



MAY 3, 2019

# PATIENT APPOINTMENT SCHEDULING SYSTEM

## FINAL REPORT

IE 4425 TERM PROJECT

J COLLIN GUIDRY



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# Problem Description

## Background

A hospital is seeking an efficient method to schedule appointments and checkups for its patients. Currently, patients visiting departments throughout the hospital are prompted to schedule an appointment with the receptionist at the front desk of the department they are visiting.

## Rationale

Each clinic currently operates independently from others within the hospital, and their records do not have the capability to integrate with other departments inside the hospital. Departments are seeking a solution to access patient schedules from other departments, such that doctors can view the entirety of a patient's appointment history.

# Objectives and Scope

The hospital is seeking an effective means to alleviate their scheduling issues. By implementing a new scheduling system that holds all appointment records within a database, interdepartmental synchronization will be increased, and time that would otherwise be spent exchanging appointment records would be saved and spent more efficiently.

In order to utilize the appointment database to its full extent, and to streamline the flow of information within the hospital, a simple windows forms application will be built with a user-friendly interface to be used by each department's receptionists, doctors, as well as

those scheduling appointments from the hospital's call center. Another key feature of this application is to allow doctors to append additional information to any given appointment record after a patient has been seen and/or treated. Gathering more details on patients following each appointment would further increase the hospital's business intelligence and oversight for analytical purposes and also allow for more efficient patient care.

# Deliverables

## Access Database to SQL server database - April 12th

This database will be designed for use with a C#.NET windows forms application. Prior to use as a data source for the application, this database will be perfected, populated with sample data, and will be migrated to a SQL server.

Information entered by administrators, receptionists, and doctors will be stored into this SQL server database on the hospital's network; therefore, simplifying the distribution of this application across all computers within the hospital. The application has also been tested using Microsoft Azure's cloud SQL server, allowing it to be used from multiple networks with computers having the .NET Framework installed. As Azure's cloud database cannot be accessed using LSU's eudroam, for demoing purposes the C# application, SQL server and database will operate locally with SQL Server Management Studio.

## Patient Scheduling System interface - April 20<sup>th</sup>

The windows application itself will be designed with an initial login page, for doctor and receptionist user types.

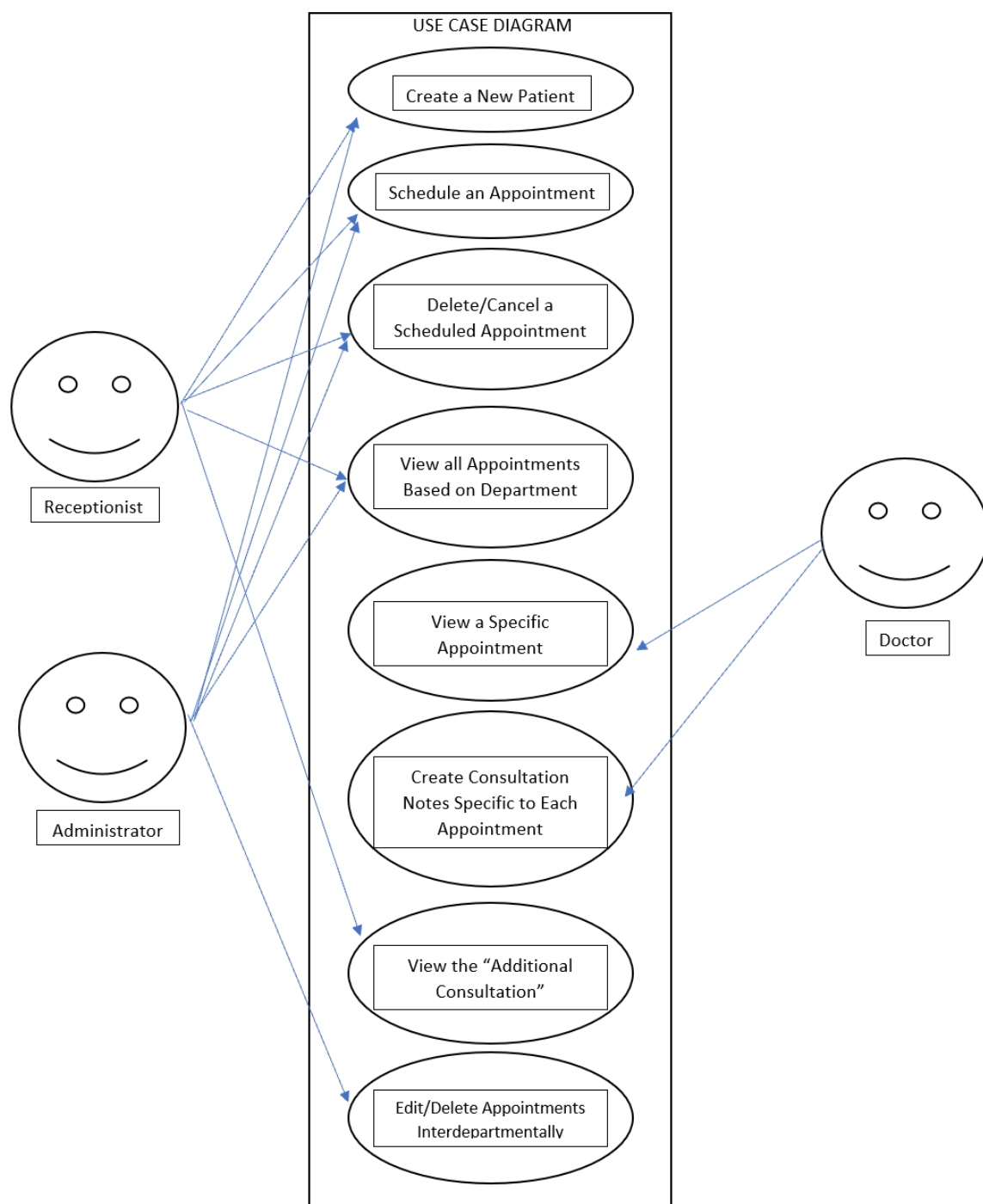
Receptionists will have the ability to view all appointments by department, create new patients, schedule new appointments, delete scheduled appointments. Doctors should be able to view all appointments within his or her department, or just that doctor's

