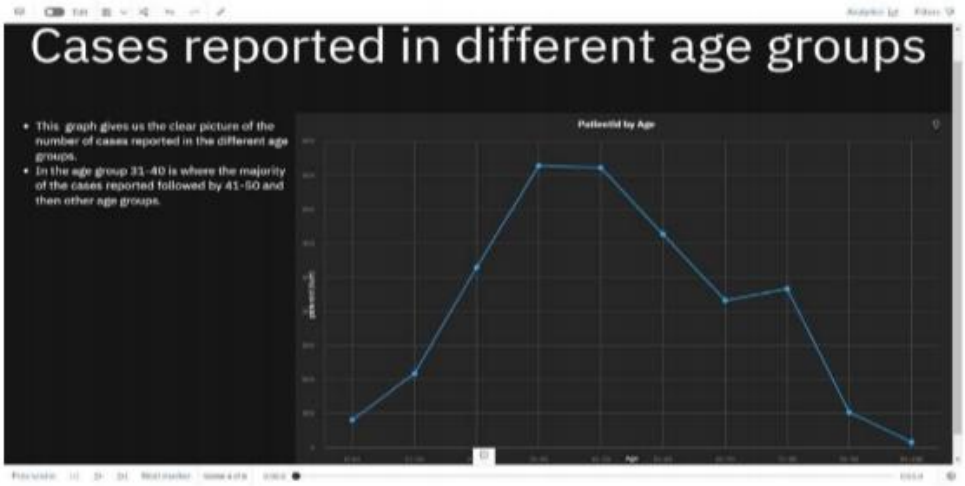
1. Creating stories and performing.
2. Perform animation render image from website.
3. Included graphs and charts
4. Creating web applications using bootstrap.
5. Embedded the cognos with web applications.

Severity of illness reported by case id:

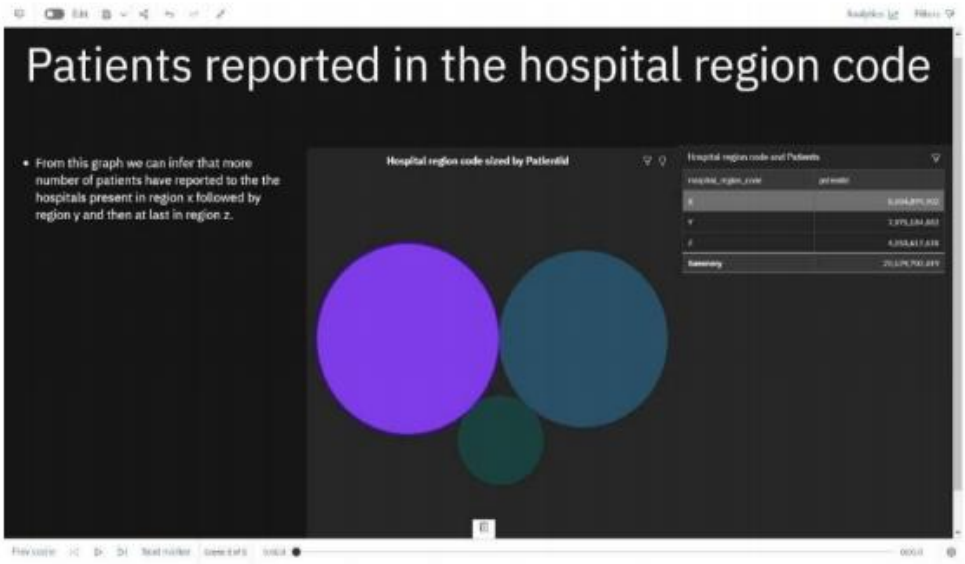


Availability of extra rooms in hospital depending on hospital type code:

Cases reported in different age groups:



Patients report in the hospital by region code:



Total admission:

7.3 Database Schema

- Casee_id
- Hospital_code
- Hospital_type_code
- City_Code_Hospital
- Hospital_region_code
- Available Extra Rooms in Hospital
- Department
- Ward_Type
- Ward_Facility_Code
- Bed Grade
- Patient id
- City_Code_Patient
- Type of Admission
- Severity of Illness
- Visitors with Patient
- Age
- Admission_Deposit
- Stay

8 TESTING

8.1 Test Cases

1. Verify the user is able to get the responsiveness of all the graphs.
2. Verify the user and get the entire visualization of the dashboard report.
3. Verify the user to get the complete interaction with the website.
4. Check if the entire dashboard, Report is visible.
5. Users can view pages in the report.
6. Verify the user is able to access the no of bed based on the region.
7. Verify the user is able to access the bed grade with respect to the severity of illness.
8. Verify the user is able to access the parameters based on the length of stay.
9. Verify the user is able to compare the department based on the Severity of illness.

