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Medical Center Management System

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Table of content

Abstract

The Medical Center Management System represents a database for a small-scale medical center with multiple rooms and doctors with different specializations. The system manages every move through the patient's journey in a seamless way, besides the staff management functionalities in the medical center.

Requirements

The medical center management system has the following requirements:

- The system must have the following data collection: Patients, Doctors, Rooms, Staff, Appointments, and Prescriptions.
- The main functionality is to record the appointments for patients and each Appointment may have one or multiple doctors.
- An appointment must be placed in a room.
- An appointment is created by a staff member.
- Each prescription must be associated with an appointment.
- Each room may be supervised by one or more staff members.

Based on the previous requirements the medical center management system needs the following data entities:

Patients: consists of the primary data needed from the patient which are: a unique ssn, name, DoB, sex, date of the first visit, phone Num, address, email, and Blood type.

Doctors: consists of the primary data needed about the doctors who work at the center which are: a unique ssn, name, DoB, sex, phone Num, address, email, specialization, and salary.

Rooms: consists of all rooms in the center and its specifications as follows: a unique ssn, name, and type which can be examination room, office, or waiting room.

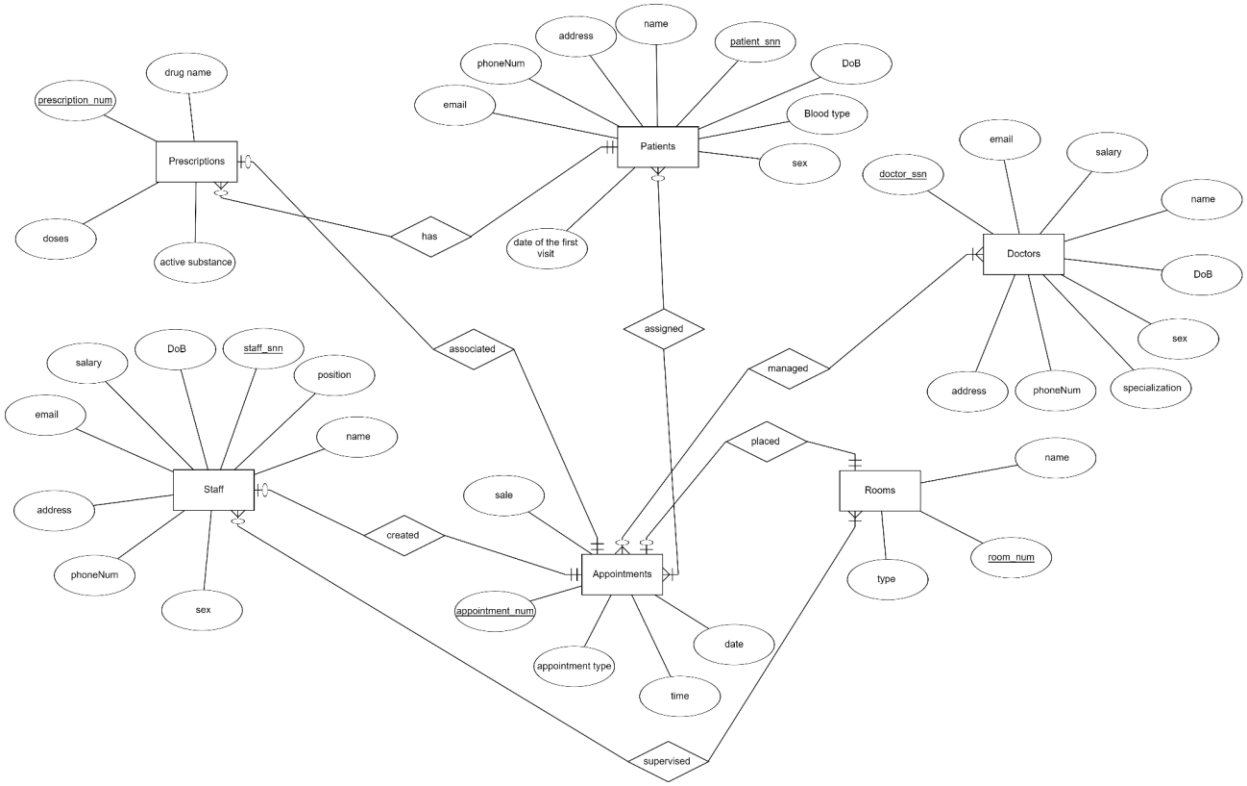
Staff: consists of the primary data needed about the staff members who work at the center which are: a unique ssn, name, DoB, sex, phone Num, address, email, position, and salary.

Appointments: consist of the primary data needed about all the appointments held in the center as follows: a unique number, date, time, and appointment type, and an appointment has a patient, a doctor, a room, and an issuer(Staff member).