appointment. Then, be able to select an appointment and specify if the patient attended, needs additional treatment, or to be sent to another department.

This additional consultation completed by the doctors will then be viewed in the receptionists' form in the case that action may need to be taken to call or follow up with a patient.

# Design Report

## USE CASE DIAGRAM



## Users

### Receptionist

These individuals will have the ability to view appointments interdepartmentally. Although they may view the appointments table for all departments, they will only have the ability to create, schedule and delete appointments within their designated department. This entity is also represented as “Admins” in the database and is given more functionality than doctors.

### Doctor

Doctors will not be able to schedule their own appointments but can view all appointments within their own Department and can filter for just their own appointments. Additionally, they will only be able to indicate whether or not a patient must schedule a follow-up appointment, mark appointment attendance and input consultation notes based on patients’ appointments. This can be done interdepartmentally.

### Administrators

Administrators have the permissions to complete any task in any department. This means that administrators can create, edit and delete appointments. Additionally, they can provide an indication as to whether or not a patient must need a follow-up appointment, mark appointment attendance and input consultation notes based on patients’ appointments interdepartmentally.

## Use Case 0: Login

Doctors, Administrators and Receptionists will be prompted with a login screen where they can enter their previously created hospital credentials. Entity credentials are stored in the database that is edited by hospital administrators. When a user logs in successfully, queries are used to select the user’s department, first name, and last name so they can be stored as public variables and displayed in other forms. When Administrators log in, their department is set to “Hospital Administration” by default.