8.2 User Acceptance Testing

1. Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the [ProductName] 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	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	8	5	0	3	16
Duplicate	1	0	5	0	6
External	0	3	2	1	6
Fixed	13	4	3	16	36
Not Reproduced	0	1	0	0	1
Skipped	0	1	0	1	2
Won't Fix	1	4	2	1	8
Totals	23	18	12	22	75

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

9. RESULTS

9.1 Performance Metrics:

Spearhead hospital and health system improvements by using standardized data and analytics on a variety of topics such as healthcare performance measurements Healthcare performance measurements are aggregated, quantified and analyzed data on a particular healthcare- related activity. Their purpose is to identify opportunities for reducing costs, improving quality of care and increasing efficiency of care delivery. They're also used to monitor other initiatives that an institution wants to track- or needs to track- to satisfy regulatory requirements. These measurement initiatives are typically developed and operated with the active involvement of the physicians and hospital staff whose performance is being measured as well as government and other third party agencies- to ensure that the measures are meaningful, and the data are accurate. Types of healthcare performance measurements include:

1. Quality and efficiency of patient care
2. Cost of healthcare services
3. Disparities in performance
4. Care outcomes

10. ADVANTAGES & DISADVANTAGES

ADVANTAGES:

The work processes and organization structures of healthcare providers directly impact the quality of care patients receive and the likelihood of positive patient outcomes. Measuring the effect of process and organization changes on outcomes and operational efficiencies requires the ability to collect and analyze healthcare provider data related to these processes and structures in complex healthcare environments.

DISADVANTAGES:

Realizing the potential of data analytics to transform the healthcare industry begins by understanding how the technology can be applied to address healthcare providers' challenges, including staff recruitment and utilization, operational efficiencies, and enhanced patient experiences. Patient-centered healthcare depends on knowing what patients want and need. Data analytics holds the key to unlocking this vital information.

11.CONCLUSION

Health-care data Analytics Dashboard can improve the ability of health service facilities and stakeholders to predict disease epidemics and health related events, prevent human errors, improve early preventive care, provide warning signs to the public, facilitate evaluation of programs and related policies health, and facilitate decision making to find out faster and respond appropriately.

12. FUTURE SCOPE

Healthcare data analytics refers to the process of working on raw datasets related to healthcare and analyzing them to find hidden patterns, trends, etc., thus paving a way for further improvements at patient-level as well as business-level. Since we talked about healthcare-related data in the above definition, let us now understand what healthcare data is. Healthcare data is nothing but any data that is related to the patient and the healthcare facilities such as medical records, scan and test reports, hospital records,etc. Different tools are used to collect this data. Some of the important tools and ways are electronic health records (EHRs), patient portals, master patient indexes (MPIs), online health-related mobile applications, etc. Not only does this help in data-driven informed decision-making, but it also helps in providing a personalized experience and treatment to the patients.

13. REFERENCE

[1] Big data analytics for drug discovery, September 2013 IEEE International Conference on Bioinformatics and Biomedicine.

[2] Data analytics in healthcare: management, analysis and future prospects. 19th June 2019.

[3] Electronic Health Records in Chiropractic Practice: Common Challenges and Solutions, Journal of Chiropractic Humanities, Volume 24, Issue 1, 5th December 2017.

[4] Systematic review of clinical prediction models to support the diagnosis of asthma in primary care. NPJ primary care respiratory medicine, Vol. 29,9th May 2019.

[5] VACCINATED - Visual Analytics for Characterizing a Pandemic Spread VAST 2010 Mini Challenge 2 Award: Support for Future Detection.

