RMIT International
University Vietnam
School of Science,
Engineering & Technology

RMIT UNIVERSITY

Practical Database Concepts
ISYS3414
Group Project

Saigon South Campus

Supervisor: Dr. Tran Minh Tuan

Course Coordinator: Dr. Truong Nguyen Xuan Vinh

Date of Submission: May 5th, 2023

Group No.1

Huynh Nhat Anh – S3924763

Dinh Duy Linh Dan – S3978544

Nguyen Le Thuc Quynh – S3924993

Nguyen Dinh Minh Chau – S3923010

We declare that in submitting all work for this assessment, we have read, understood and agreed to the content and expectations of Assessment Declaration

We give RMIT University permission to use our work as an exemplar and for showcase/exhibition display.

INTRODUCTION

Developing a hospital management system is the second topic of Assessment 2 - Group Project, delivered by the course ISYS3414 - Practical Database Concepts. As the technical specification states, our team needs to construct a system to manage a hospital's operation and the target users of the system must involve physicians and patients. Furthermore, it is required to invent an application for the users to interact with the database. Hence, this report will indicate our progress in designing the database to help the readers understand the operation principle. Over and above that, it will thoroughly demonstrate all the features of our product.

While working on this project, our team depended on several digital tools. First of all, we visualized the entity-relationship model by diagrams.net. Secondly, the MySQL Workbench, version 8.0CE, was applied to yield SQL queries and insert data. The final platform is Oracle Apex, which was for building our application.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

PROJECT BACKGROUND & MOTIVATIONS

1. Topic

Project Topic: Hospital Management System

Healthcare has always been an essential need in society. Even a single hospital receives the entrance of thousands of patients, meaning an addition of thousands of medical records must be stored.

Thankfully, the rise of digitalization makes the procedure much more straightforward and efficient. Patients' information storage has recently been migrated from paper cards with plain text to magnetic stripe cards and is ready to be integrated into National Identity Cards. The trend points out the necessity of a database to permanently store all essential data logically. With the database management system (DBMS), hospitals' and patients' information can be kept up to date without many anomalies, be secured and be ready to be retrieved for the development of specific applications.

Although the Hospital Management System project could not interest the majority, our team found this topic practical and valuable. During the COVID-19 pandemic, almost all hospitals are seriously overloaded, and many "field hospitals" are set up to treat a large number of patients. In that situation, the databases of healthcare centers even require logical and appropriate design and careful management to store the data properly and ensure the best treatment for people in need. Indeed, medical history is vital in deciding the procedure for each patient. As prospective software engineers, we heartedly want to develop products that can effectively assist many people; Thus, this project is an opportunity for us to improve our hands-on experience and get insight into how data are processed in a hospital and what their usage is in reality.

In this project, besides designing an effective database, we will also build an application to provide beneficial functions for doctors, nurses, other hospital departments and patients. We aim to provide a better user experience with friendly interfaces so that the system can minimize data loss and redundancy and maximize workflow efficiency.

2. People

Members	Description	Role
Dan Dinh	• Student ID: s3978544 • Email: s3978544@rmit.edu.vn - Dan is interested in algorithms and solving logical problems. She used to study biology hard in high school, so discovering about medical treatments and medicines is attractive to her. - Relevant skills: front-end development using HTML/CSS and JavaScript, database management using SQL Server, MySQL and Oracle SQL, applying Microsoft Excel for collecting and generating data. - Dan is the project manager and leader of team No1. She is a hard-working colleague and the bridge between our team and our supervisors. o Assigning and managing tasks o Database creation and data collection o Generating queries with advanced SQL	Data and Database Administrator
Chau Nguyen	• Student ID: s3923010 • Email: s3923010@rmit.edu.vn - Chau is interested in designing things to solve problems and apply theories in her products. - Relevant skills: Using Microsoft Words and Excel, database management with SQL Server and MySQL. - Chau worked as a designer on this project, which means she is responsible for building the entity relationship diagram and translating the design to MySQL code. This section of the project is a valuable opportunity for her to show her critical thinking in database development and become more accomplished in MySQL. o Designing presentation slides as she has experienced in pitching and presenting. o Designing database system o Writing the report	Database Designer
Anh Huynh	• Student ID: s3924763 • Email: s3924763@rmit.edu.vn - Anh is passionate about solving riddles and learning new things that attract her curiosity. For her, developing expertise in many fields is also a method to learn more about herself. As a result, studying Oracle Apex as a tool to apply her SQL studies is a fantastic opportunity for Anh to challenge herself in a sector she was previously unfamiliar with. - Relevant skills: Basic understanding of Microsoft Excel, including exporting and importing files, as well as front-end development applying Oracle Apex - Anh has basic skills in building applications and utilizing Oracle Apex. Therefore, with Quynh, Anh is the main front-end developer. Although this project is her first opportunity to explore Structured	Application Developer

	Query Language and Oracle tools, she proves her rapid speed of learning them. o Front-end developing the application using Oracle Apex o Implementing features for application	
Quynh Nguyen	• Student ID: s3924993 • Email: s3924993@rmit.edu.vn - Quynh is keen on logical design and creating applications. - Relevant skills: developing applications using Oracle Apex, front-end and back-end development. - Quynh has spent plenty of time learning SQL and Oracle Apex. Since she is an adept learner and a high-performance colleague, she plays the role of a bug-fixer of team No1. Moreover, she holds the position as an advisor for database design. o Testing and debugging the application o Writing the report o Recommending extra features for the application	Tester and Advisor

Table 1: Members' Contacts, Roles and Interests

3. Scope

3.1 Requirements Specifications

- Patients and doctors are identified by their unique ID types.
- There would be a table to store their personal information.
- Any medical treatment or admission records of patients must be stored and can be retrieved.
- Patients and Doctors should be able to interact by some features: book appointments, admit rooms.
- There exist facilities in the hospital at least contain rooms.
- Nurses and ward boys must have some features to interact with patients to take care of them.
- There is a bill generator in the system.

3.2 Deliverables

- Multi-user system including Admin, Employee, and Patient account types.
- Common features such as Login and Registration System.
- Hospital databases can be analyzed using Interactive Reports and visualized Charts.
- UI UX designs: dashboard, navigation bar and menu system, etc. for end users.
- Patients' available features:

o Edit some personal information (phone, email, address, etc.)
o Book appointment with doctors
o Check the appointments information they have been booked
o Change account's password

- Employees' available features: account type for doctors, nurses, physicians, ward boys, etc.

o Check the appointment being booked by patients
o Check the assigned shifts
o Create prescription
o Assign medicine and treatment
o Add patients' notation (what kinds of accidents, the injury levels, allergies, etc.)
o Admit patients and discharge inpatients

- Admins' available features: account type for Chief Executive Officer, Executive Manager, etc.

o Edit employees' information
o Assign shifts for employees
o Generate bills

3.3 Out of Scope

- Advanced HTML and CSS added to the system
- Further specialized breakdown features for employees (only nurses can admit patients to the hospital)
- Non-medical facilities except for rooms
- Payment system for patients to deal continuously with the bill issues
- Feedback system from patients

3.4 Optimal Outcomes

If all the expected features are successfully implemented, our project becomes a multi-functional Hospital Management System which completely changes paper- to computer-based tasks. This helps the manager reduce the cost of human resources and the friendly user interface will improve workflow by retrieving the data directly from the application.

APPLICATION DESIGN AND IMPLEMENTATION

4. Entity-Relation Diagram

4.1 Entity-Relation Model

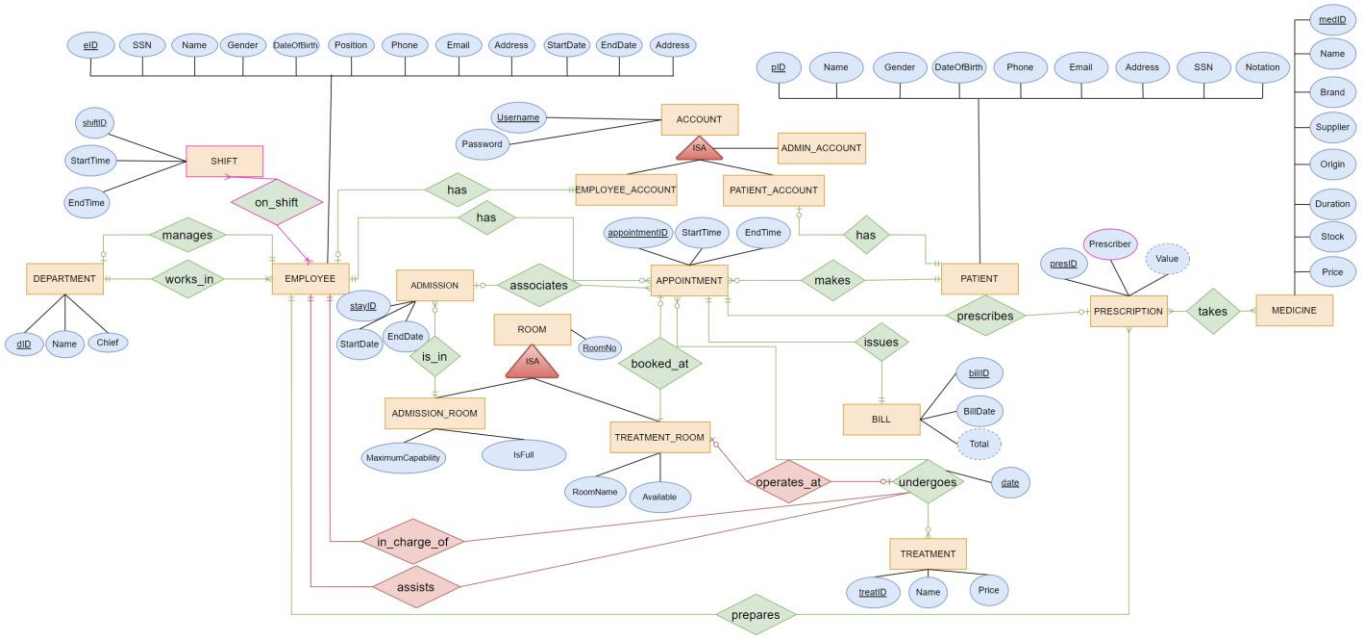


Figure 1: ERD Model

4.2 Assumptions

Entity Sets

Note: All the X mentioned in the following assumptions is a specific digit from 0 to 9.

- **EMPLOYEE (also known as Staff)**

- eID: It is used to identified every employee of the hospital and is formed in a pattern eXXX.
- SSN: Social Security Number of each employee is a 9-digit number whose every 3 digits is separated by a dash "-" and it is unique.
- Position: Every department has "Doctor", "Nurse", "Ward boy", "Officer" and "Technician" whereas the Pharmacity Department only has "Pharmacist" and "Officer". "Officer" has the same role as an administrator of the system.
- StartDate: All employees need to have the start working day.
- EndDate: It is available for any staff who no long works in the hospital. This field can be NULL.

- **PATIENT**

- pID: This is the primary key used to identified a patient. Its format is pXXX.
- SSN: The domain of patient's SSN is the same at this of an employee.
- Notation: A note is a text field which stores any specifications of a patient such as disabilities.

- **ACCOUNT**

An account is used to log in the system. Each has a username as a Primary key and a password which are all unique in the relation. There are three types of account: ADMIN_ACCOUNT, EMPLOYEE_ACCOUNT and PATIENT_ACCOUNT, which is referenced to an employee and a patient, respectively.

- **DEPARTMENT**

- dID: A dID is formed by dXX.
- Name: The name of each department is unique and NOT NULL. Some department name is got from the referenced website [1].

- **SHIFT**

- shiftID: A shiftID is in the format of sXX, it uniquely identifies each shift created.
- StartTime and EndTime: Each shift has different start time and end time, the time of different shifts can overlap each other.

- **APPOINTMENT**

An appointment is a consultation session between a doctor and a patient which is identified by the appointmentID.

- **ROOM**

- RoomNo: A list of room number is stored in this table
- There are two types of room in the hospital ADMISSION_ROOM and TREATMENT_ROOM.

- **ADMISSION_ROOM**

- Capacity: A single room for admission can have one or more patients, depending on the initial capability.
- CurrentNumber: This attribute indicates the number of patients in a room at the current time, whenever a patient is assigned to a room, the CurrentNumber of that room increases one.

- **TREATMENT_ROOM**

- RoomName: Each TREATMENT_ROOM is specifically utilized for a treatment, for example Operation Theatre, Intensive Care Unit (ICU), so its name is NOT NULL.
- Available: This field's type is boolean. Every room is used by one case at a time and when it is booked, the value is FALSE. The default value is TRUE.

- **TREATMENT**

- treatID: In a format of tXX, it identifies a treatment.
- Name: A name of a treatment is unique
- Price: Price of the treatment contributes the total value of a patient's bill.

- **ADMISSION**

This relation stores the history of admission includes the code (stayID), start date and end date.

- **MEDICINE**

- medID: The medicines cause the same effects but from different brands is considered as different medicines in this relation.
- Price: Each medicine has a price which contributes to the value of the prescription it associates to.

- **PRESCRIPTION**

- presID: It is the primary key of this relation. It is in the pattern of prXX.
- Prescriber: The prescriber takes the medicine for a prescription is an employee of the hospital.
- Value: Value is a derived attribute. It is the total price of all medicines taken in each prescription.

- **BILL**

A bill is only issued when all the treatment of a patient is done and the whole fee is paid; therefore, there will not be any changes in the bill total afterwards.

- billID: Each bill has its own identification number in the format of bXXX.
- Total: The total value of a bill is calculated by:

Total = SUM(TREATMENT.Price) + PRESCRIPTION.Value
+ 2000 * (ADMISSION.EndDate – ADMISSION.StartDate)

Relationship Sets

- **EMPLOYEE works_in DEPARTMENT:** An employee works in only 1 and 1 department. A department has at least 1 employee.
- **EMPLOYEE manages DEPARTMENT:** An employee manages 0 or 1 department, while a department must have one manager.
- **EMPLOYEE on_shift SHIFT:** An employee is on many shifts but in different times. A shift has many employees working on.
- **ADMIN_ACCOUNT, EMPLOYEE_ACCOUNT and PATIENT_ACCOUNT is_a ACCOUNT:** There are three account types, one for employees and one for patients.
- **PATIENT and EMPLOYEE has_a PATIENT_ACCOUNT and EMPLOYEE_ACCOUNT:** A patient might have an account, while an employee must have an account. An account belongs to either a patient or an employee.
- **PATIENT makes_appointment with EMPLOYEE(Doctor):** A patient can make an appointment with many employees whose position is a doctor. A doctor has appointment with zero or many patients.

- **APPOINTMENT books_at TREATMENT_ROOM(Consultation Room):** An appointment is booked at one and only one consultation room. A consultation is booked by many appointments.
- **APPOINTMENT associates with ADMISSION:** An appointment might associate with one admission but an admission must belong to an appointment.
- StartDate and EndDate contributes to the total fee in BILL.
- **ADMISSION is_in ADMISSION_ROOM:** An admission is assgined to an admission room. An admission room can have many or no admission.
- **APPOINTMENT undergoes TREATMENT:** An appointment associates with zero to many treatments. A treatment is assigned to no or many appointments as a remedy for the patient in that appointment.
- **UNDERGOES relationship between APPOINTMENT and TREATMENT operates_at TREATMENT_ROOM: (aggregation relationship)** A treatment being associated might be operated at a treatment room and a treatment can be used for operating zero to one treatment being associated.
- **EMPLOYEE(Doctor) in_charge_of undergone TREATMENT: (aggregation relationship)** A treatment associated with an appointment is responsible by one and only one doctor.
- **EMPLOYEE(Nurse) assists undergone TREAMENT: (aggregation relationship)** A treatment associated with an appointment is assisted by one and one nurse.
- **APPOINTMENT prescribes PRESCRIPTION:** After an appointment, a doctor might precribe a prescription.
- **EMPLOYEE(Pharmacist) prepares PRESCRIPTION:** A pharmacist prepares zero to many prescriptions. A prescription is prepared by one and only one pharmacist.
- **PRESCRIPTION takes MEDICINE:** A prescription takes up to many types of medicine and a medicine is mentioned in many prescriptions.
- **APPOINTMENT issues BILL:** An appointment issues a bill with all the related price and a bill belongs to one and only one appointment.

5. Relational schema

- **ADMIN_ACCOUNT** (Username, Password).
- **EMPLOYEE_ACCOUNT** (*EMPLOYEE.eID eID*, Username, Password).
- **EMPLOYEE** (eID, SSN, Name, Gender, DateOfBirth, Phone, Email, Address, *DEPARTMENT.dID Department*, Position, StartDate, EndDate, Details).