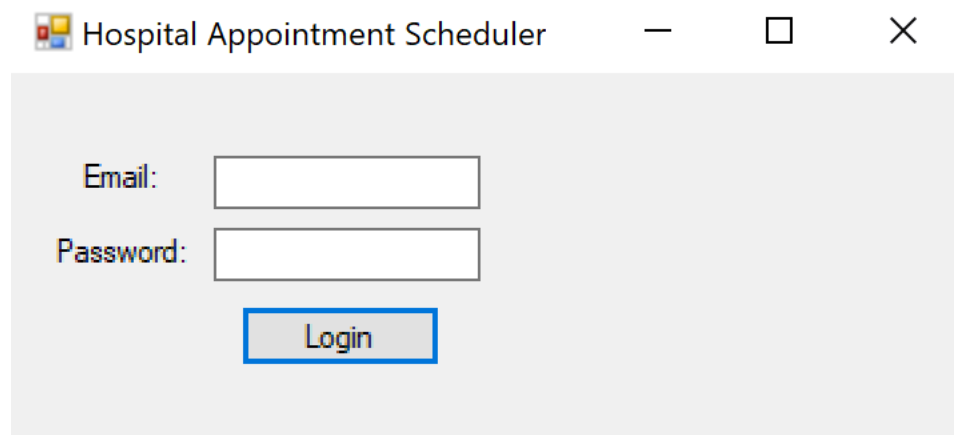
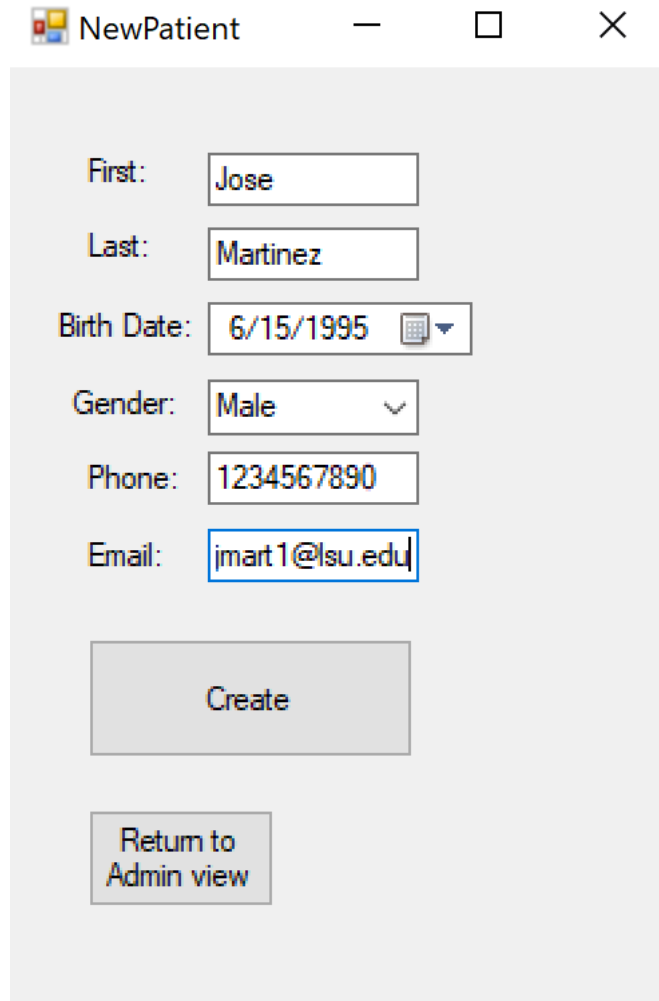
The image shows a screenshot of a web application window titled "Hospital Appointment Scheduler". The window has a standard title bar with a minimize button, a maximize button, and a close button. The main content area is light gray and contains a login form. The form has two input fields: "Email:" and "Password:". Below these fields is a "Login" button. The "Email:" label is in a blue font, and the "Password:" label is in a black font. The "Login" button is a blue rectangle with the word "Login" in white text.

Figure 1: Log-in Form



### Use Case 1: Create a New Patient

Receptionists and Administrators have the ability to schedule new patients into the system. New patient record will be inserted into the patient table within the database upon clicking “create.”



The image shows a software window titled "NewPatient" with standard window controls (minimize, maximize, close). Inside the window is a form with the following fields and controls:

- First:** Text input field containing "Jose".
- Last:** Text input field containing "Martinez".
- Birth Date:** Text input field containing "6/15/1995" with a calendar icon and a dropdown arrow.
- Gender:** Dropdown menu showing "Male" with a downward arrow.
- Phone:** Text input field containing "1234567890".
- Email:** Text input field containing "jmart1@lsu.edu".
- Create:** A large rectangular button.
- Return to Admin view:** A rectangular button.

Figure 2: Create New Patient Form



## Use Case 2: Schedule an Appointment

Users will be entered into the scheduling screen where their designated department will be presented upon loading. In this menu, the user can change the date, time and enter appointment details. The doctors are organized by department. By clicking “Schedule Appointment,” the patient’s appointment will be inserted into the appointment table and will update the database. When a user commits a new record into the Appointments table, it includes the unique ID of the patient and doctor rather than their names. Both selected names are stored, then used to query the Doctors and Patients to obtain the ID of each, allowing for proper entry into Appointments.