14. APPENDIX

SOURCE CODE

```
<!DOCTYPE html>
<html lang="en">

<head>
  <meta charset="utf-8">
  <meta content="width=device-width, initial-scale=1.0" name="viewport">

  <title>Hospital Health Care</title>
  <meta content="" name="description">
  <meta content="" name="keywords">

  <!-- Favicons -->
  <link href="assets/img/favicon.png" rel="icon">
  <link href="assets/img/apple-touch-icon.png" rel="apple-touch-icon">

  <!-- Google Fonts -->
                                                                    <link
href="https://fonts.googleapis.com/css?family=Open+Sans:300,300i,400,400i,600,600i,700,700i|Raleway:300,300i,400,400i,500,500i,600,600i,700,700i|Poppins:300,300i,400,400i,500,500i,600,600i,700,700i" rel="stylesheet">

  <!-- Vendor CSS Files -->
  <link href="assets/vendor/fontawesome-free/css/all.min.css" rel="stylesheet">
  <link href="assets/vendor/animate.css/animate.min.css" rel="stylesheet">
  <link href="assets/vendor/bootstrap/css/bootstrap.min.css" rel="stylesheet">
  <link href="assets/vendor/bootstrap-icons/bootstrap-icons.css" rel="stylesheet">
```

```
  <link href="assets/vendor/boxicons/css/boxicons.min.css" rel="stylesheet">
  <link href="assets/vendor/glightbox/css/glightbox.min.css" rel="stylesheet">
  <link href="assets/vendor/remixicon/remixicon.css" rel="stylesheet">
  <link href="assets/vendor/swiper/swiper-bundle.min.css" rel="stylesheet">

  <!-- Template Main CSS File -->
  <link href="assets/css/style.css" rel="stylesheet">

  <!-- =======================================================
  * Template Name: Medilab - v4.9.1
  * Template URL: https://bootstrapmade.com/medilab-free-medical-bootstrap-theme/
  * Author: BootstrapMade.com
  * License: https://bootstrapmade.com/license/
  ======================================================= -->
</head>

<body>

  <!-- ======= Top Bar ======= -->
  <div id="topbar" class="d-flex align-items-center fixed-top">
    <div class="container d-flex justify-content-between">

    </div>
  </div>

  <!-- ======= Header ======= -->
  <header id="header" class="fixed-top">
    <div class="container d-flex align-items-center">
```

```
            <h1 class="logo me-auto"><a href="index.html"> MJRK Hospital Health Care Service</a></h1>
            <!-- Uncomment below if you prefer to use an image logo -->
            <!-- <a href="index.html" class="logo me-auto"><img src="assets/img/logo.png" alt="" class="img-fluid"></a>-->

            <nav id="navbar" class="navbar order-last order-lg-0">
              <ul>
                <li><a class="nav-link scrollto active" href="#hero">Home</a></li>
                <li><a class="nav-link scrollto" href="#about">About</a></li>
                <li><a class="nav-link scrollto" href="#services">Services</a></li>
                <li><a class="nav-link scrollto" href="#departments">Departments</a></li>

              </ul>
              <i class="bi bi-list mobile-nav-toggle"></i>
            </nav><!-- .navbar -->


          </div>
        </header><!-- End Header -->

        <!-- ======= Hero Section ======= -->
        <section id="hero" class="d-flex align-items-center">
          <div class="container">
            <h1>Welcome to Hospital Health Care Service </h1>
              <h2>We are team of talented designers making websites for Analytics For Hopital HealthCare</h2>
            <a href="#about" class="btn-get-started scrollto">Get Started</a>
          </div>
```

```
</section><!-- End Hero -->

<main id="main">

  <!-- ======= Why Us Section ======= -->
  <section id="why-us" class="why-us">
    <div class="container">

      <div class="row">
        <div class="col-lg-4 d-flex align-items-stretch">
          <div class="content">
            <h3> Our Main Purpose</h3>
            <p>
```

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 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.

Suppose you have been hired as Data Scientist of Health Man – a not for profit

organization dedicated to manage the functioning of Hospitals in a professional and optimal manner.

<h4>Goal</h4>
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 of stay is divided into 11 different classes ranging from 0-10 days to more than 100 days.