- **PATIENT_ACCOUNT** (*PATIENT.pID pID*, Username, Password).
- **PATIENT** (pID, SSN, Name, Gender, DateOfBirth, Phone, Email, Address, Notation).
- **DEPARTMENT** (dID, Name, *EMPLOYMEE.eID Chief*).
- **ROOM** (RoomNo).
- **ADMISSION_ROOM** (*ROOM.RoomNo RoomNo*, Capacity, CurrentNumber).
- **TREATMENT_ROOM** (*ROOM.RoomNo RoomNo*, RoomName , Available).
- **SHIFT** (shiftID, StartTime, EndTime).
- **ON_SHIFT** (*SHIFT.shiftID Shift, EMPLOYEE.eID Employee*).
- **APPOINTMENT** (ID, *EMPLOYEE.eID (Doctor) Doctor*, *PATIENT.pID Patient,* StartTime, EndTime *TREATMENT_ROOM.RoomNo Room*).
- **TREATMENT** (ID, Name, Price).
- **MEDICINE** (ID, Name, BrandName, SupplierName, Origin, Duration, Stock, Price).
- **PRESCRIPTION** (presID, *EMPLOYEE.eID (Pharmacist) Prescriber*, *APPOINTMENT.ID Appointment*, Value).
- **TAKE_MEDICINE** (*MEDICINCE.ID Medicine, PRESCRIPTION.presID Prescription*).
- **ADMISSION** (stayID, StartDate, EndDate, *ROOM.RoomNo RoomNo*, *APPOINTMENT.ID Appointment*).
- **UNDERGOES** (*APPOINTMENT.appointmentID*, *TREATMENT.treatID Treatment*, Date, *EMPLOYEE.eID (Doctor) Physician*, *EMPLOYEE.eID (Nurse, Ward boy) Assistant*, *TREATMENT_ROOM.RoomNo RoomBooking*).
- **BILL** (bID, Bill_Date, Total).

6. Database Creation

The full database with meaningful data is created and inserted in a "no1" database whose code can be viewed in a file called **ISYS3414_DB_No1.sql**. Generally, the database will best run with MySQL Workbench 8.0 or later as there are specific features and syntax that are constrained in this platform. Because of the limited size of a database for a course project, the data type for each attribute is designed with the purpose of saving as much memory as possible. For example, the primary key of DEPARTMENT table is inserted in a pattern of "dXX", where "X" is a digit (0-9), starting from "d01". We only insert eight departments for our hospital, so the number part will not exceed that pattern. Therefore, VARCHAR(3) is well enough to store the attribute as "the first 128 Unicode code points are encoded as 1 byte in UTF-8"[2].

Beside using CHECK to create domain constraints of relations, TRIGGERS are also used to deal with complicated conditions and inserting derived attributes like the total value of a bill.

7. Application features

7.1 Application features

7.1.1 Common Features

- **View HomePage**

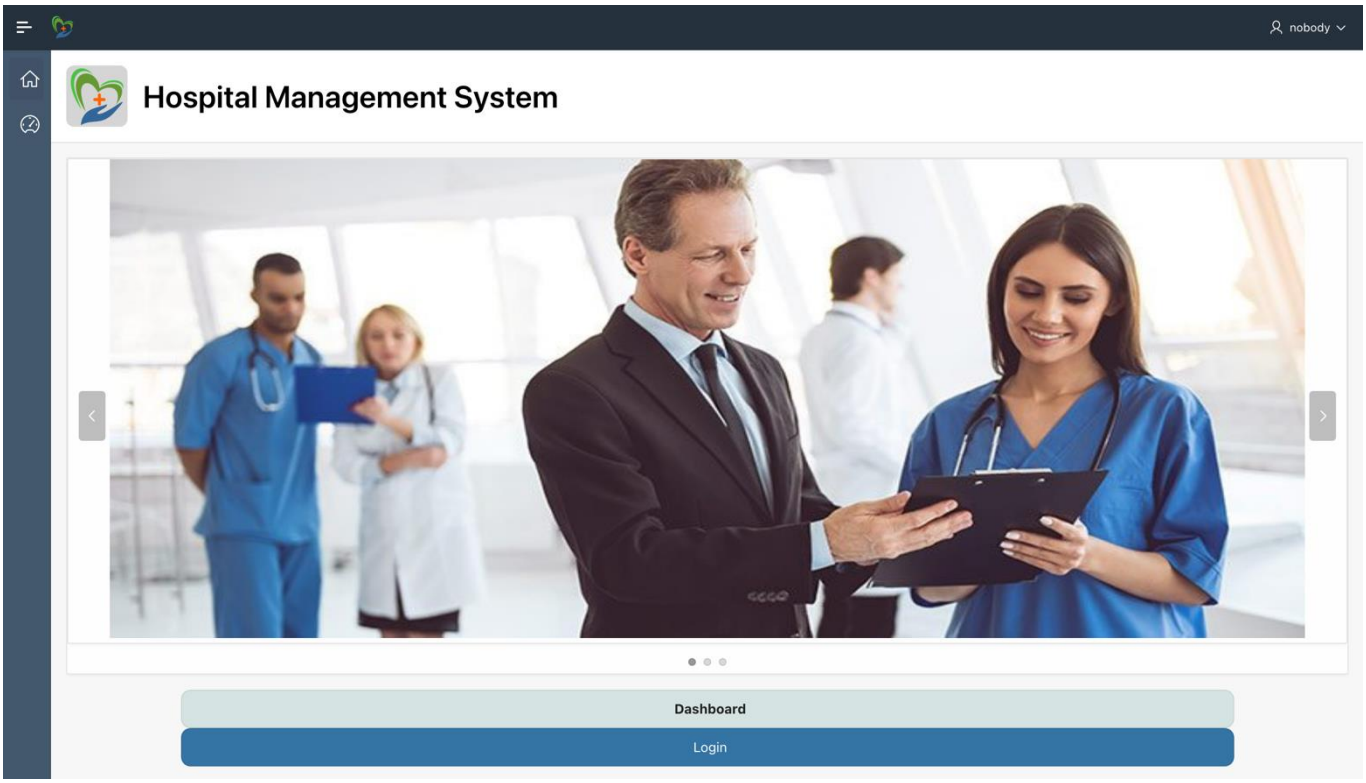


Figure 2: HomePage from the Guest User's View

Guest users will see this page below when they use our system. The guests will see hospital's email and hotline contact in the page footer so they can contact to book our service.

By this page, it introduces the users to another 2 pages they can jump directly into which is *Dashboard* and *Login Page*.

Guest users can click on the '*Dashboard' button* on *HomePage* or use the (side) *Navigation Menu* (Figure 3, 4). To protect the information, all pages showing for patients, employees and admin(s) are being hidden excepted for the accepted-type account logging in.

Figure 4: Side Navigation Menu

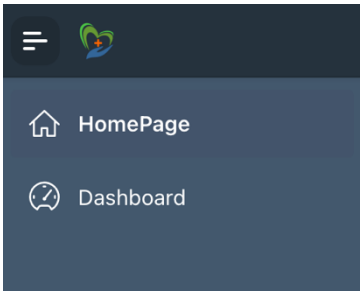


Figure 3: Navigation Menu

- **View Dashboard**

  Dashboard shows related information about employees working in the hospital to help guests perceive a general statistic and increase the hospital's reliability. Guests can partially rely on those data to decide if they use the service or not.

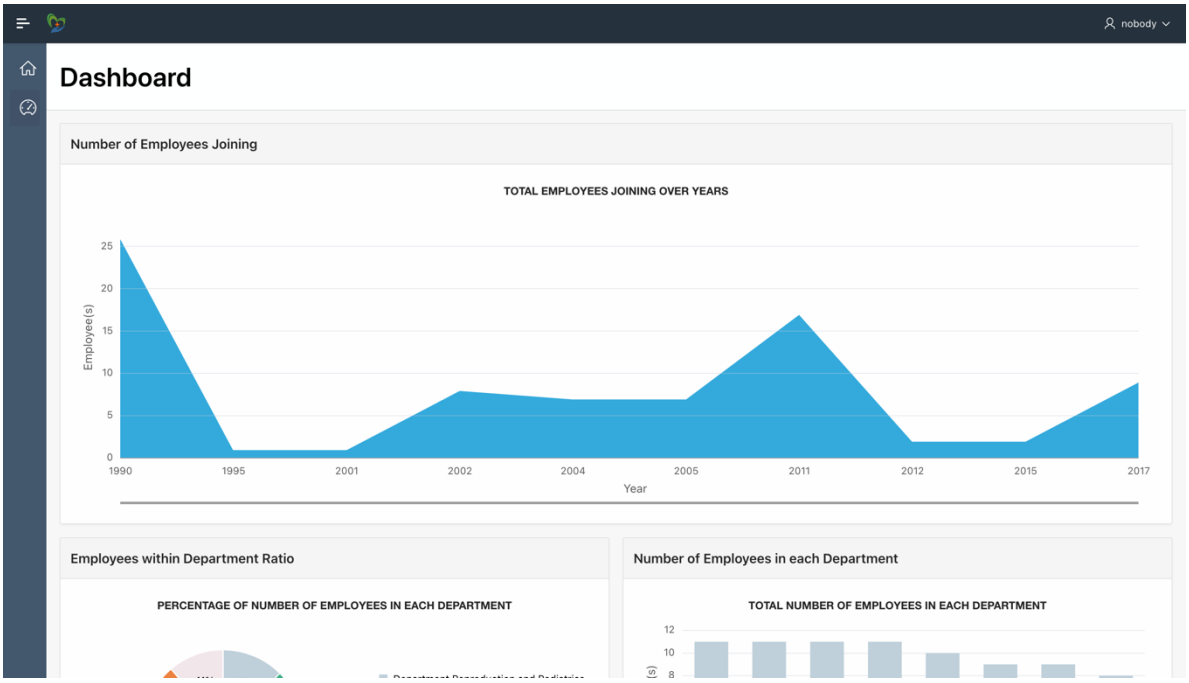


Figure 5: Dashboard from Guest User View

- **User Login System**

  The *Login System* contains two text fields to input including username and its password. Users can sign in with a provided (existing) account or a registered one.

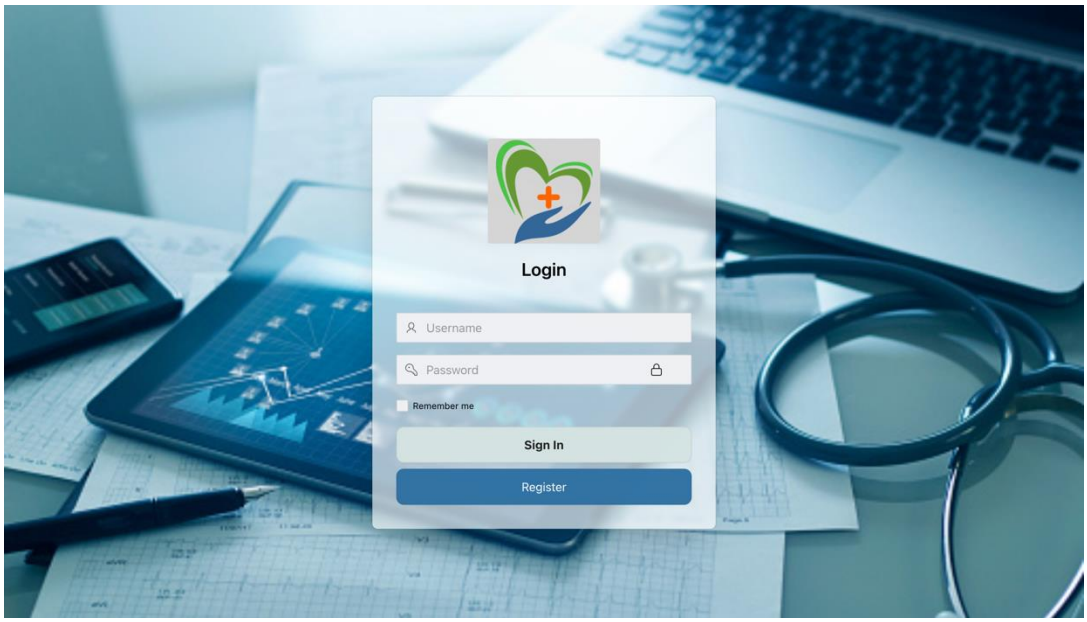


Figure 6: Login System

- **User Registration System**

After contacting the hospital, patients will be provided with a patient ID to validate their identity before accessing our user database.

After clicking the green '*Create*' button and getting a success message, the system will redirect users to the *Login System* and they can use the registered account that has been created to sign in.

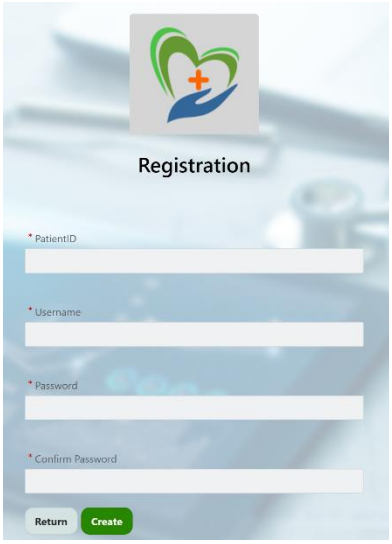


Figure 7: Registration Form

7.1.2 Patient Features

A patient account can access to *Book Appointment* feature by Navigation Menu (Figure 8).

It is used to book a specific doctor with preferred day, time and room.

All the doctors' information were hidden to protect their privacy excluding any name, certification(s) and department.

To book an appointment, patient users can choose their preferred doctors showing by Card-list three in a row.

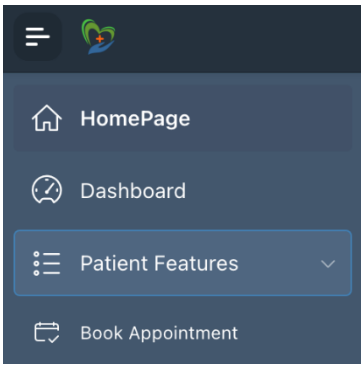


Figure 8: Patient Feature - Book Appointment shown in Navigation Menu

Patient users can interact with the page through two components:

- *Card-list* to book the doctors for appointment.
- *Order By* to sort doctors' name or department alphabetically and sort doctors' ID by default.

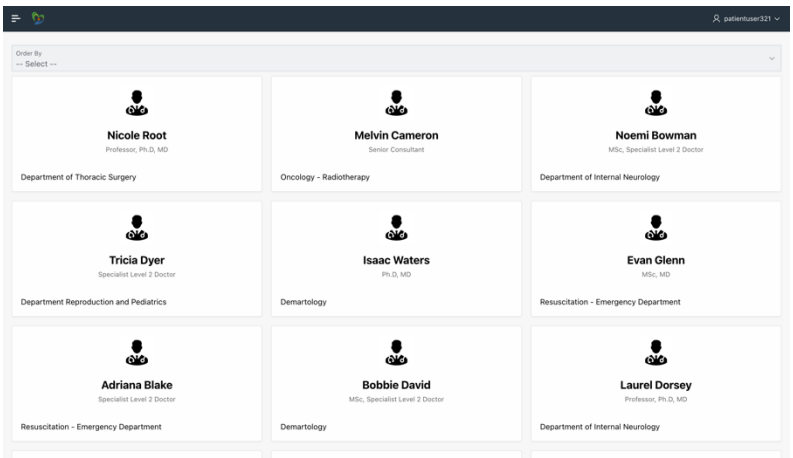


Figure 9: Doctors Card'list from Patient Users View

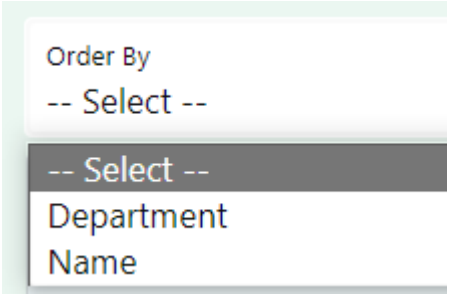


Figure 10: Order By – Sorting List

After choosing the preferred doctor, a dialog – *Book Appointment Form* will appear for users to input needed information. The *Room Schedule* Calendar is right below to check if the room has been booked or there are many appointments holding so patients can be proactive about booking time (Figure 12).

Invalid booking or Doctors' sudden business would be canceled and notified to patients as soon as possible.