The 'NewAppointment' window displays the following information:

- Date:** 05/06
- Time:** 10:30 AM
- Schedule Appointment** button
- Return to Admin view** button
- Details:** Jose needs to visit the Neurology clinic. In fact, he is so smart he needs his brain examined.
- Doctor Department:** Neurology
- Doctor Name:** Nicki Fynes
- Patient Name:** Jose Martinez

Two tables are shown below the details:

	LastName	FirstName
	Manoelli	Erich
	Marklin	Denney
▶	Martinez	Jose
	Matissoff	Effie
	Matuszak	Carl
	Maydway	Tonye
	McAmish	Marianne

	LastName	FirstName
	Carbert	Rubin
▶	Fynes	Nicki
	Sichardt	Tobi
*		

Figure 3: Interface for Creating Appointment Records

## Use Cases 3 & 4: Delete/Cancel a Scheduled Appointment and View all Appointments Based on Department

Once scheduled, appointments will appear in the data grid view and can be edited by receptionists or deleted by hospital administrators. The receptionist’s department is shown by default, allowing for appointment records to be edited. By selecting an appointment, clicking “Delete Selected Appointment”

The 'AdminView' window displays the following information:

- Welcome, Mike Tiger**  
**Your Department: Radiology**
- Create New Patient** button
- Schedule Appointment** button
- Filter appointments by department:** Radiology
- Return to Login** button
- Appointment ID:** 688
- Date:** 12/29/2018
- Time:** 6:00 PM
- Details:** This appointment has been attended and needs a followup scheduled.
- ☒ Attendance
- ☒ Needs Followup
- Update Table** button
- Delete Selected Appointment** button

	ApptTime	Department	Doctors_LastName	FirstName	Patients_LastName	Patients_Gender	Details	Attendance	FollowUpApptNeed
▶	6:00 PM	Radiology	Poon	Hurlee	Skupinski	Male	This appointment...	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	12:30 PM	Radiology	Yekel	Ebba	Yushkin	Female		<input type="checkbox"/>	<input type="checkbox"/>

Figure 4: Form Displaying All Appointments with Updating and Deleting Allowed

will trigger the deletion of the appointment from the database. An event handler for the data grid view is used, such that when the table is clicked, values from the currently selected row are stored and displayed above the table. When an appointment has been selected, its details are shown and can be changed before the user updates the given row in the database. Once the table is updated, the form is re-loaded to display any changes.

When selecting another department, records can be viewed, but not updated nor deleted.

**AdminView**

Welcome, Mike Tiger  
Your Department: Radiology

Create New Patient | Schedule Appointment

Filter appointments by department: Neurology

Return to Login

Appointment ID: 806  
Date: 05/06/2019  
Time: 10:30 AM

Details: Jose needs to visit the Neurology clinic. In fact, he is so smart he needs his brain examined.

☐ Attendance  
☐ Needs Followup

	AppointmentID	ApptDate	ApptTime	Department	Doctors_LastName	FirstName	Patients_LastName	Patients_Gender	Details	Attendance
▶	806	5/6/2019	10:30 AM	Neurology	Fynes	Jose	Martinez	Male	Jose needs to vis...	
	601	1/14/2019	10:00 AM	Neurology	Fynes	Richmound	Tydeman	Male		

Figure 5: Form Displaying All Appointments with Restricted Editing

Receptionist attempts to edit appointment outside of their department, the information will be greyed out. Administrators are the only individuals that may do this.

### Use Cases 5 & 6: View a Specific Appointment and Create Additional Consultation Notes Based on Specific Appointments

Doctors will be able to view specific appointments and create additional consultation notes based on patient history and diagnoses. Additionally, they can mark as to whether or not the patient attends their appointment and indicate the necessity for a patient follow-up. Appointment notes and details will be inserted into the appointments table upon clicking "Update."

**DoctorView**

Name: John Smith  
Department: Cardiology

205

☒ Did this patient attend the appointment?  
☒ Will this patient need another appointment scheduled?