<iframe src="https://eu2.ca.analytics.ibm.com/bi/?perspective=explore&pathRef=.my_folders%2Ffin&closeWindowOnLastView=true&ui_appbar=false&ui_navbar=false&shareMode=embedded&subView=model000001848e8ee871_00000000" width="500" height="600" frameborder="0" gesture="media" allow="encrypted-media" allowfullscreen=""></iframe>

```
            </div>



          </div>
         </div>
       </div><!-- End .content-->
     </div>
   </div>

  </div>
</section><!-- End Why Us Section -->

<!-- ======= About Section ======= -->
<section id="about" class="about">
  <div class="container-fluid">




     </div>
   </div>

  </div>
</section><!-- End About Section -->

<!-- ======= Counts Section ======= -->
<section id="counts" class="counts">
  <div class="container">
```

```
<div class="row">

 <div class="col-lg-3 col-md-6">
  <div class="count-box">
   <i class="fas fa-user-md"></i>
                    <span  data-purecounter-start="0"  data-purecounter-end="85"
data-purecounter-duration="1" class="purecounter"></span>
   <p>Doctors</p>
  </div>
 </div>

 <div class="col-lg-3 col-md-6 mt-5 mt-md-0">
  <div class="count-box">
   <i class="far fa-hospital"></i>
                     <span  data-purecounter-start="0"  data-purecounter-end="5"
data-purecounter-duration="1" class="purecounter"></span>
   <p>Departments</p>
  </div>
 </div>

 <div class="col-lg-3 col-md-6 mt-5 mt-lg-0">
  <div class="count-box">
   <i class="fas fa-flask"></i>
                    <span  data-purecounter-start="0"  data-purecounter-end="12"
data-purecounter-duration="1" class="purecounter"></span>
   <p>Research Labs</p>
  </div>
 </div>
```

```
            <div class="col-lg-3 col-md-6 mt-5 mt-lg-0">
              <div class="count-box">
                <i class="fas fa-award"></i>
                                    <span   data-purecounter-start="0"   data-purecounter-end="150"
data-purecounter-duration="1" class="purecounter"></span>
                <p>Awards</p>
              </div>
            </div>

          </div>

        </div>
      </section><!-- End Counts Section -->

      <!-- ======= Services Section ======= -->
      <section id="services" class="services">
        <div class="container">

          <div class="section-title">
            <h2>Services</h2>
            <p>Provide information to the user through visualisation.</p>
          </div>
    <div>

                                                                                    <iframe
src="https://eu2.ca.analytics.ibm.com/bi/?perspective=explore&amp;pathRef=.my_folders%2Ffin
al&amp;closeWindowOnLastView=true&amp;ui_appbar=false&amp;ui_navbar=false&amp;shar
eMode=embedded&amp;subView=model000001848e02faaf_00000000"          width="1000"
```

height="600" frameborder="0" gesture="media" allow="encrypted-media" allowfullscreen="">
</iframe>
<iframe src="https://eu2.ca.analytics.ibm.com/bi/?perspective=explore&pathRef=.my_folders%2Ffina&closeWindowOnLastView=true&ui_appbar=false&ui_navbar=false&shareMode=embedded&subView=model000001848e7a58c1_00000004" width="1000" height="600" frameborder="0" gesture="media" allow="encrypted-media" allowfullscreen=""></iframe>
<iframe src="https://eu2.ca.analytics.ibm.com/bi/?perspective=dashboard&pathRef=.my_folders%2Fsivi&closeWindowOnLastView=true&ui_appbar=false&ui_navbar=false&shareMode=embedded&action=view&mode=dashboard&subView=model000001848ef76350_00000000" width="1000" height="600" frameborder="0" gesture="media" allow="encrypted-media" allowfullscreen=""></iframe>

</section><!-- End Services Section -->

<!-- ======= Appointment Section ======= -->

<!-- ======= Departments Section ======= -->
<section id="departments" class="departments">

<h2>Departments</h2>
We are providing services for five departments.

```
<div class="row gy-4">
  <div class="col-lg-3">
    <ul class="nav nav-tabs flex-column">
      <li class="nav-item">
            <a class="nav-link active show" data-bs-toggle="tab" href="#tab-1">TB and
Chest Disease</a>
      </li>
      <li class="nav-item">
        <a class="nav-link" data-bs-toggle="tab" href="#tab-2">Genecology</a>
      </li>
      <li class="nav-item">
        <a class="nav-link" data-bs-toggle="tab" href="#tab-3">Anesthesia</a>
      </li>
      <li class="nav-item">
        <a class="nav-link" data-bs-toggle="tab" href="#tab-4">Radiotherapy</a>
      </li>
      <li class="nav-item">
        <a class="nav-link" data-bs-toggle="tab" href="#tab-5">Surgery</a>
      </li>
    </ul>
  </div>
  <div class="col-lg-9">
    <div class="tab-content">
      <div class="tab-pane active show" id="tab-1">
        <div class="row gy-4">
          <div class="col-lg-8 details order-2 order-lg-1">
            <h3>TB and Chest Disease</h3>
                <p class="fst-italic"> Tuberculosis (TB) is caused by a bacterium called
```