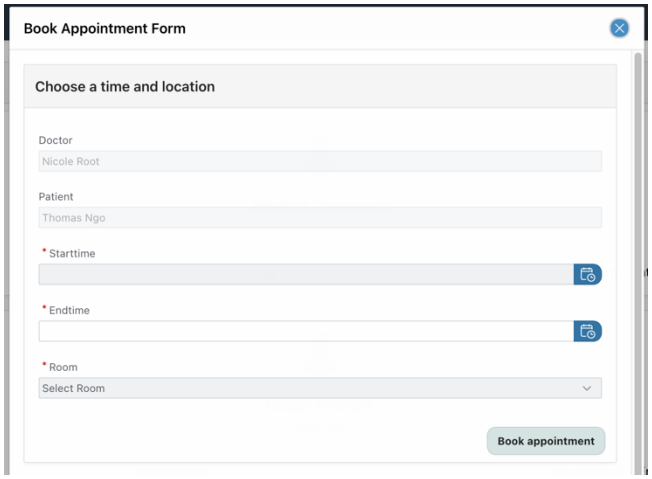


Figure 11: Book Appointment Form

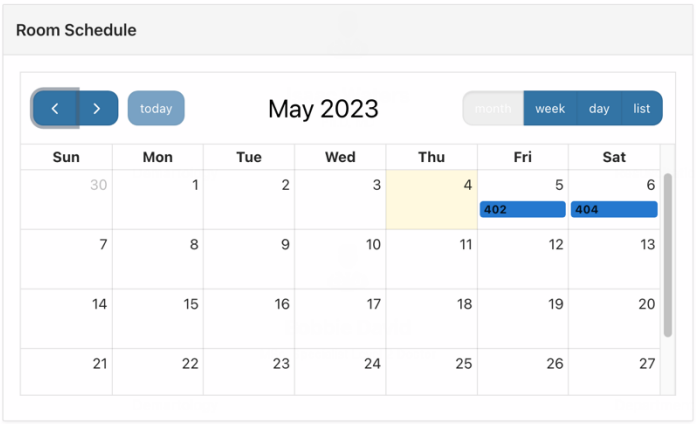


Figure 12: Room-Scheduled Calendar

7.1.3 Employee Features

Employee accounts have many tools to respond to their patients. After an appointment with patients, they can base on the appointment ID to identify which patients they are interacting with.

There are three tools expanded in this application: create medical prescription, assign patients to treatment group, and admit patients to a particular room.

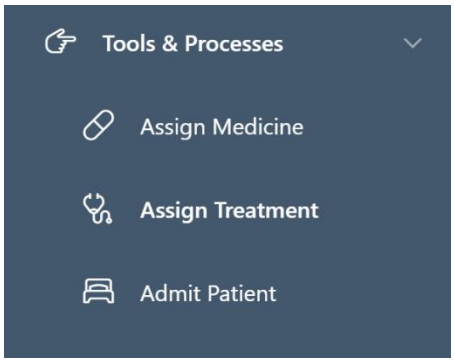


Figure 13: Employee Specialized Tool

- **Create Medical Prescription**

  If doctors think their patients need to take medicine, they can use the 'Add Medicine' tool placed in the Navigation Menu. To implement, doctors select the *Appointment ID* and *Medicine type* as required to the form below. The listed *Appointment IDs* would have been yet generated to bill.

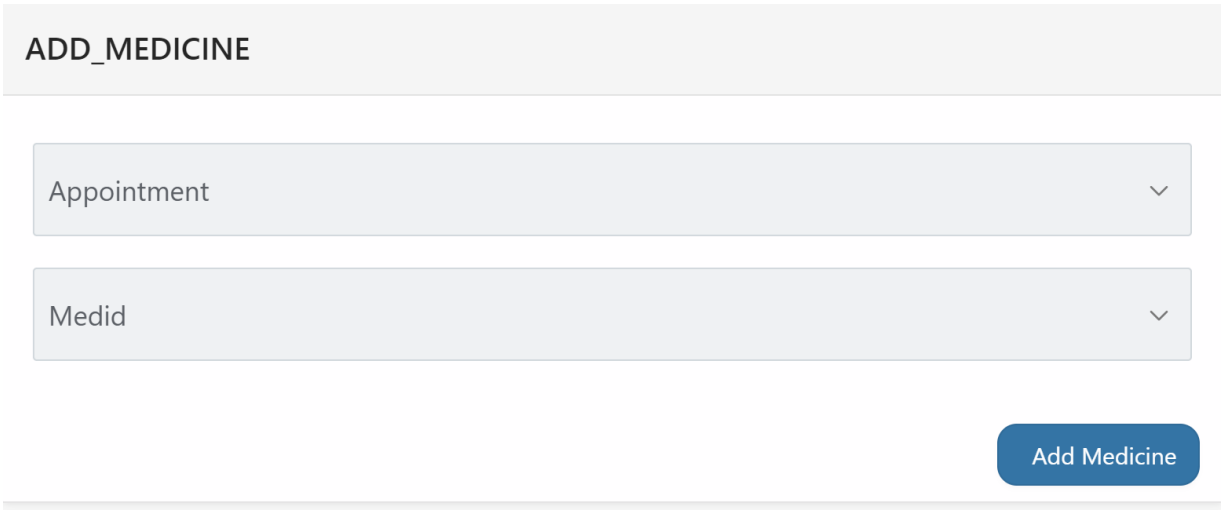


Figure 14: Add Medicine to A Patient's Prescription Form

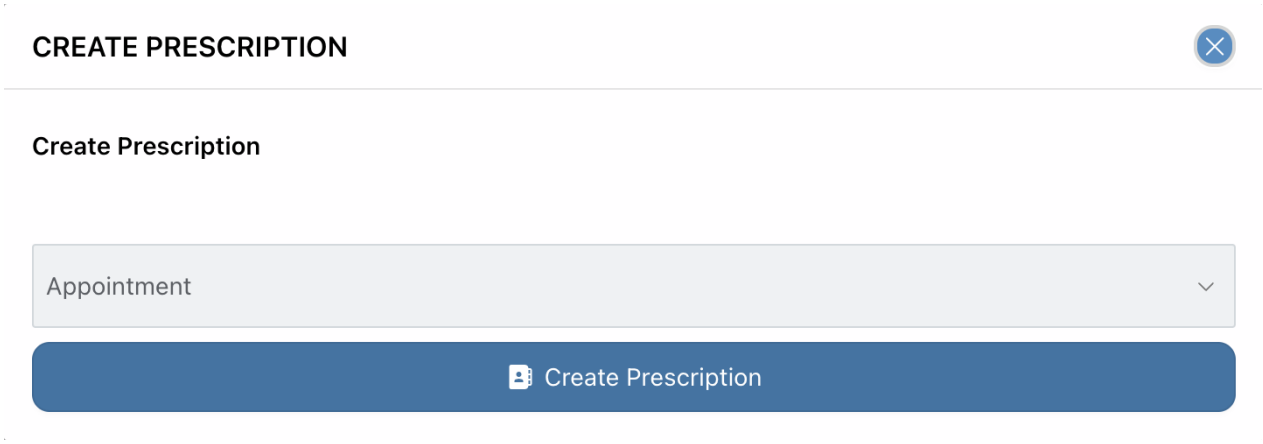


Figure 15: Prescription Generator

However, if the *Appointment ID* does not appear on the list even if its bill has not been issued, the doctor should click the blue button saying "Appointment not in the list? Create a prescription for it!" By doing this, a dialog pops up and a list of *Appointment IDs* which have not had a prescription is available for selection and a new prescription is created and the dialog is closed; therefore, after *refreshing* the *Add Medicine* page, the *Appointment ID* required will now appear in the list and be ready to add medicines.

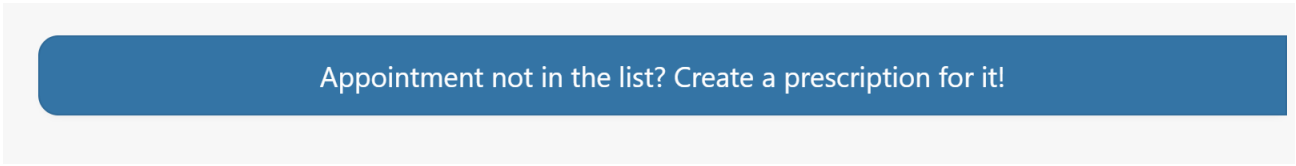


Figure 16: Prescription Generator

- **Assign Treatment**

This tool allows employees to assign treatment methods to specific patients by *Appointment ID*. Moreover, they must select an operation day, the assigned treatment, and a physician taking responsibility. Two components – assistant and room are optional. After finishing, press '*Assign Treatment*' button to take action.

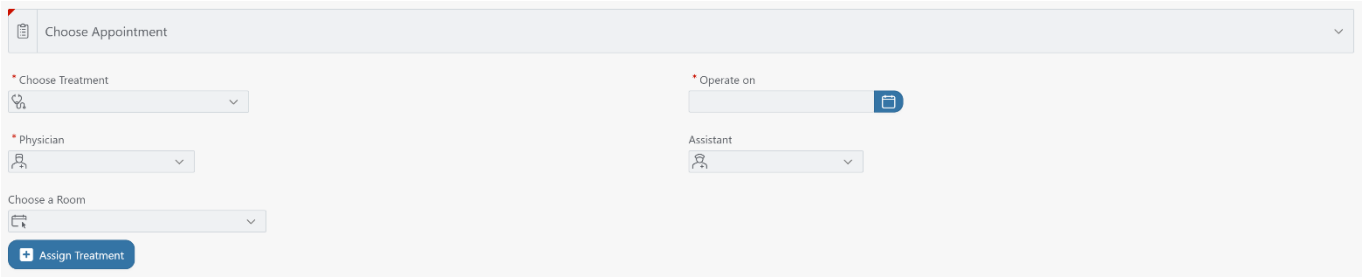


Figure 17: Assign Treatment Tool

- **Admit Patient**

  If it is necessary, staff could admit patients to take care of them better. For convenience in recording patients' information, before patients to be admitted to the hospital, it is required for employees taking responsibility of the tool to select *Appointment ID*, the *date of admission*, and the *patient's room*.

Figure 18: Admit Patient

Beside specialized tools, employee accounts also have special access to the hospital related Information and Interpretation.

Figure 19: Medical Information available from Employees' View

- **Medical Record**

  In this page, the employee can view the medical history of patients by choosing the *Appointment ID* and press the "Show Details" button to see all the related information of their patients including Patient Details, Hospitalization, Treatment Details and Medicine Details. In the Patient Details area, all fields are disabled apart from "Notation" field for the employee (e.g., Doctor) to edit and click the Save button to update the data. In the Hospitalization

area, the user can click in the “Discharge Patient” button to discharge the patient if he/she is still in the hospital.

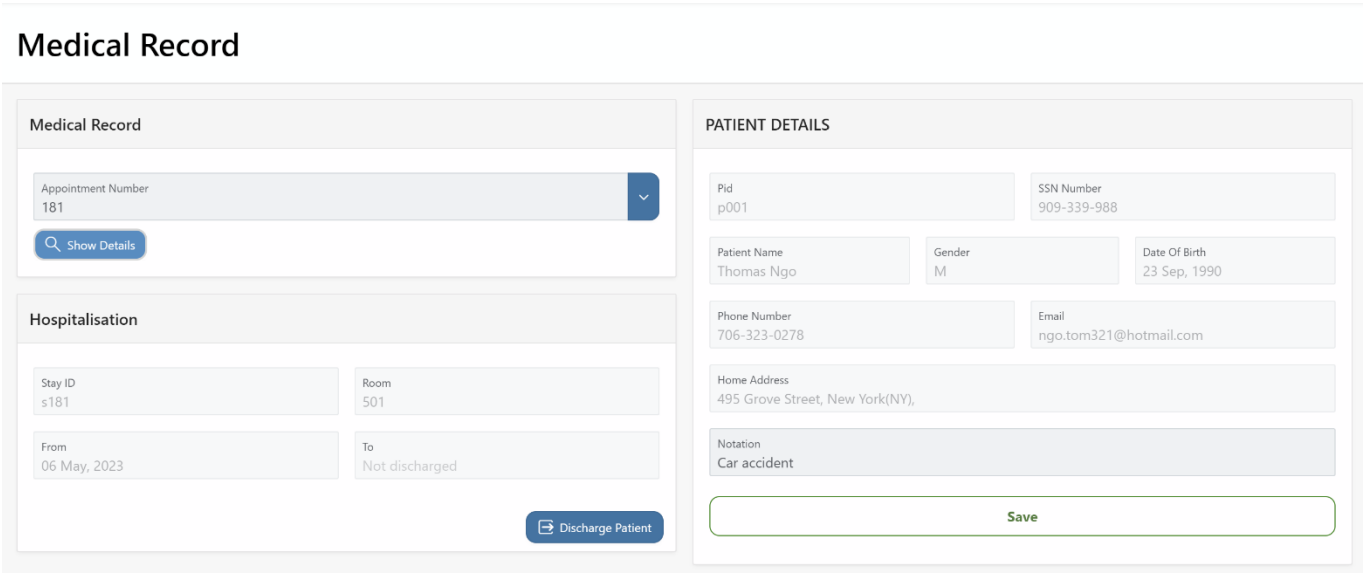


Figure 20: Changeable Patients’ Notation and Discharge Inpatient Features

A confirm dialog appears and prompts the user to select the appropriate *Appointment ID* then click the yellow button.

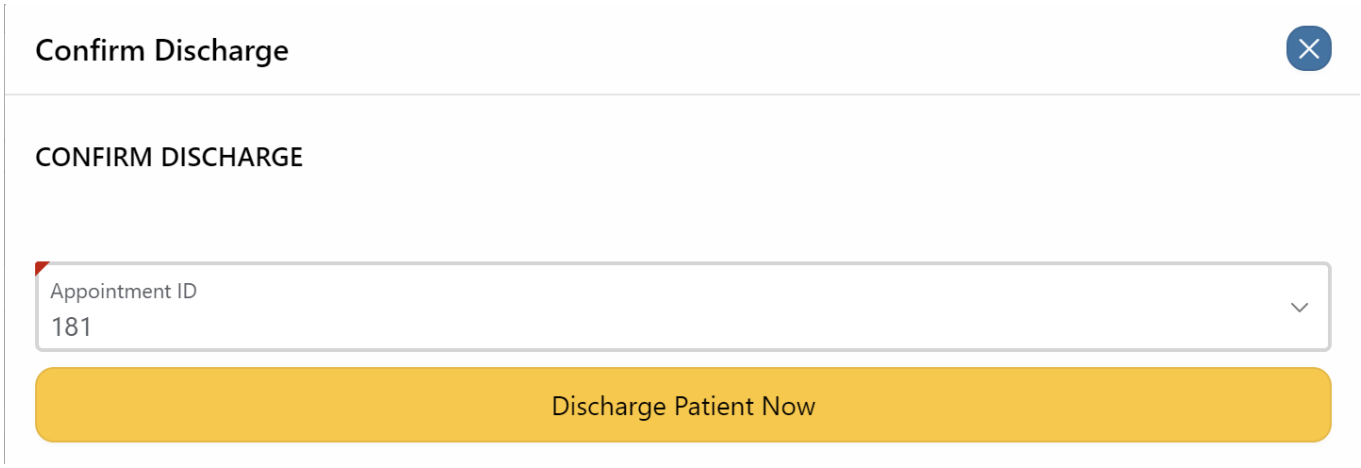


Figure 21: Discharge Action Confirm

The doctor can also view the details in the treatments and medicines that the patient has been assigned in the Treatment and Medicine area. It also shows the staff’s name that created the corresponding prescription.