Update

Return to Login

Filter for John Smith:

Appointment Notes:  
notes

Details:

	AppointmentID	ApptDate	ApptTime	Department	Doctors_LastName	FirstName	Patients_LastName	Patients_Gender	Details	Attendance
	272	9/28/2018	4:30 PM	Cardiology	Smith	Ewart	Twitchings	Male		<input checked="" type="checkbox"/>
	357	3/1/2018	4:30 PM	Cardiology	Smith	Jacquelin	Cioetti	Female		<input type="checkbox"/>
	772	11/14/2016	5:30 PM	Cardiology	Smith	Haywood	Cuerdale	Male		<input type="checkbox"/>
	514	9/7/2016	8:00 AM	Cardiology	Smith	Corina	Ramsby	Female		<input type="checkbox"/>
	164	1/19/2016	1:00 PM	Cardiology	Smith	Hamil	Gillaspy	Male		<input type="checkbox"/>
▶	205	10/23/2015	3:30 PM	Cardiology	Smith	Sterne	Delve	Male		<input checked="" type="checkbox"/>
	39	8/20/2015	9:30 AM	Cardiology	Smith	Nina	Heppner	Female		<input type="checkbox"/>
	713	7/13/2015	8:30 AM	Cardiology	Smith	Britni	Hawking	Female		<input type="checkbox"/>
	706	2/7/2015	5:00 PM	Cardiology	Smith	Wilfrid	Ellacott	Male		<input type="checkbox"/>
	196	3/30/2014	9:00 AM	Cardiology	Smith	Ivar	Phinnis	Male		<input type="checkbox"/>
	124	3/9/2014	9:00 AM	Cardiology	Smith	Carlye	Odde	Female		<input type="checkbox"/>

Figure 6: Appointments sorted by Department (in this case Cardiology)

### Use Case 7: View Additional Consultation Notes

Once populated, the appointments table will display the doctor's additional consultation notes that were entered through the DoctorView form.

Welcome, Mike Tiger  
Your Department: Radiology

Create New Patient Schedule Appointment

Filter appointments by department  
Radiology

Return to Login

Appointment ID: 688  
Date: 12/29/2018  
Time: 6:00 PM

This appointment has been attended and needs a followup scheduled.

☒ Attendance  
☒ Needs Followup

Update Table Delete Selected Appointment

AppointmentID	ApptDate	ApptTime	Department	Doctors_LastName	First Name	Patients_LastName	Patients_Gender	Details	Attenda
443	9/8/2018	12:30 PM	Radiology	Yekel	Ebba	Yushkin	Female		
184	9/3/2018	4:30 PM	Radiology	Gussin	Dilan	Syson	Male		
48	9/2/2018	10:30 AM	Radiology	Gussin	Frederigo	Guirard	Male		
658	8/10/2018	12:30 PM	Radiology	Pelham	Markus	Greenway	Male		
512	7/22/2018	6:30 PM	Radiology	Pelham	Marianna	Simeoni	Female		
33	7/15/2018	2:30 PM	Radiology	Gussin	Zoe	Bindley	Female		
406	3/12/2018	2:30 PM	Radiology	Gussin	Ivy	MacDeamaid	Female		
439	12/25/2017	12:00 PM	Radiology	Gussin	Briney	Woolerton	Female		
329	9/12/2017	2:30 PM	Radiology	Poon	Sada	Hugin	Female		
344	6/10/2017	3:30 PM	Radiology	Yekel	Shoshanna	Greenside	Female		

Figure 7: Appointments Sorted by Department (in this case Radiology)

### Use Case 8: Edit/Delete Appointments Interdepartmentally

Hospital administrators are the only individuals that have permissions to edit/delete appointments across all departments. This is to prevent receptionists from meddling in the records of other departments.

Welcome, Dr. Knapp  
Your Department: Hospital Administration

Create New Patient Schedule Appointment

Filter appointments by department  
Hospital Administration

Return to Login

Appointment ID:  
Date: 05/02/2019  
Time:

Details:

Call Center  
Cardiology  
Gastroenterology  
Neurology  
Ophthalmology  
Orthopedics  
Pathology  
Primary Care  
Radiology  
Surgical  
Urology

Delete Selected Appointment

Figure 8: Combo Box That Allows Different Users to View Different Department Appointments

# Data Model

This 3NF entity relationship design (ERD) functions to allow Admins (receptionists) and Administrators (hospital administrators) to make changes to the Appointments table, but are not associated with the appointments themselves. Admins and Doctors are related to unique departments to limit functionality within application to their respective department, while Administrators do not have departments and can edit or view any appointment. The Appointments table, the primary table of focus for this solution, has three relationships which associate each appointment with a unique doctor, patient, and dedicated time slot. For the purpose of testing the application, hundreds of rows of randomly generated 'mock data' was used for Appointments, Patients, Doctors, and Admins.