Mycobacterium tuberculosis. The bacteria usually attack the lungs, but TB bacteria can attack any part of the body such as the kidney, spine, and brain. Not everyone infected with TB bacteria becomes sick.

```
                </div>
                <div class="col-lg-4 text-center order-1 order-lg-2">
                  <img src="assets/img/departments-1.jpg" alt="" class="img-fluid">
                </div>
              </div>
            </div>
            <div class="tab-pane" id="tab-2">
              <div class="row gy-4">
                <div class="col-lg-8 details order-2 order-lg-1">
                  <h3>Genecology</h3>
```

a branch of ecology concerned primarily with the species and its genetically variant subdivisions, with their position in nature and, with the controlling and ecological factors.

```
                </div>
                <div class="col-lg-4 text-center order-1 order-lg-2">
                  <img src="assets/img/departments-2.jpg" alt="" class="img-fluid">
                </div>
              </div>
            </div>
            <div class="tab-pane" id="tab-3">
              <div class="row gy-4">
                <div class="col-lg-8 details order-2 order-lg-1">
                  <h3>Anesthesia</h3>
```

Anesthesia is a medical treatment that prevents patients from feeling pain during procedures like surgery, certain screening and diagnostic tests, tissue

sample removal (e.g., skin biopsies), and dental work. It allows people to have procedures that lead to healthier and longer lives.

<img src="assets/img/departments-3.jpg" alt="" class="img-fluid">

<h3>Radiotherapy</h3>

Radiation therapy (also called radiotherapy) is a cancer treatment that uses high doses of radiation to kill cancer cells and shrink tumors. At low doses, radiation is used in x-rays to see inside your body, as with x-rays of your teeth or broken bones