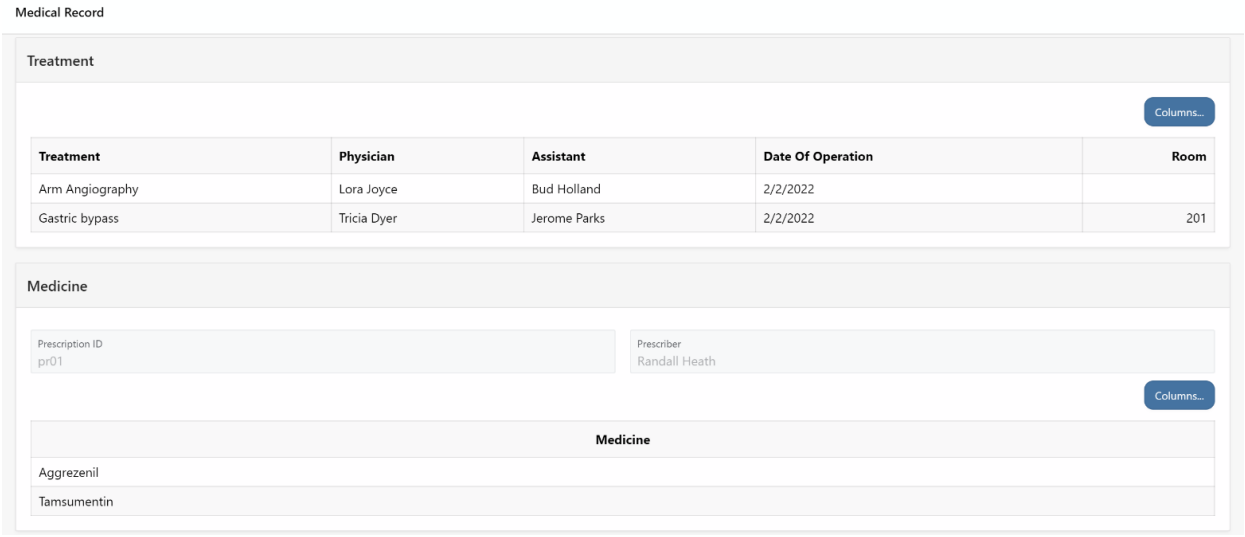


Figure 22: Patient's Treatment and Medicine Taking

- **Medicine Information**

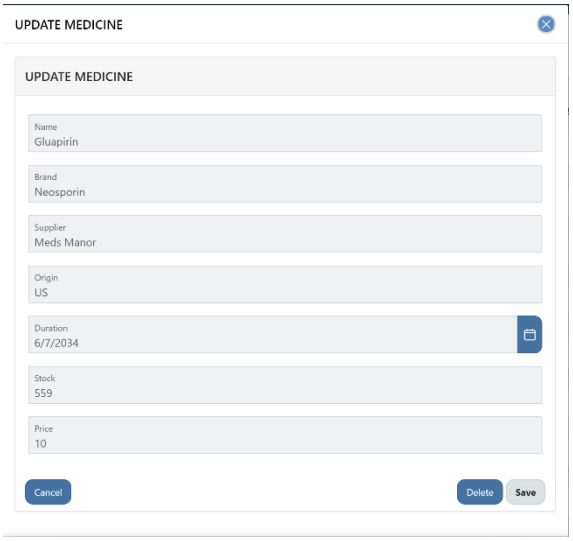


Figure 23: Update Medicine Dialog

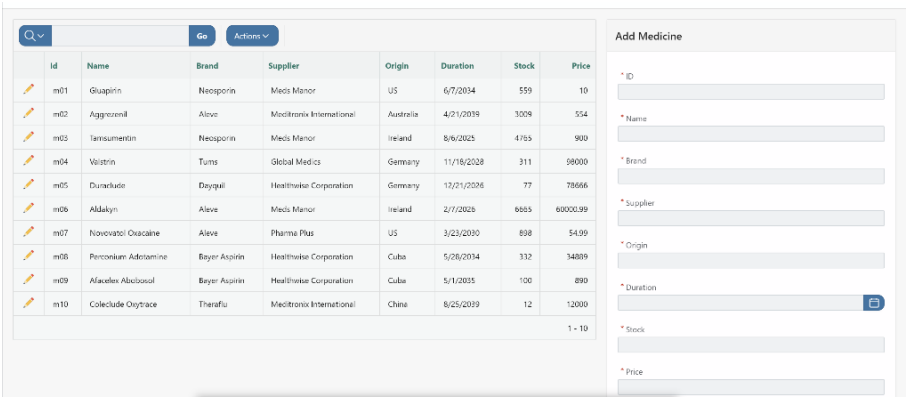


Figure 24: Editable Medicine Information and Adding new Medicine Features

The user can see the full information of all types of medicine that were and are used in the hospital or add a new medicine to the database by utilizing the *Add Medicine* area (see Figure 24). By clicking the pencil icon, the users are able to update or delete the corresponding medicine (see Figure 23).

- **Treatment Information**

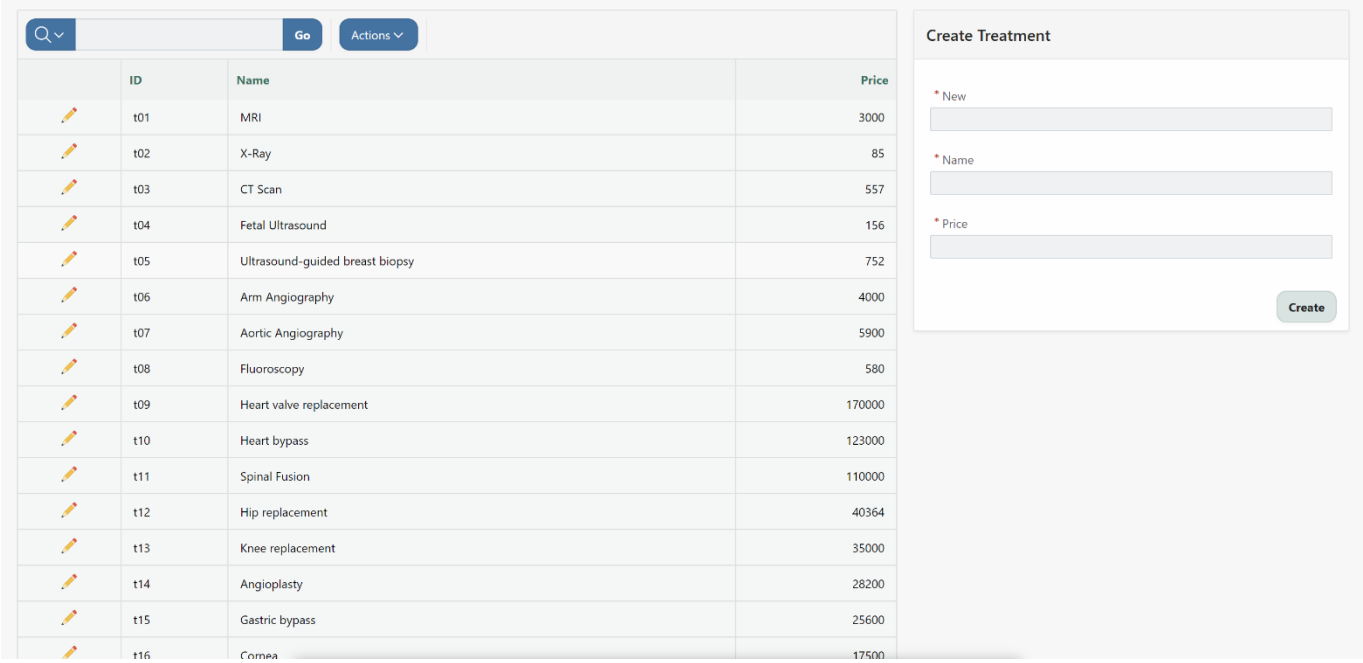


Figure 25: Editable Treatment Information and Create Treatment Feature

The Treatment Information page works exactly the same as how the Medicine Information page does. The user is allowed to create, read, update and delete any rows they want (see Figure 25).

7.1.4 Administrator Features

An admin account has access to all other users' features to check pages' functions and control the service's quality. Admin accounts also have itself multiple features to manage the hospital's information.

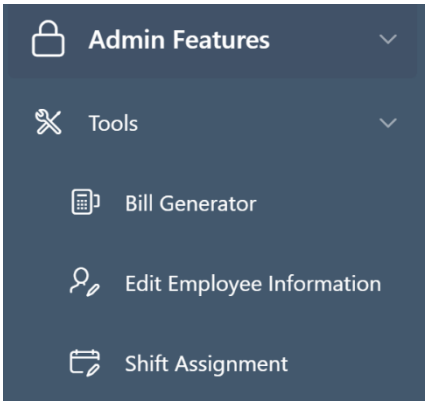


Figure 26: Specialized Admin Accounts' Features

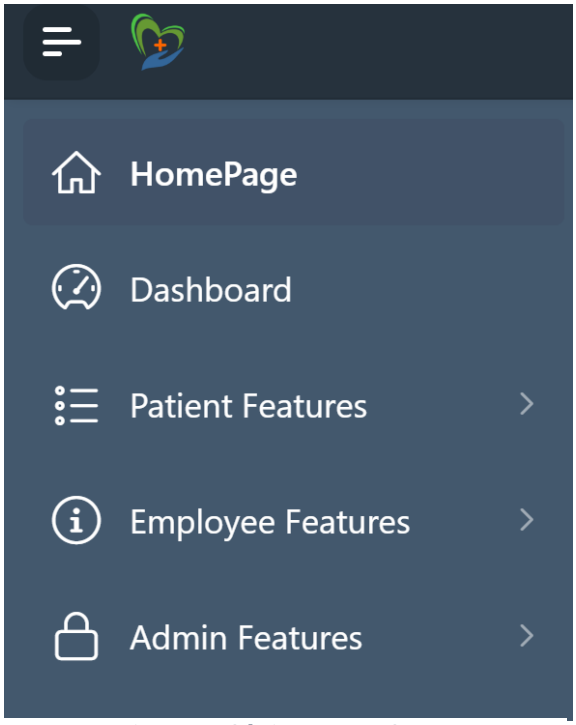


Figure 27: Admin Features Access

Other than employees' and customers' reports and charts discussed in the following sections (see Section 7.1.5, 7.1.6), admin accounts can generate bills, edit employees' information, and assign shifts for specific employees.

- **Bill Generator**

  After recovery, to discharge patients from the hospital, the Chief Executive Officer or Executive Manager taking admin roles will use the *Bill Generator* to account all the services that patients used. Make sure that the patient has been discharged from the hospital before the bill is generated, otherwise, an error message will show up.

  By selecting the *Appointment ID*, the corresponding patient's information will appear in the right-column boxes.

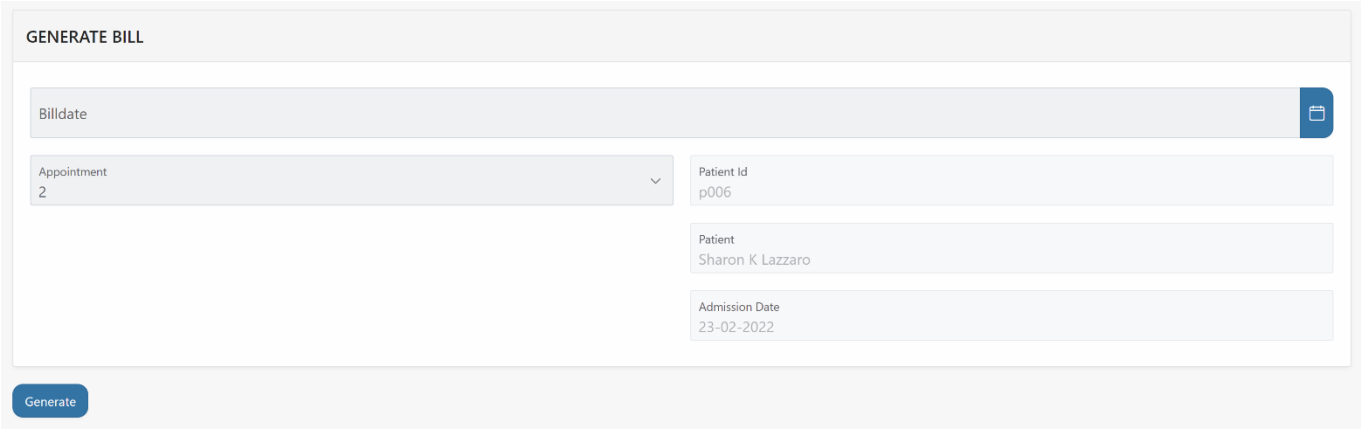


Figure 28: Bill Generator Executed Form

- **Edit Staffs Information**

This tool is useful whenever the hospital needs to update their staff information, especially updating *Achieved Certification(s)*. Using the same Card-list containers as *Booking Appointment* Patient Features (see Section 7.1.2) but admin-account type can view all relating information of the employees stored in the hospital's database.

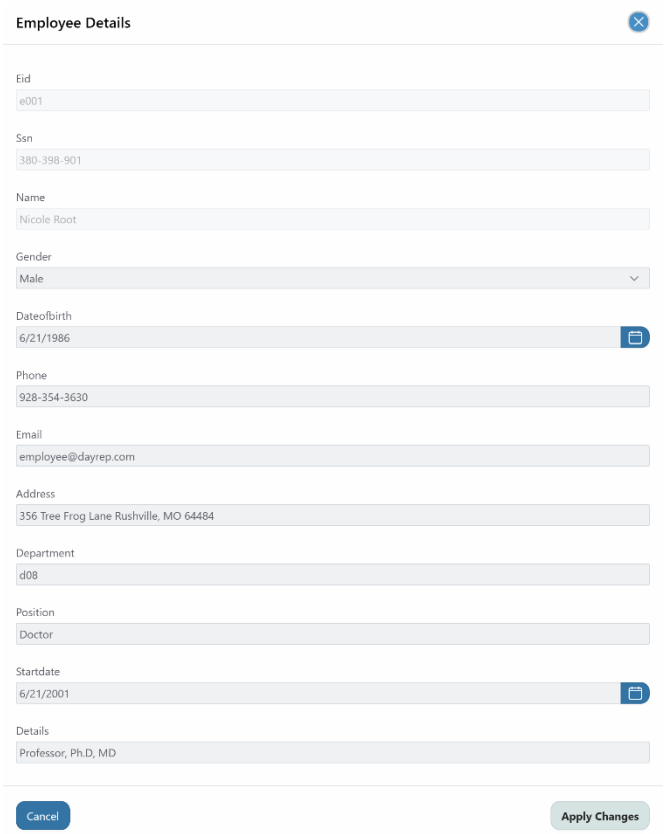


Figure 29: Employee Details

- **Assign Shift(s) for Employees**

  The one has an admin account can assign shift for every staff with any time slots. By clicking on a date of the calendar on the right side, it will generate a shift id. Clicking again on that blue box, a shift details form will be shown up and editable.

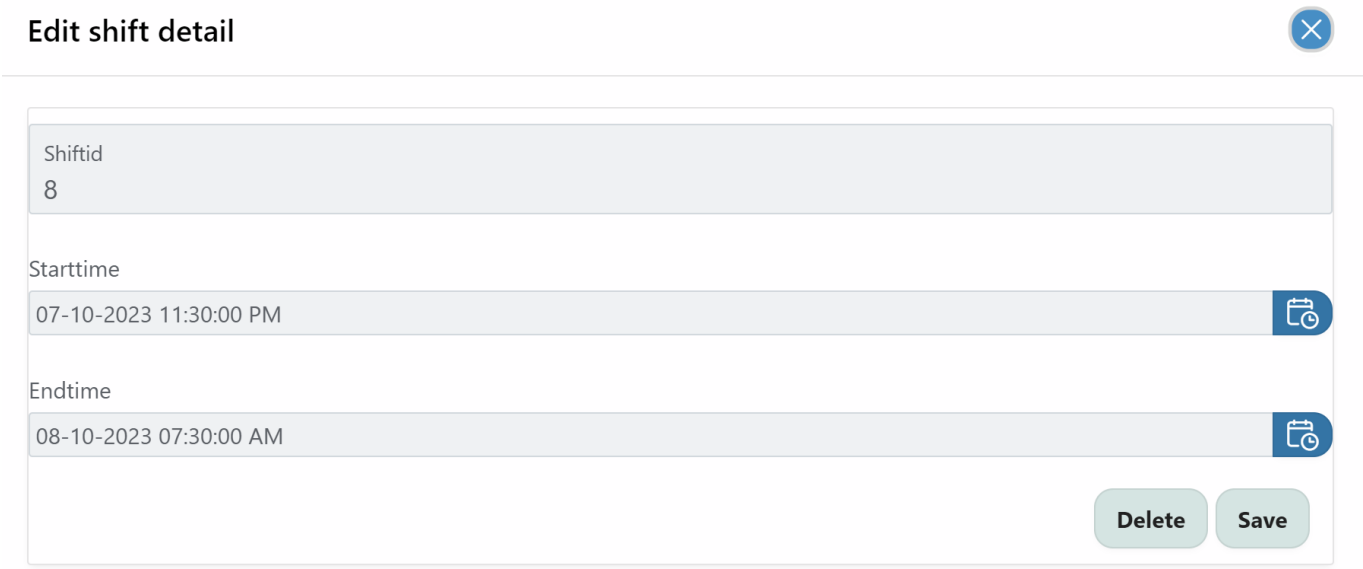


Figure 30: Editable Shift Details Form

After customizing the shift calendar, admin should use the Assign Shift form to pick an employee for that shift. It is available to assign many employees to one shift slot, but the system recommends being two employees per slot at a time.