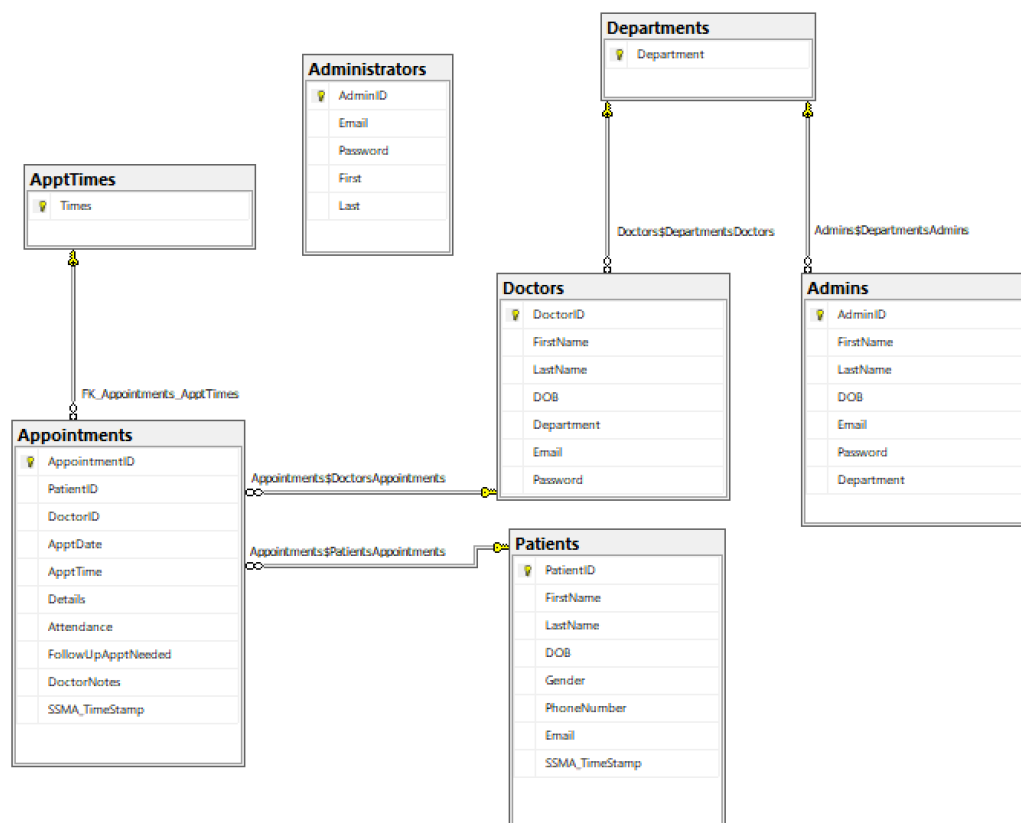


Figure 9: SQL Server Management Studio ERD Diagram

# Navigation System

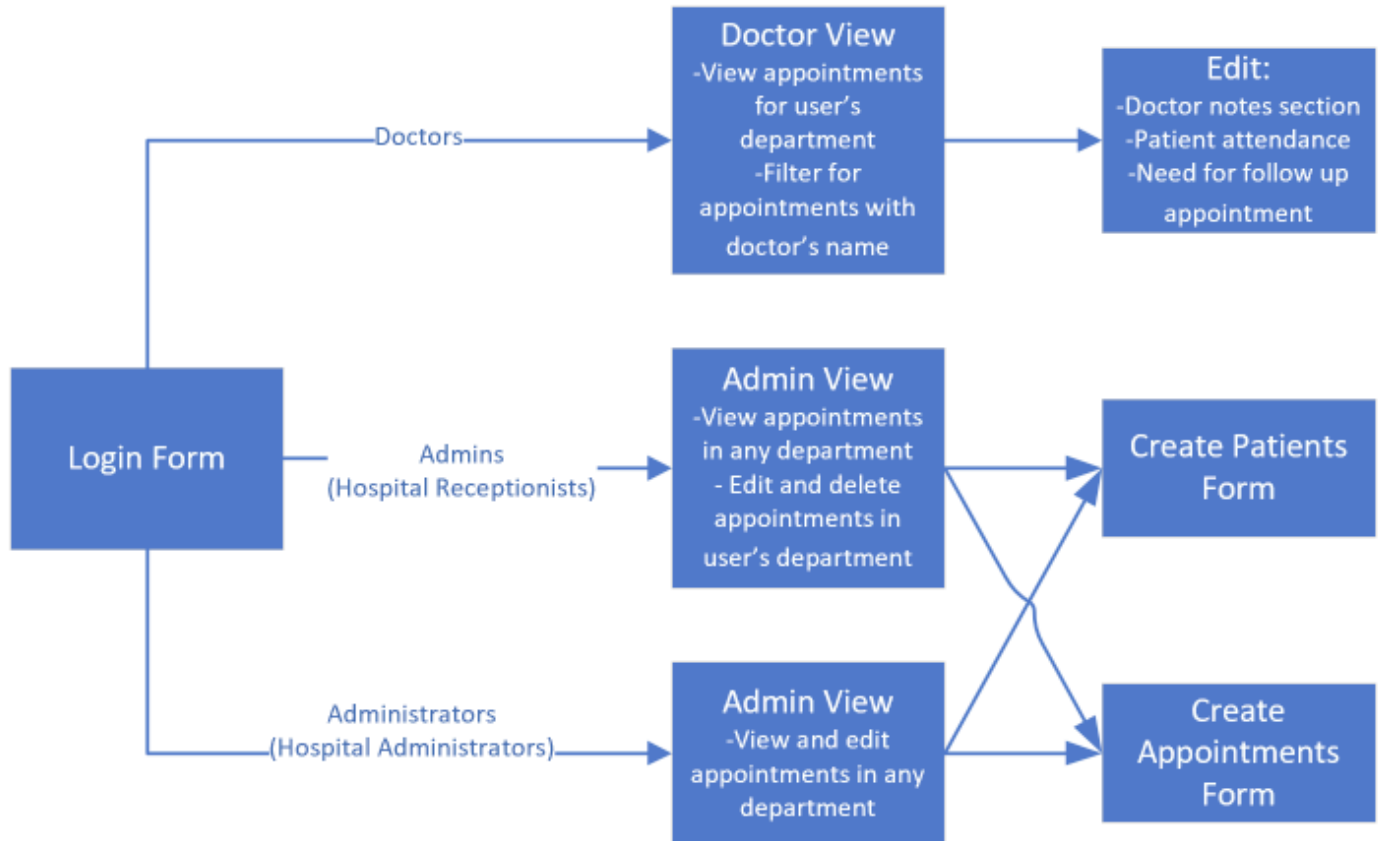


Figure 10: Flow diagram of user form navigation and permissions

## Appendix: Data Dictionary

Key	Entity	Column	Data Type	Allow Nulls
PK	Appointments	AppointmentID	int	F
FK	Appointments	PatientID	int	F
FK	Appointments	DoctorID	int	F
	Appointments	ApptDate	DateTime	F
	Appointments	Details	Short Text	T
	Appointments	Attendance	Boolean	T
	Appointments	FollowUpAppNeeded	Boolean	T
	Appointments	DoctorNotes	Long Text	T
PK	Doctors	DoctorID	int	F
	Doctors	FirstName	Short Text	F
	Doctors	LastName	Short Text	F
	Doctors	DOB	DateTime	F
FK	Doctors	Department	Short Text	F
	Doctors	Email	Short Text	F
	Doctors	Password	Short Text	F
PK	Patients	PatientID	int	F
	Patients	FirstName	Short Text	F
	Patients	LastName	Short Text	F
	Patients	DOB	DateTime	F
	Patients	Gender	Short Text	F
	Patients	PhoneNumber	int	F
	Patients	Email	Short Text	F
	Admins	AdminID	int	F
	Admins	FirstName	Short Text	F
	Admins	LastName	Short Text	F
	Admins	DOB	DateTime	F
	Admins	Email	Short Text	F
	Admins	Password	Short Text	F
FK	Admins	Department	Short Text	F
PK	Administrators	AdminID	int	F
	Administrators	Email	Short Text	F
	Administrators	Password	Short Text	F
	Administrators	First	Short Text	F
	Administrators	Last	Short Text	F
PK	Departments	Department	Short Text	F
PK	ApptTimes	Times	Short Text	F