<img src="assets/img/departments-4.jpg" alt="" class="img-fluid">

<h3>Surgery</h3>

A procedure to remove or repair a part of the body or to find out whether disease is present.

```
            <div class="col-lg-4 text-center order-1 order-lg-2">
              <img src="assets/img/departments-5.jpg" alt="" class="img-fluid">
            </div>
          </div>
        </div>
      </div>
    </div>

  </div>
</section><!-- End Departments Section -->




<!-- ======= Gallery Section ======= -->
<section id="gallery" class="gallery">
  <div class="container">

    <div class="section-title">
      <h2>Gallery</h2>

    </div>
  </div>

  <div class="container-fluid">
    <div class="row g-0">
```

```
<div class="col-lg-3 col-md-4">
  <div class="gallery-item">
    <a href="assets/img/gallery/gallery-1.jpg" class="galelry-lightbox">
      <img src="assets/img/gallery/gallery-1.jpg" alt="" class="img-fluid">
    </a>
  </div>
</div>

<div class="col-lg-3 col-md-4">
  <div class="gallery-item">
    <a href="assets/img/gallery/gallery-2.jpg" class="galelry-lightbox">
      <img src="assets/img/gallery/gallery-2.jpg" alt="" class="img-fluid">
    </a>
  </div>
</div>

<div class="col-lg-3 col-md-4">
  <div class="gallery-item">
    <a href="assets/img/gallery/gallery-3.jpg" class="galelry-lightbox">
      <img src="assets/img/gallery/gallery-3.jpg" alt="" class="img-fluid">
    </a>
  </div>
</div>

<div class="col-lg-3 col-md-4">
  <div class="gallery-item">
    <a href="assets/img/gallery/gallery-4.jpg" class="galelry-lightbox">
      <img src="assets/img/gallery/gallery-4.jpg" alt="" class="img-fluid">
    </a>
```

```
  </div>
</div>

<div class="col-lg-3 col-md-4">
  <div class="gallery-item">
    <a href="assets/img/gallery/gallery-5.jpg" class="galelry-lightbox">
      <img src="assets/img/gallery/gallery-5.jpg" alt="" class="img-fluid">
    </a>
  </div>
</div>

<div class="col-lg-3 col-md-4">
  <div class="gallery-item">
    <a href="assets/img/gallery/gallery-6.jpg" class="galelry-lightbox">
      <img src="assets/img/gallery/gallery-6.jpg" alt="" class="img-fluid">
    </a>
  </div>
</div>

<div class="col-lg-3 col-md-4">
  <div class="gallery-item">
    <a href="assets/img/gallery/gallery-7.jpg" class="galelry-lightbox">
      <img src="assets/img/gallery/gallery-7.jpg" alt="" class="img-fluid">
    </a>
  </div>
</div>

<div class="col-lg-3 col-md-4">
  <div class="gallery-item">
```

```
          <a href="assets/img/gallery/gallery-8.jpg" class="galelry-lightbox">
            <img src="assets/img/gallery/gallery-8.jpg" alt="" class="img-fluid">
          </a>
        </div>
      </div>

    </div>

  </div>
 </section><!-- End Gallery Section -->

 <!-- ======= Contact Section ======= -->
 <!-- End Contact Section -->

</main><!-- End #main -->

<!-- ======= Footer ======= -->
<footer id="footer">

 <div class="footer-top">
  <div class="container">
   <div class="row">

    <div class="col-lg-3 col-md-6 footer-contact">
     <h3>Hospital Health Care</h3>
     <p>
      A108 Adam Street <br>
      New York, NY 535022<br>
      United States <br><br>
```

```
    <strong>Phone:</strong> +1 5589 55488 55<br>
    <strong>Email:</strong> info@example.com<br>
  </p>
</div>

<div class="col-lg-2 col-md-6 footer-links">
  <h4>Useful Links</h4>
  <ul>
    <li><i class="bx bx-chevron-right"></i> <a href="#">Home</a></li>
    <li><i class="bx bx-chevron-right"></i> <a href="#">About us</a></li>
    <li><i class="bx bx-chevron-right"></i> <a href="#">Services</a></li>
    <li><i class="bx bx-chevron-right"></i> <a href="#">Terms of service</a></li>
    <li><i class="bx bx-chevron-right"></i> <a href="#">Privacy policy</a></li>
  </ul>
</div>

<div class="col-lg-3 col-md-6 footer-links">
  <h4>Our Services</h4>
  <ul>
    <li><i class="bx bx-chevron-right"></i> <a href="#">Web Design</a></li>
    <li><i class="bx bx-chevron-right"></i> <a href="#">Web Development</a></li>
                    <li><i class="bx bx-chevron-right"></i> <a href="#">Product
Management</a></li>
    <li><i class="bx bx-chevron-right"></i> <a href="#">Marketing</a></li>
    <li><i class="bx bx-chevron-right"></i> <a href="#">Graphic Design</a></li>
  </ul>
</div>

<div class="col-lg-4 col-md-6 footer-newsletter">
```

```
            <h4>Join Our Newsletter</h4>
            <p>Tamen quem nulla quae legam multos aute sint culpa legam noster magna</p>
            <form action="" method="post">
              <input type="email" name="email"><input type="submit" value="Subscribe">
            </form>
          </div>

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

    <div class="container d-md-flex py-4">

      <div class="me-md-auto text-center text-md-start">
        <div class="copyright">
          &copy; Copyright <strong><span></span></strong>. All Rights Reserved
        </div>
        <div class="credits">
          <!-- All the links in the footer should remain intact. -->
          <!-- You can delete the links only if you purchased the pro version. -->
          <!-- Licensing information: https://bootstrapmade.com/license/ -->
                <!-- Purchase the pro version with working PHP/AJAX contact form: https://bootstrapmade.com/medilab-free-medical-bootstrap-theme/ -->
          Designed by <a href="https://bootstrapmade.com/">BootstrapMade</a>
        </div>
      </div>
      <div class="social-links text-center text-md-right pt-3 pt-md-0">
        <a href="#" class="twitter"><i class="bx bxl-twitter"></i></a>
        <a href="#" class="facebook"><i class="bx bxl-facebook"></i></a>
```

```
            <a href="#" class="instagram"><i class="bx bxl-instagram"></i></a>
            <a href="#" class="google-plus"><i class="bx bxl-skype"></i></a>
            <a href="#" class="linkedin"><i class="bx bxl-linkedin"></i></a>
          </div>
        </div>
      </footer><!-- End Footer -->

      <div id="preloader"></div>
        <a href="#" class="back-to-top d-flex align-items-center justify-content-center"><i class="bi bi-arrow-up-short"></i></a>

      <!-- Vendor JS Files -->
      <script src="assets/vendor/purecounter/purecounter_vanilla.js"></script>
      <script src="assets/vendor/bootstrap/js/bootstrap.bundle.min.js"></script>
      <script src="assets/vendor/glightbox/js/glightbox.min.js"></script>
      <script src="assets/vendor/swiper/swiper-bundle.min.js"></script>
      <script src="assets/vendor/php-email-form/validate.js"></script>
    <!-- Template Main JS File -->
      <script src="assets/js/main.js"></script>
    </body>
    </html>
```

GitHub Link:

https://github.com/IBM-EPBL/IBM-Project-22999-1659864039

Project Demo Link:

https://drive.google.com/file/d/19ZptJg0eNiJWFk-EsLMNEX--5pFbyaT7/view?usp=drivesdk