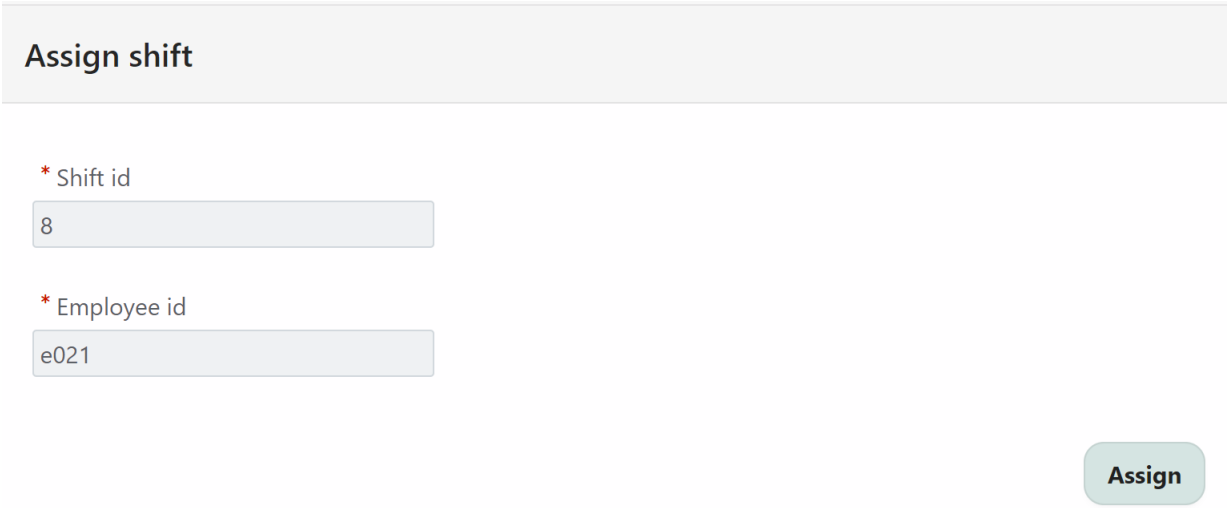


Figure 31: Shift Assignment Form

Afterwards, the corresponding staff name(s) who have been assigned to show up in Employee Calendar on the left.

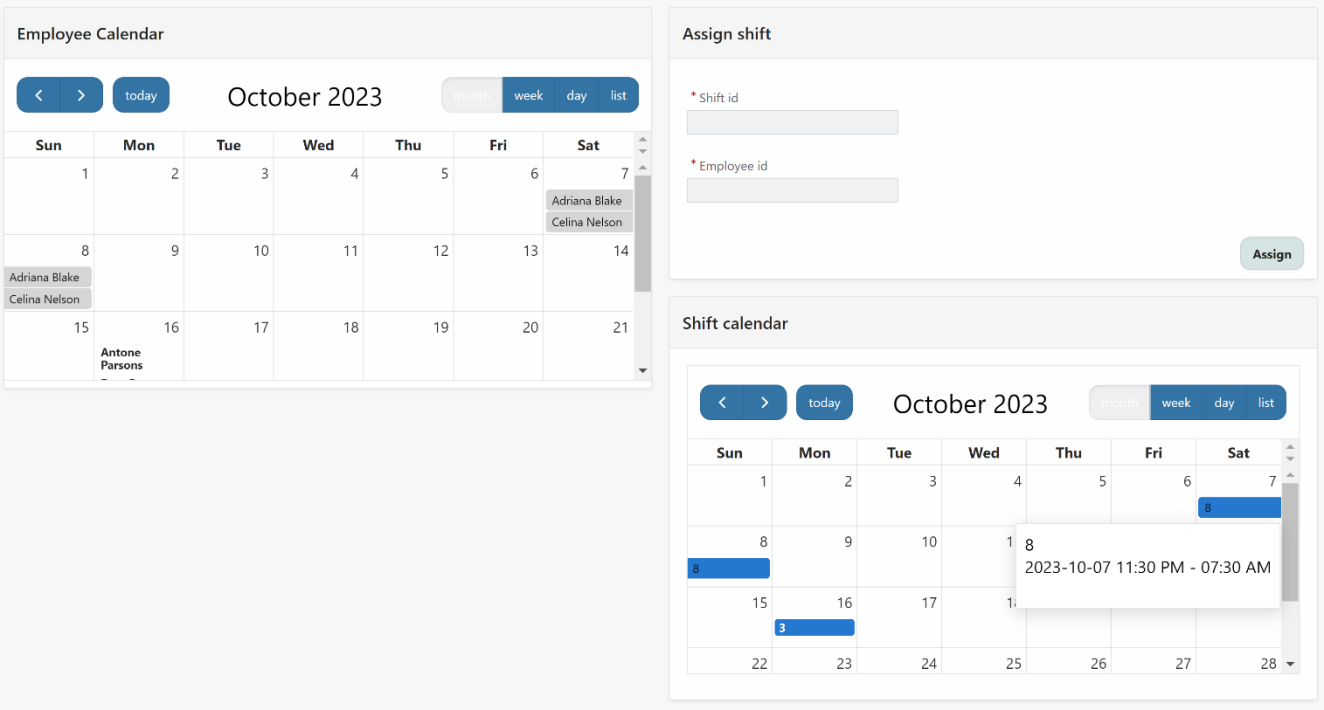


Figure 32: The whole Shift Featured Page

7.2 Reports

1. Medicine

Go Actions

Id	Name	Brand	Supplier	Origin	Duration	Stock	Price
m01	Gluapirin	Neosporin	Meds Manor	US	6/7/2034	559	10
m02	Aggrezenil	Aleve	Meditronix International	Australia	4/21/2039	3009	554
m03	Tamsumentin	Neosporin	Meds Manor	Ireland	8/6/2025	4765	900
m04	Valstrin	Tums	Global Medics	Germany	11/18/2028	311	98000
m05	Duraclude	Dayquil	Healthwise Corporation	Germany	12/21/2026	77	78666
m06	Aldakyn	Aleve	Meds Manor	Ireland	2/7/2026	6665	60000.99
m07	Novovatol Oxacaine	Aleve	Pharma Plus	US	3/23/2030	898	54.99
m08	Perconium Adotamine	Bayer Aspirin	Healthwise Corporation	Cuba	5/28/2034	332	34889
m09	Afacelex Abobosol	Bayer Aspirin	Healthwise Corporation	Cuba	5/1/2035	100	890
m10	Coleclude Oxytrace	Theraflu	Meditronix International	China	8/25/2039	12	12000

1 - 10

Figure 33: Medicine Interactive Report

Medicine report is where medical practitioners can find information about medications for which the hospital is responsible. Normally, doctors and pharmacists use this report to check the medicine names, origins and prices in order to consult with patients. Moreover, they can seek items by different fields such as ID, name, brand and so on (see Figure 34). It also allows to download the data.

2. Treatment Information

Go Actions

ID	Name	Price
t01	MRI	3000
t02	X-Ray	85
t03	CT Scan	557
t04	Fetal Ultrasound	156
t05	Ultrasound-guided breast biopsy	752
t06	Arm Angiography	4000
t07	Aortic Angiography	5900
t08	Fluoroscopy	580
t09	Heart valve replacement	170000
t10	Heart bypass	123000
t11	Spinal Fusion	110000
t12	Hip replacement	40364
t13	Knee replacement	35000
t14	Angioplasty	28200

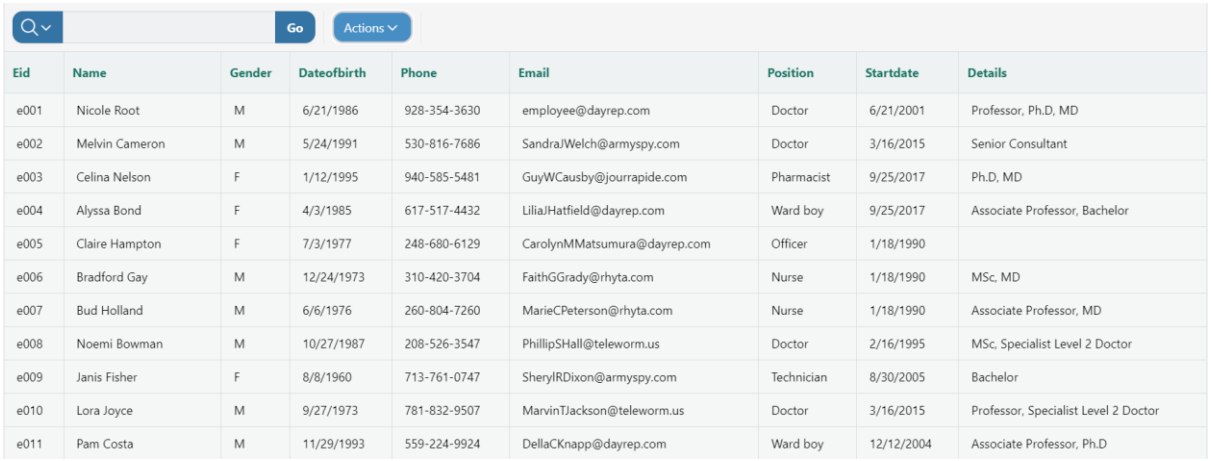
Figure 34: Treatment Interactive Report

The report on the Treatment Information page shows all the information about each treatment. Alike to the Medicine Report that is demonstrated above, this is also a highly interactive tool facilitating

employees to attain the information. There are several features integrated to this page. For example, employees can filter the data and do calculation with price.

Reports for The Administrator

1. Employee Report



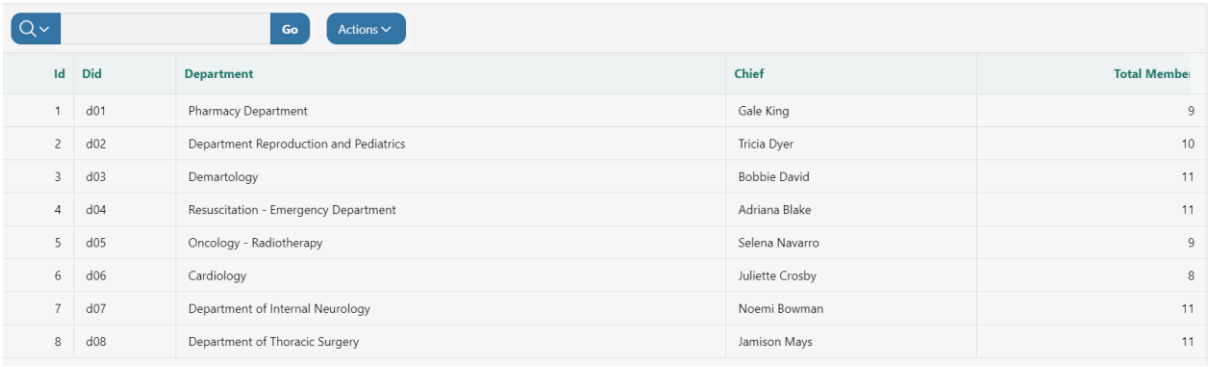
Go Actions

Eid	Name	Gender	Dateofbirth	Phone	Email	Position	Startdate	Details
e001	Nicole Root	M	6/21/1986	928-354-3630	employee@dayrep.com	Doctor	6/21/2001	Professor, Ph.D, MD
e002	Melvin Cameron	M	5/24/1991	530-816-7686	SandraJWelch@armyspy.com	Doctor	3/16/2015	Senior Consultant
e003	Celina Nelson	F	1/12/1995	940-585-5481	GuyWCausby@jourrapide.com	Pharmacist	9/25/2017	Ph.D, MD
e004	Alyssa Bond	F	4/3/1985	617-517-4432	LiliaJHatfield@dayrep.com	Ward boy	9/25/2017	Associate Professor, Bachelor
e005	Claire Hampton	F	7/3/1977	248-680-6129	CarolynMMatsumura@dayrep.com	Officer	1/18/1990	
e006	Bradford Gay	M	12/24/1973	310-420-3704	FaithGGrady@rhyta.com	Nurse	1/18/1990	MSc, MD
e007	Bud Holland	M	6/6/1976	260-804-7260	MarieCPeterson@rhyta.com	Nurse	1/18/1990	Associate Professor, MD
e008	Noemi Bowman	M	10/27/1987	208-526-3547	PhillipSHall@teleworm.us	Doctor	2/16/1995	MSc, Specialist Level 2 Doctor
e009	Janis Fisher	F	8/8/1960	713-761-0747	SherylRDixon@armyspy.com	Technician	8/30/2005	Bachelor
e010	Lora Joyce	M	9/27/1973	781-832-9507	MarvinTJackson@teleworm.us	Doctor	3/16/2015	Professor, Specialist Level 2 Doctor
e011	Pam Costa	M	11/29/1993	559-224-9924	DellaCKnapp@dayrep.com	Ward boy	12/12/2004	Associate Professor, Ph.D

Figure 35: Employee Interactive Report

The administrator has the right to view the employees' information as shown in Figure 35.

2. Department Report



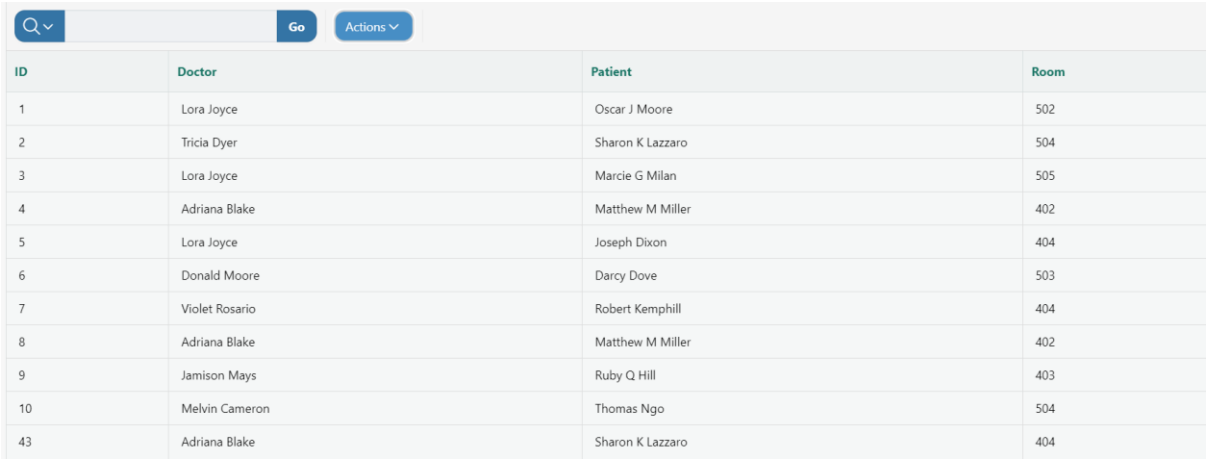
Go Actions

Id	Did	Department	Chief	Total Membe
1	d01	Pharmacy Department	Gale King	9
2	d02	Department Reproduction and Pediatrics	Tricia Dyer	10
3	d03	Demartology	Bobbie David	11
4	d04	Resuscitation - Emergency Department	Adriana Blake	11
5	d05	Oncology - Radiotherapy	Selena Navarro	9
6	d06	Cardiology	Juliette Crosby	8
7	d07	Department of Internal Neurology	Noemi Bowman	11
8	d08	Department of Thoracic Surgery	Jamison Mays	11

Figure 36: Department Interactive Report

Also, the information related to the hospital's departments is also viewable to the administrator.

3. Appointment Report



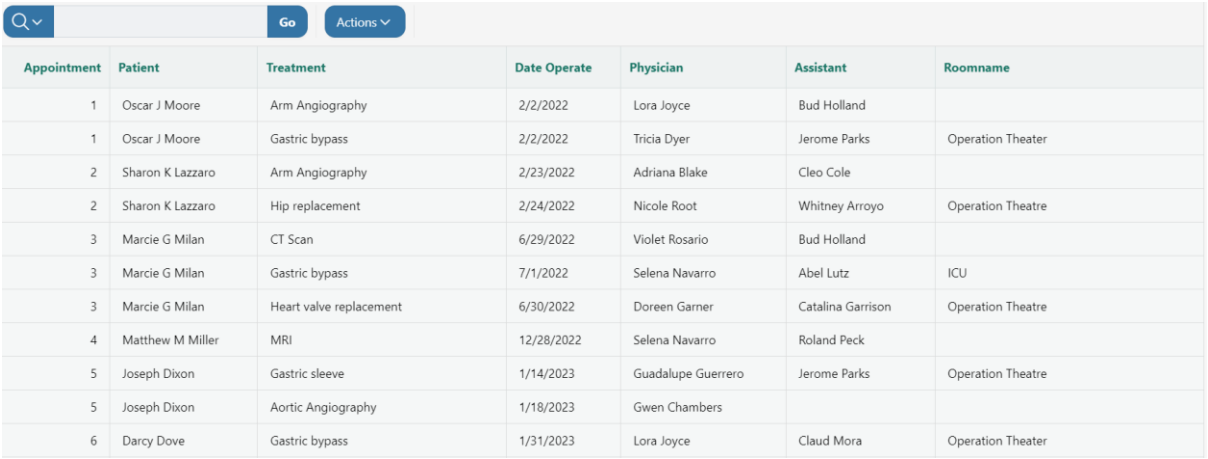
Go Actions

ID	Doctor	Patient	Room
1	Lora Joyce	Oscar J Moore	502
2	Tricia Dyer	Sharon K Lazzaro	504
3	Lora Joyce	Marcie G Milan	505
4	Adriana Blake	Matthew M Miller	402
5	Lora Joyce	Joseph Dixon	404
6	Donald Moore	Darcy Dove	503
7	Violet Rosario	Robert Kemphill	404
8	Adriana Blake	Matthew M Miller	402
9	Jamison Mays	Ruby Q Hill	403
10	Melvin Cameron	Thomas Ngo	504
43	Adriana Blake	Sharon K Lazzaro	404

Figure 37: Appointment Interactive Report

Since the administrator account is created to manage both staff accounts and patients accounts, it is necessary to let the admin access the details of every medical visit such as the doctor, the patient and the location. Beyond that, a smart search bar is integrated to optimize the searching.

4. Customer Service Information



Go Actions

Appointment	Patient	Treatment	Date Operate	Physician	Assistant	Roomname
1	Oscar J Moore	Arm Angiography	2/2/2022	Lora Joyce	Bud Holland	
1	Oscar J Moore	Gastric bypass	2/2/2022	Tricia Dyer	Jerome Parks	Operation Theater
2	Sharon K Lazzaro	Arm Angiography	2/23/2022	Adriana Blake	Cleo Cole	
2	Sharon K Lazzaro	Hip replacement	2/24/2022	Nicole Root	Whitney Arroyo	Operation Theatre
3	Marcie G Milan	CT Scan	6/29/2022	Violet Rosario	Bud Holland	
3	Marcie G Milan	Gastric bypass	7/1/2022	Selena Navarro	Abel Lutz	ICU
3	Marcie G Milan	Heart valve replacement	6/30/2022	Doreen Garner	Catalina Garrison	Operation Theatre
4	Matthew M Miller	MRI	12/28/2022	Selena Navarro	Roland Peck	
5	Joseph Dixon	Gastric sleeve	1/14/2023	Guadalupe Guerrero	Jerome Parks	Operation Theatre
5	Joseph Dixon	Aortic Angiography	1/18/2023	Gwen Chambers		
6	Darcy Dove	Gastric bypass	1/31/2023	Lora Joyce	Claud Mora	Operation Theater

Figure 38: Service Providing Interactive Report

This is a record of services which a patient experienced from the time he checks in to the time he checks out.

7.3 Charts

Charts for The Administrator

1. Employee Analysis

At the current time, our team generated two charts which are **Age Distribution Among Employees** and **Top Five Employees Booked By Patients** (see Figure 40, 41).

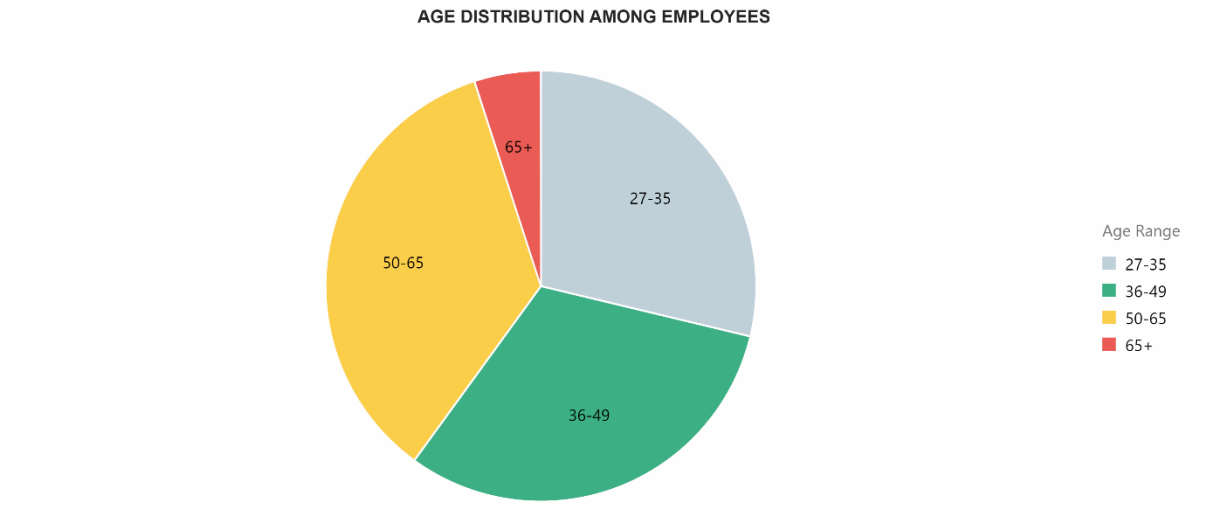


Figure 39: Age Distribution of Employees demonstrated by Pie Chart

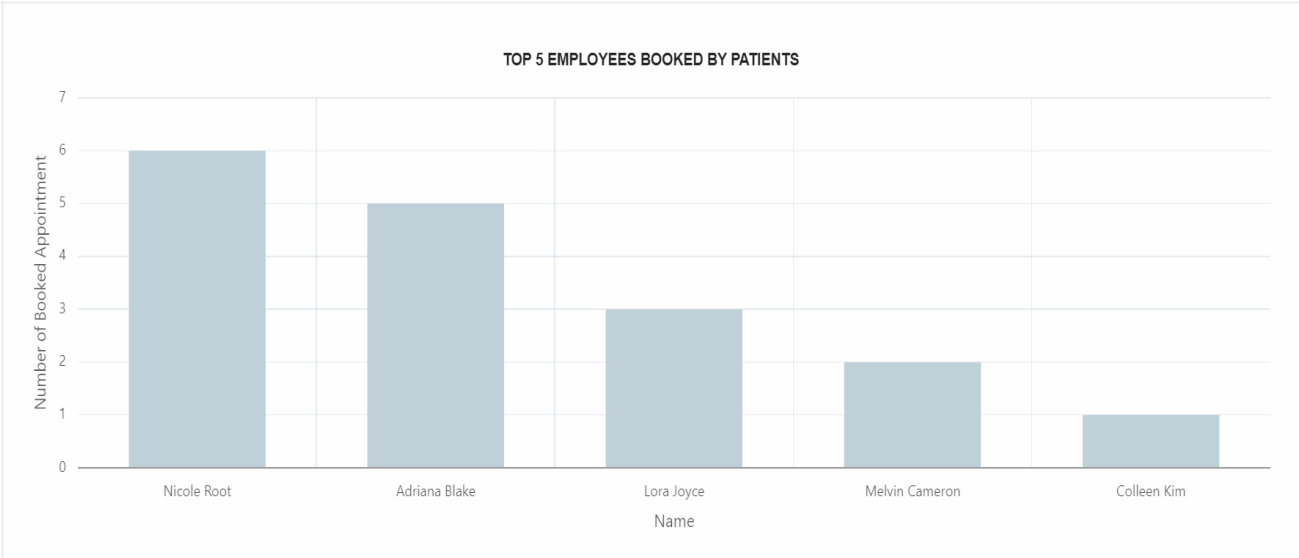


Figure 40: The Top Five Employees of the time presented by Bar Chart

With those charts, the viewer can see the value of every pie or bar by pointing their mouse over this pie or bar. For example, at the sector of 50-65-year-old staff, the number 28 appears right at the cursor means that there are 28 employees from 50 to 65 (see Figure 42).

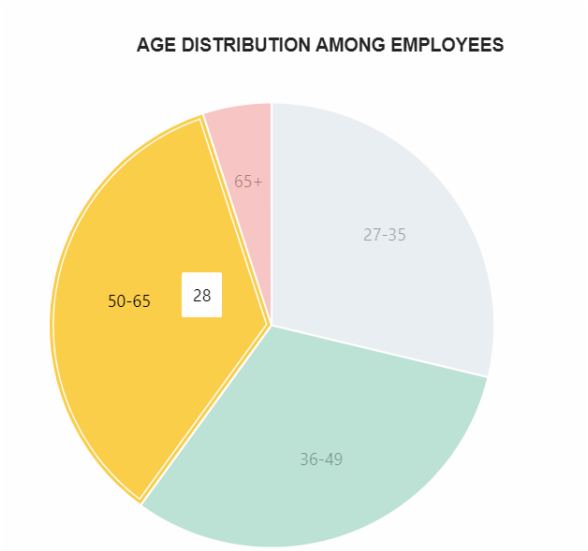


Figure 41: Value Displayed by Hover

2. Customer Analysis

In terms of customer investigation, there are 3 charts which are **Number Of Customers Have Birthday In Month, Gender Ratio** and **Patient Account Register** (see Figure 43, 44, 45). As a business, the hospital prioritizes these statistical analyses because it is crucial to study the basic customers' patterns and biographical data to develop the service.

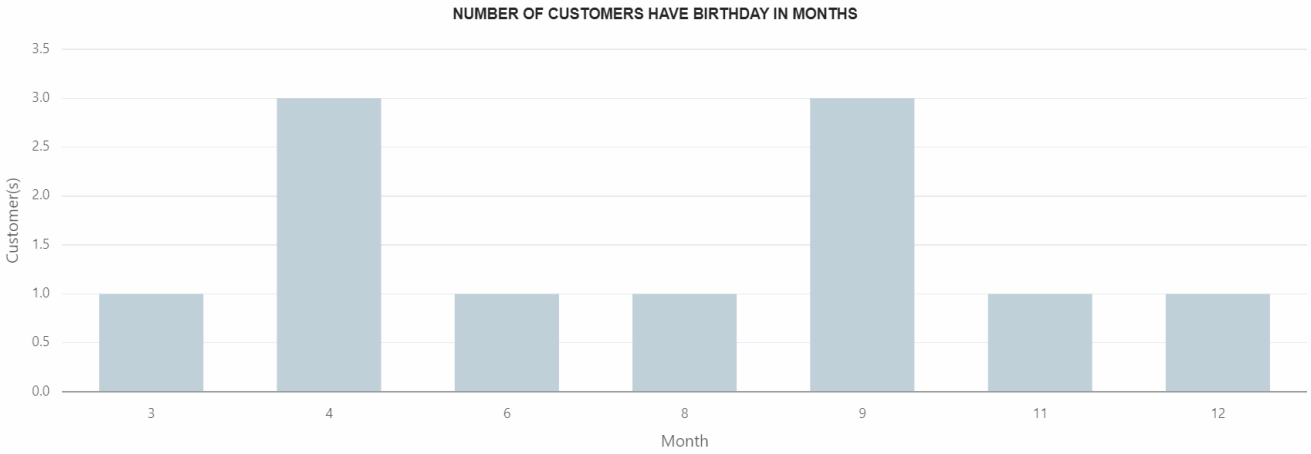


Figure 42: Patients Birthday in Months demonstrated by Bar Charts

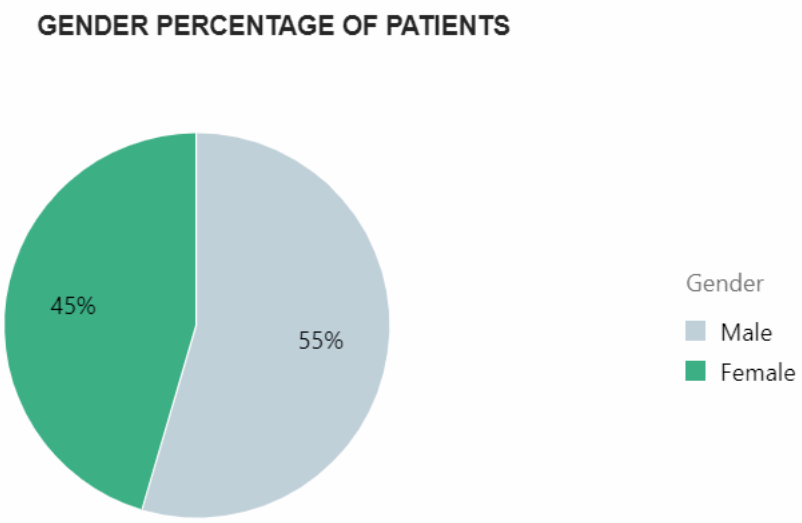


Figure 43: Gender Ratio demonstrated by Pie Chart

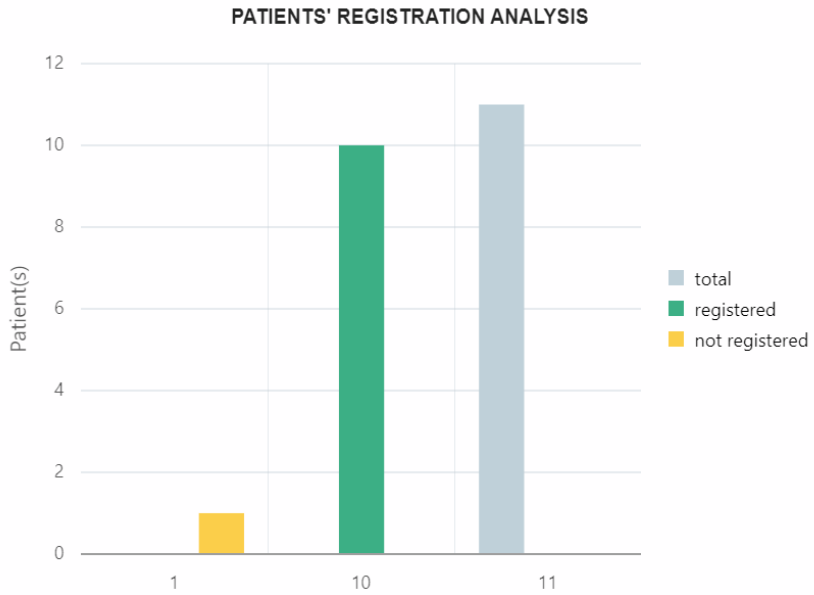


Figure 44: Registered Account Status between Patients

To know the values of these bars of the chart **Patients' Registration Analysis**.

To read the statistics of **Patients' Registration Analysis**, the administrator can either look at the values on the vertical and horizontal axes or place the cursor on the bars.

7.4 Extra features

- An interactive Slider with automatically changeable after every five seconds

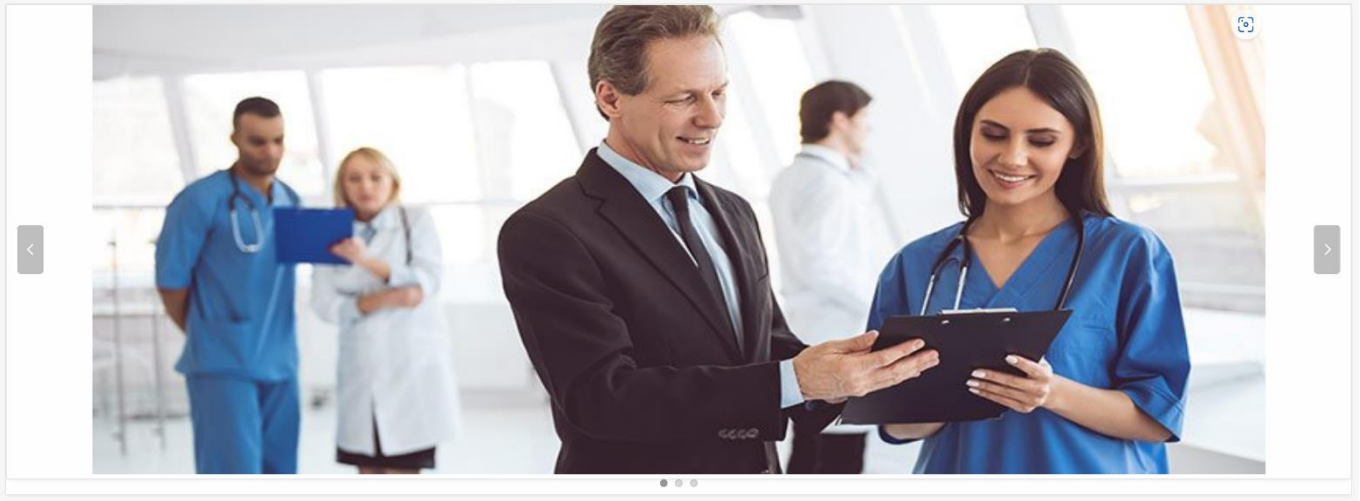


Figure 45: Picture 1 in Interactive Slider

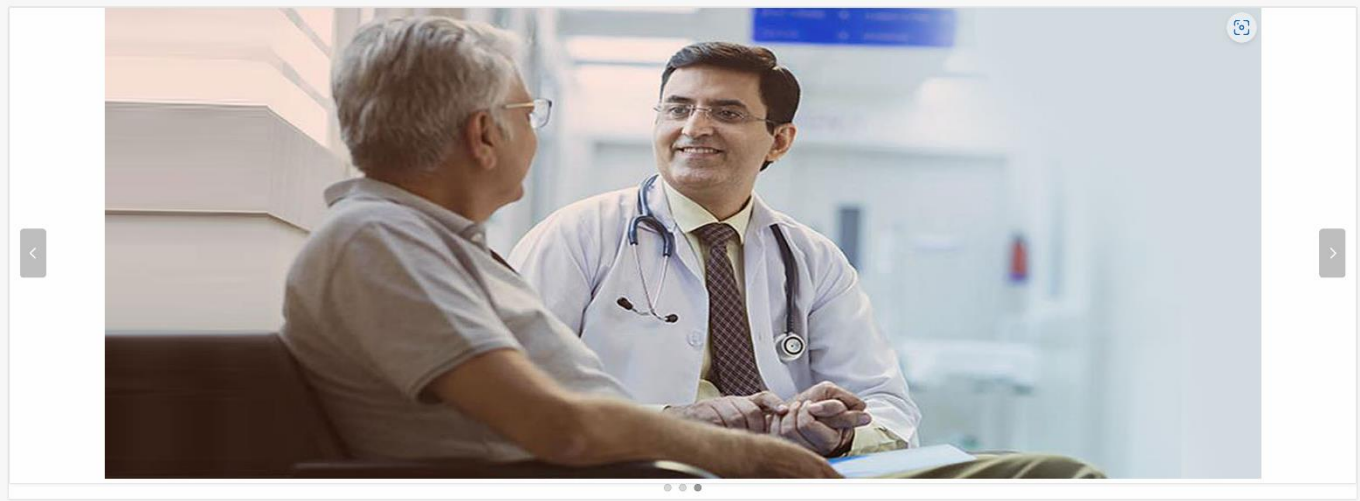


Figure 46: Picture 2 in Interactive Slider

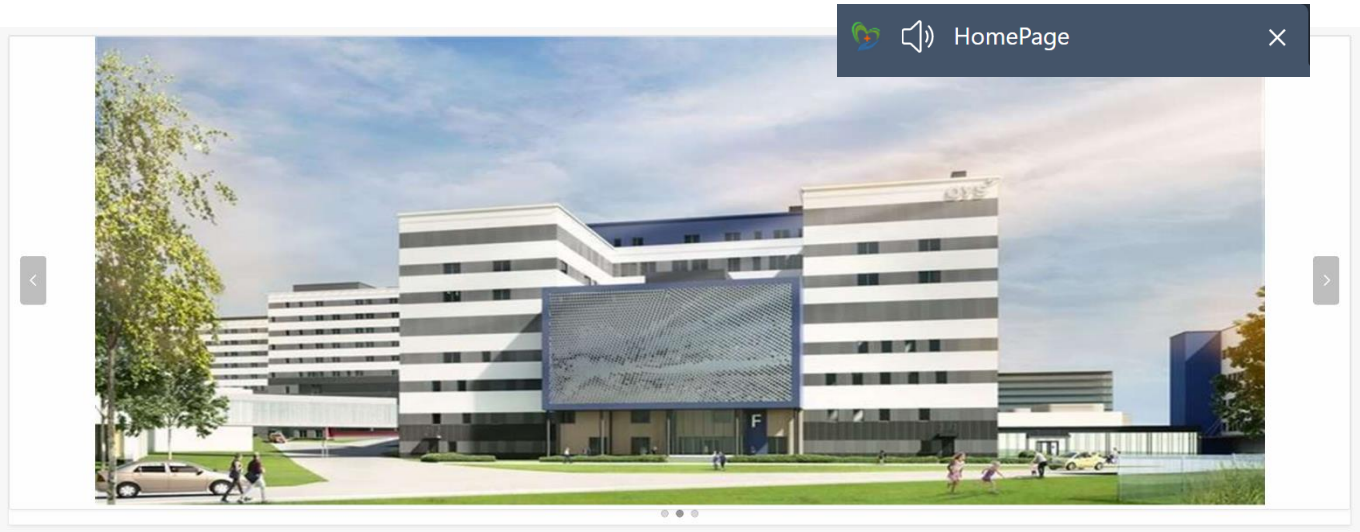


Figure 47: Picture 3 in Interactive Slider

- An autoplay audio in *HomePage* Background

- Page footer showing the hospital contacts and customized theme options (see Appendix C). However, it is not available for guests to customize their themes.

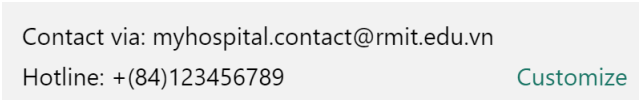


Figure 48: Page Footer

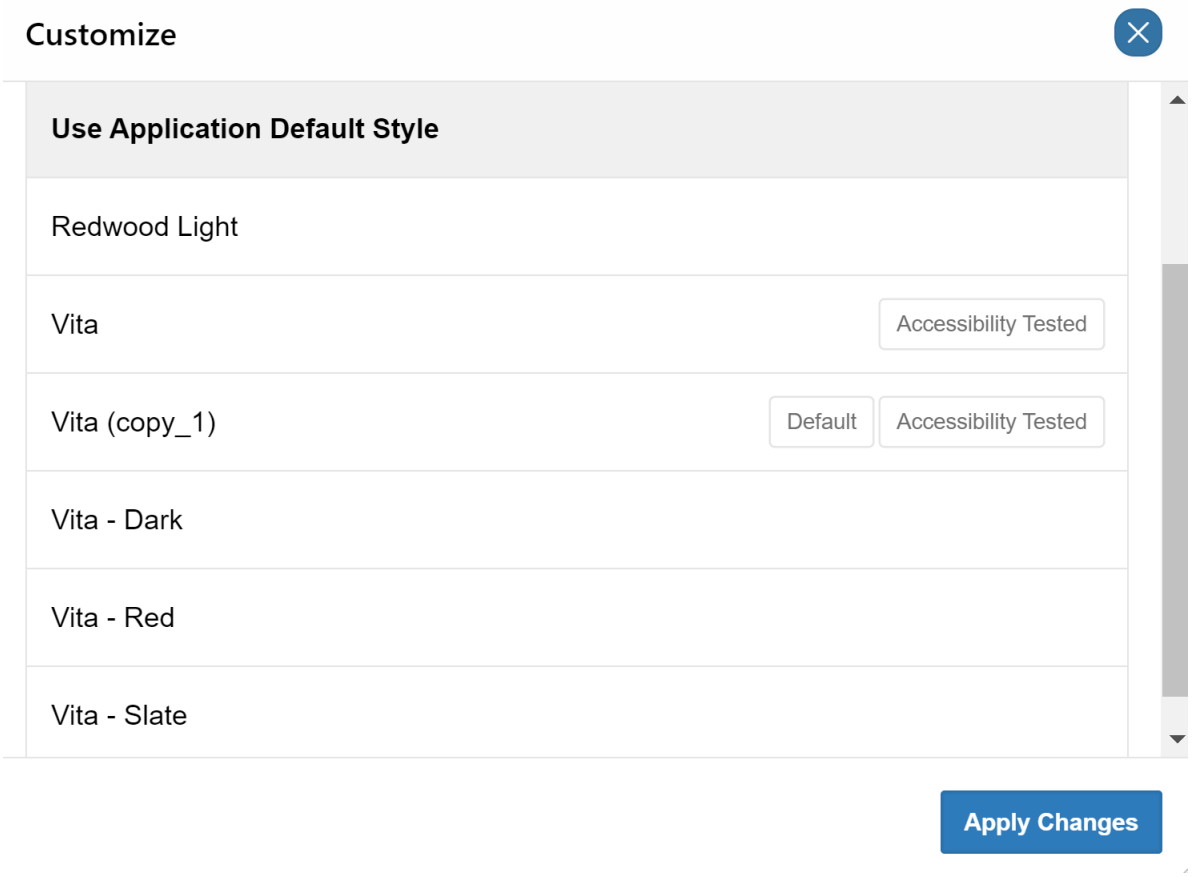


Figure 49: Application Theme options

- Login System can view hidden password being inputted.

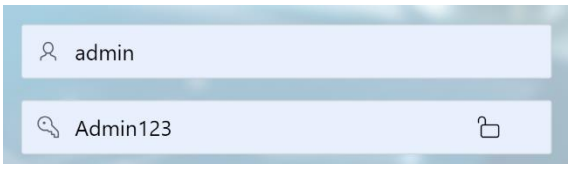


Figure 50: Show Password UI Builder

- Login shortcut disappears when there is an existing account logging in.

Figure 51: Login Shortcut no longer available

- Appropriate functionalities for each user account type:
  - ➢ Navigation Bar
    - All account types including guests have Login System tab.
    - Patients can view their user profiles and their bookings.
    - Employees can view their user profiles, their shifts, and their booked appointments by patients.
    - Admin does not have user profile, shift, and appointment being assigned.

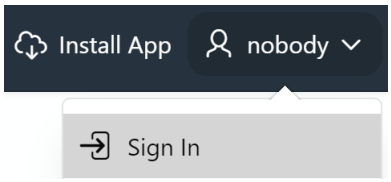


Figure 52: Guest User's Navigation Bar

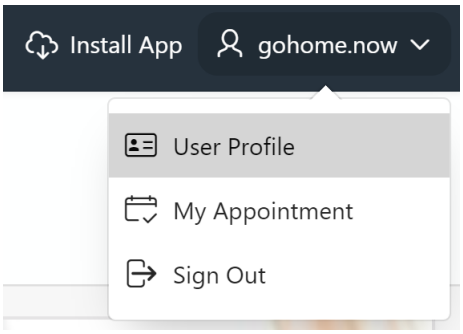


Figure 53: Patient User's Navigation Bar

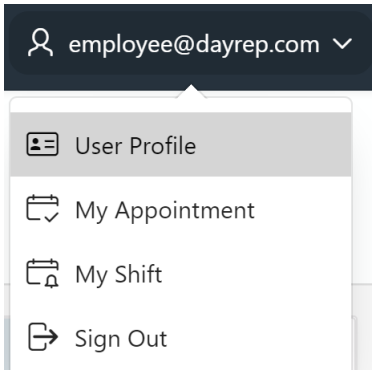


Figure 54: Employee User's Navigation Bar

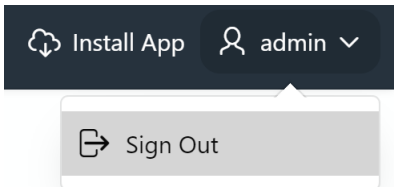


Figure 48: Admin's Navigation Bar

7.5 Application and Accounts

Application URL: https://apex.oracle.com/pls/apex/f?p=TEAM-NO1-HOSPITAL-MANAGEMENT-SYSTEM

List of Accounts:

- Admin account:
  - Username: Admin
  - Password: Admin123
- Employee account:
  - Username: employee@dayrep.com
  - Password: 12345
- Patient account:
  - Username: gohome.now
  - Password: hu8dw1

FINAL REFLECTION

To be honest, this assignment in ISYS3414 is literally the first project of most of our team members, so the experience is definitely valuable and memorable.

Section		Reflection
Group project experience		○ Planning is significant to keep track of the progress of the project. It is better to divide all the tasks that the team needs to finish into manageable sprints which each consists of small milestones of all tasks, so there will not be anything left empty at the end. Although sticking to the timeline is necessary, developers like us should also be flexible, as risks that can appear at any time. We initially created a risk list; however, it does not include everything like Oracle APEX server in maintenance. ○ Another feature of running a project that we have been through is to stay up late at night, especially when the project is on the edge of launching. It seems like the silent night makes the best atmosphere for us to work efficiently without any worries. Discovering this truth is helpful for each developer; however, it would be better to work anytime and anywhere because developing and solving problems are more likely to be our main activities in the future and we had better get used to them.
Technical experience	Conceptual design	Conceptual design: Deciding what the system will manage is important to make a clear and concise Entity Relationship Diagram (ERD) as entities make the basic skeleton of a database. We at first spent a lot of time on coming up with an ERD and it seemed to be complicated. By consulting our supervisor, we learned to form a straightforward process in which we want the users to walk through when accessing our system. Therefore, we can just paid attention to the objects to make it entities and leave the other characteristics as their attributes where appropriate. Also, we learn from one of our discussing session with our supervisor, Tuan Tran [3] that there was no right or wrong design and we should do what worked best with our necessities.
	Logical design	When the conceptual design has been concluded, converting it to a relational schema is much simpler, so it should be done as soon as possible to continuously conduct the next step.
	Physical design	We struggled quite a lot in this step because we expect our data to be realistic and big enough. Because we lack knowledge about medical and hospital, making up some random words to filling in the data is impossible. We later chose to use some online auto-generated machines (see Appendix D) to get random data and store them in Microsoft Excel file for managing. To handle the complicated constraints of our database (see Section 4.2), we learned to work with triggers for insert actions and it is absolutely helpful.
	Application development	○ As students using this tool for the first time, our team think that this platform is helpful everyone who want to build their own application without expertising in coding and is

	using Oracle APEX	deliberately suitable for basic courses in database management like ISYS3414 of RMIT University Vietnam. The service assissted us to put our ideas onto the hospital database into practice with useful components and tools. On the other hand, getting familiar with the platform took a considerable amount of time. As the server is usually maintenance, we gradually found out that the platform might be fixed on a web browser but not on others; therefore, we can switch to another browser to continue our work. o Also, we are proud that our team members are now on the progress of getting used to working with Oracle APEX and are ready to work with it at any time.
Group communication		Our time and ways of communication are initially imcompatible with each other, especially when we discuss on the ERD. Conflicts are inevitable in group work; however, we chose to calm down every single time of argument and took turn to express our ideas. While we usually had face-to-face meetings during the time of database design as we thought it was the best way to communicate, we met online most of the time for discussing omn how we develop our application and sharing some necessary techniques. Fortunately, it worked properly as we had a long time work during the university off days. For more details, please see our risk management in Appendix A.

REFERENCES

[1] Vinmec International Hospital Joint Stock Company. [Doctors in Vietnam]. https://www.vinmec.com/en/lists/doctors/all/ (accessed May 1, 2023).

[2] The International Business Machines Corporation, “UTFs.” ibm.com. https://www.ibm.com/docs/en/db2-for-zos/12?topic=unicode-utfs (accessed Apr 30, 2023).

[3] Tuan Tran Minh, private communication, Apr. 2023.

[4] Mid Kent Audit, “Corporate Risk Register,” Swale BOROUGH COUNCIL, Kent, United Kingdom, Sep. 2020, Accessed 5 May. 2023. [Online]. Available: Appendix I - Corporate Risk Register.pdf (swale.gov.uk)

[5] The One Generator’s Birthday Generator, private communication, Apr. 2023.

[6] FakeNameGenerator, private communication, Apr. 2023.

[7] GIGACalculator’s Random Date Generator, private communication, Apr. 2023.

[8] Fantasy Name Generators’ Medicine name generator, private communication, Apr. 2023.

APPENDICES

Appendix A - Up-to-date Risk Management

Team Priority	Risk Description	Key Existing Controls	Risk Score (L x I)	Planned Controls	Mitigated Score (L x I)
Overarching	**Communication Incidents** • Misunderstanding ideas of the members • Difficulties in contacting with people in a team • Cultural conflicts • Difficulties in listening and sharing among the members	• Members should share necessary materials to let everyone get the ideas easier. • We maintain at least one meeting per week.	(3 x 4) 12	• Members should provide multiple contact methods. So, the people are able to flexibly get reach to each other. • In case anyone cannot be contacted for 2 days, that person could be reported to the supervisor(s); and the task will be taken over by another member.	(3 x 2) 6
Overarching	**Lack of Knowledge and Concepts** • Misunderstanding the project requirements • Mis-apprehend the theories	• Our team can make consultations with our supervisor(s) • One person defines a project scope and lets the colleagues check it. • We should compare our designs and knowledge with the information in the materials recommended by the supervisors.	(2 x 5) 10	• Research carefully • Make consultations more frequently with the teachers or Student Academic Success in the case that the teachers are not available. • Test our design multiple times at every phase to early discover troubles.	(1 x 3) 3
Overarching	**Intense workload** • Excessive workload happens when tasks are not well-assigned to team members. It leads to exhaustion and some ill-considered aspects.	• Assign work equally and keep progresses of everyone under control. • Set a reasonable deadline.	(2 x 2) 4	• Everyone should raise their difficulties as soon as possible and let others help them. • Because this is a small project, everyone can easily get acquainted with many different sections and be ready to take over those sections or assist their peers.	(2 x 1) 2
Priority 1: Defining a	**Unclear or Inaccurate Scope**	• Confirm the requirements	(2 x 4)	• Plan and discuss effectively.	(1 x 4)

clear and suitable scope	• A vague or wrong scope makes the team misrender the product. Therefore, it cannot fulfil the teacher's requirements.	with our supervisor(s). • Get advice from the supervisor(s) on a draft design. • Demonstrate our process in a demanded flow given by the course.	8	• Use a gantt chart to navigate the process. • Abandon redundant assignments	4
Priority 2: Drawing an Entity Relationship Diagram	**Technical Issues** • Errors occurring to the tools we need lead to data loss and progress delay.	• Set an early deadline for each task • Demonstrate work in a shared folder, so we can support each other in time • Make at least one copy of all materials	(3 x 5) 15	• Set an early deadline for each task • Demonstrate work in a the shared folder, so we can support each other in time • Make at least one copy of all materials • Prepare a backup laptop • Download the materials to a computer, and a USB • Announce the supervisor(s)	(3 x 2) 6
Priority 2: Drawing an Entity Relationship Diagram	**External Risks** • Health problems • Disasters • Other personal issues	• Hold online meetings • Accept task delay one to two times (depends on task's importance and urgency)	(1 x 4) 4	• Hold online meetings • Accept task delay one to two times (depends on task's importance)	(1 x 3) 3
Priority 3: Building and Testing the application	**Technical Issues** • Oracle Apex is under maintenance • If any errors happen to this tool, our progress is prone to postponement. Furthermore, if they happens in the time of the presentation, our team will need to demonstrate the application in another way.	• We should learn to use an alternative tool.	(3 x 4) 12	• Develop the application on two different platforms parallelly. • Announce the supervisor(s) in the case of urgency.	(2 x 4) 8
Priority 3: Building and Testing the application	**External Risks** • Health problems • Disasters • Other personal issues	• Hold online meetings • Accept task delay one to two times (depends on task's	(1 x 4) 4	• Hold online meetings • Accept task delay one to two times (depends on task's importance)	(1 x 3) 3

		importance and urgency)			
Priority 4: Presentation	**Technical Issues** • If Oracle Apex does not perform precisely during the presentation time, our team cannot fully demonstrate our product's features as planned. • Data loss	• Download essential materials to our laptops and save them to a USB as well. • Prepare a backup laptop	(2 x 5) 10	• Download essential materials to our laptops and save them to a USB as well. • Prepare a backup laptop • Ask the tutor for further instruction • Develop the application not only on Oracle Apex but also on another tools. It will be helpful as one of them cannot function.	(1 x 3) 3
Priority 4: Presentation	**External Risks** • Health problems • Disasters • Other personal issues	• Assign the affected section to another member •	(2 x 2) 4	• Make sure everyone catches the presentation arrangement of the team, so that they are able to replace the person who gets the problem. • Announce the tutor about the incident	(2 x 1) 2
Priority 4: Presentation	**Internal Risk** • Change the Presentation flow	• Re-arange presenting time	(2 x 5) 10	• Practice presenting together multiple times • Rely on the timer to cut on some features in the app demo	(2 x 4) 8

Table 2: Risk Management [4]

Appendix B - Work Breakdown Structure

TASK TITLE	TASK OWNER	START DATE	DUE DATE
Preparation Before Project's Implementation			
Select roles in the team	Everyone	4/1/2023	4/1/2023
Design the Cover Page	Dan	3/30/2023	4/1/2023
Design The Database System			
Draw an ER diagram (first draft)	Chau	4/2/2023	4/4/2023
Draw the small parts of the ER diagram	Everyone	4/6/2023	4/7/2023
Combine the small parts to form the second ER diagram draft	Chau, Dan	4/8/2023	4/8/2023
Write entity relational schemas and modify the ER diagram (final draft)	Chau, Dan	4/10/2023	4/12/2023
Collect data	Dan, Anh, Quynh	4/9/2023	4/15/2023
Create SQL queries and Insert data	Chau, Dan	4/13/2023	4/20/2023
Develop The Application			
Develop the application	Quynh, Anh, Dan	4/20/2023	5/5/2023
Test the application	Everyone	4/20/2023	5/5/2023
Modify SQL Code	Dan, Chau	4/20/2023	4/30/2023
Prepare For the Presentation			
Design presentation slides	Everyone	5/1/2023	5/5/2023
Arrange the presentation and assigned parts	Quynh	5/3/2023	5/4/2023
Write The Report			
Draft	Anh	4/5/2023	4/7/2023
Introduction	Chau	4/10/2023	4/11/2023
Topic	Dan	4/5/2023	4/7/2023
People	Everyone	5/1/2023	5/4/2023
Scope	Quynh	4/6/2023	4/8/2023
Assumptions	Dan	4/5/2023	4/7/2023
Application features	Chau, Quynh, Dan	5/1/2023	5/5/2023
Application URL and accounts	Anh	4/28/2023	4/28/2023
Risk Management	Chau	5/3/2023	5/4/2023
Final reflection	Everyone	5/5/2023	5/5/2023
References and appendices	Dan, Chau	5/1/2023	5/5/2023

Proofread and format	Quynh	5/3/2023	5/5/2023
Submit	Dan	5/5/2023	5/5/2023

Table 3: Work Breakdown Structure

Appendix C - Available Theme Styles

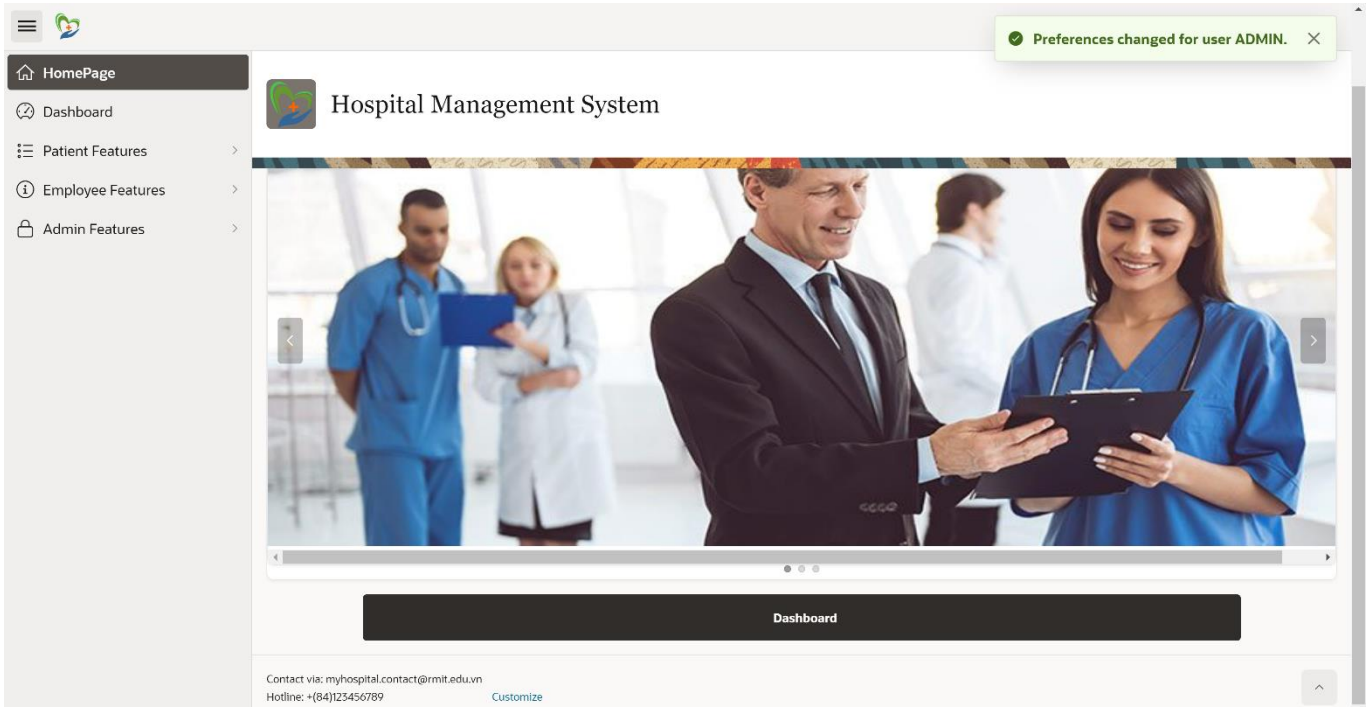


Figure 56: Redwood Light Theme

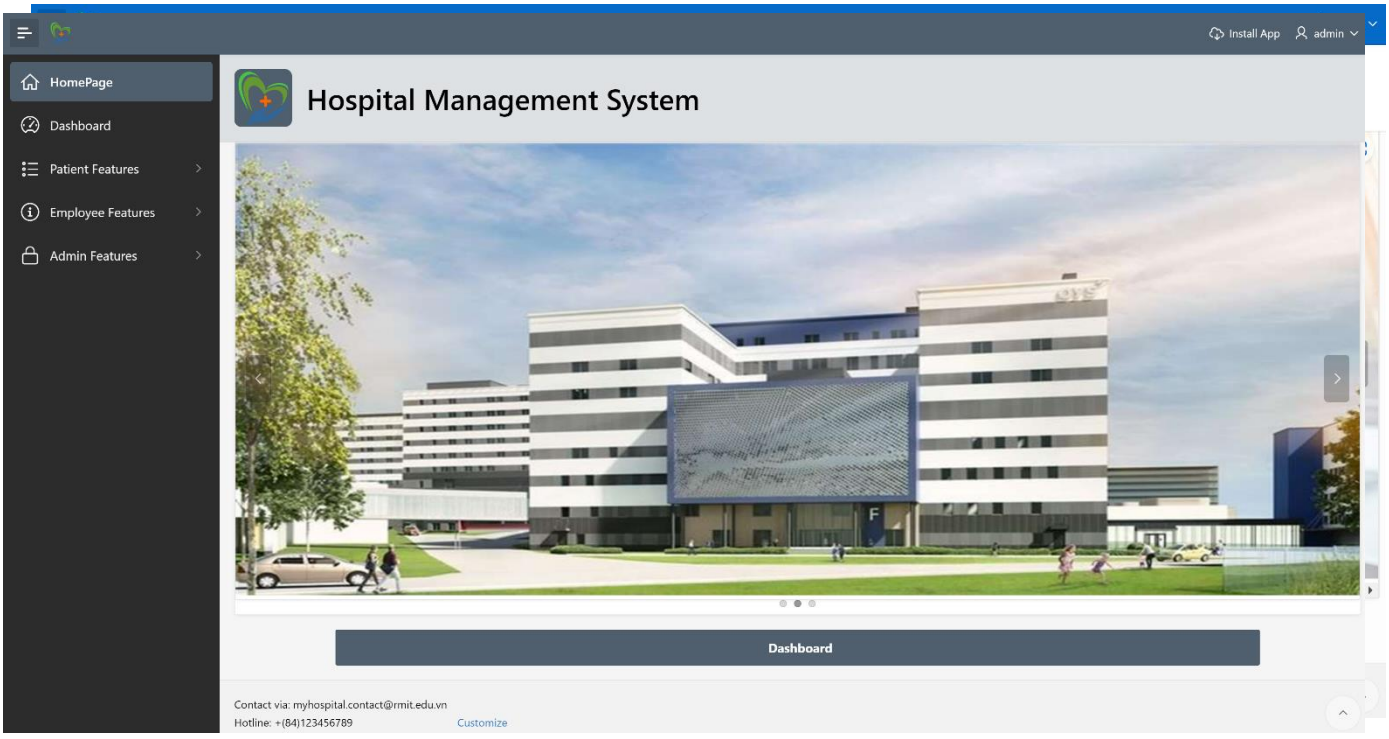


Figure 57: Vita Theme

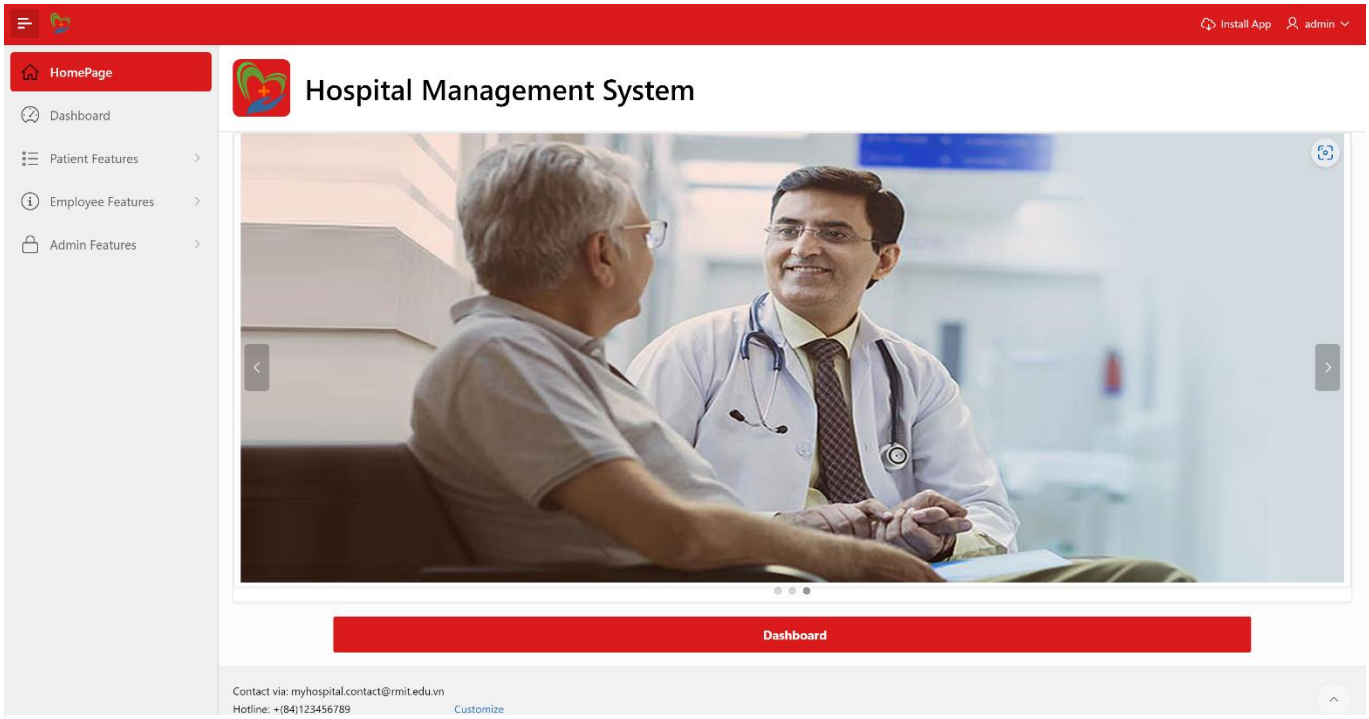


Figure 49: Vita – Red Theme

Appendix D - Auto-generated machines for Data collection

During the data collection stage, we have utilized several data auto-generated machines on the Internet. To be specific, the data usage and the corresponding websites are listed below.

- Dates of Birth of Employees were generated by The One Generator's Birthday Generator [5].
- Personal Details in both EMPLOYEE and PATIENT tables were generated by FakeNameGenerator [6].
- StartTime and EndTime in APPOINTMENT table and StartDate and EndDate in ADMISSION table were produced by GIGACalculator's system [7].
- Fantasy Name Generator [8] listed 10 types of medicine in MEDICINE table.