Prescriptions: consist of the primary data needed about all the Prescriptions issued in the center as follows: a unique number,drug name, active substance, doses, and a Prescription must be associated with an appointment.

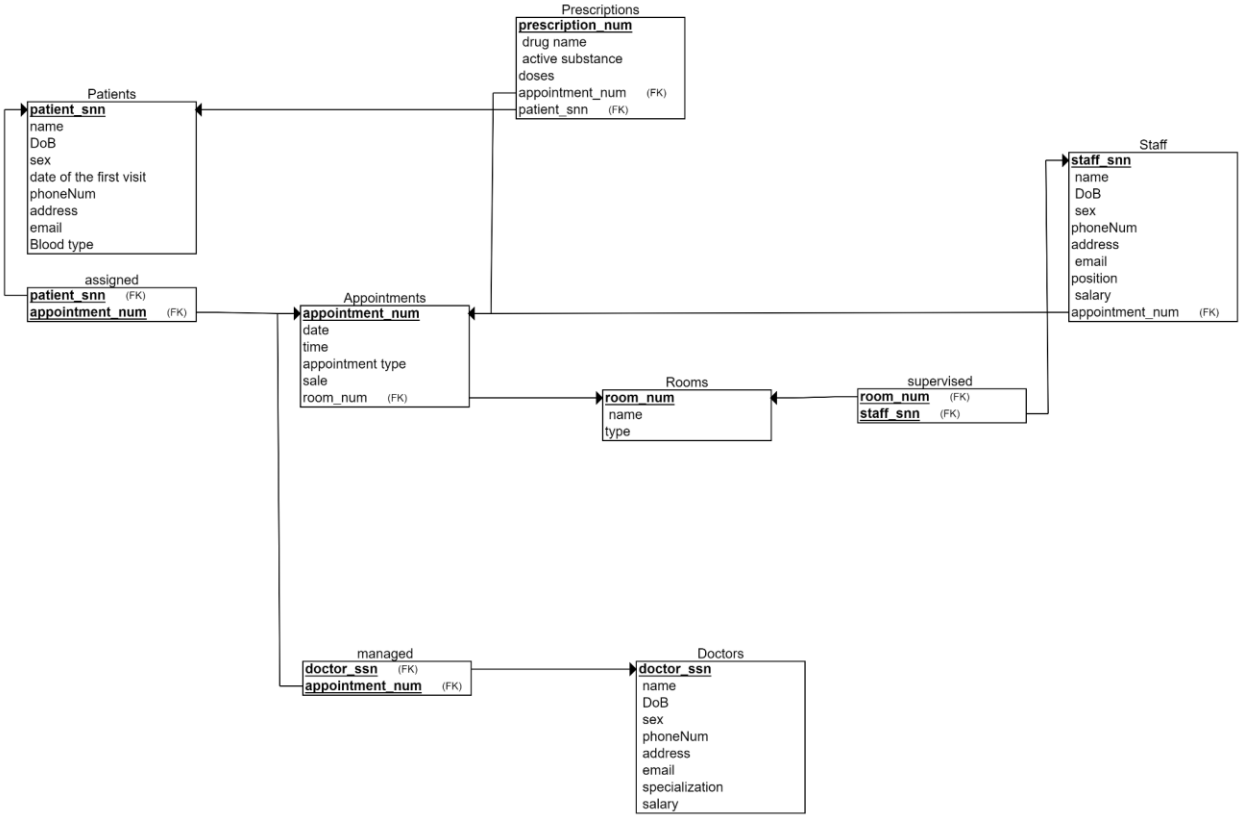
ER/EER Diagram

Based on the customer requirements, the following diagram represents the ER Diagram of the Medical Center Management System which was illustrated to describe the relations of the system's database:



Relational Schema

Based on the customer requirements and the EER Diagram, the following diagram represents the Relational Schema of the Medical Center Management System which was illustrated to describe in detail the specification of the primary keys (PK) and the foreign keys (FK) for all tables as well as, the enforcement of the referential integrity constraints across the database:



SQL Implementation

Based on the Relational Schema of the database, the following steps represent the database implementation using SQL on Oracle and the output yielded after each step:

Tables Creation

At this step, all tables were created, and the primary keys (PK) and the foreign keys (FK) were specified:

```
CREATE TABLE Patients
(
  pname VARCHAR(55) NOT NULL,
  patient_ssn VARCHAR(10) NOT NULL,
  DoB DATE NOT NULL,
  sex VARCHAR(5) NOT NULL,
  date_of_the_first_visit DATE NOT NULL,
  phoneNum VARCHAR(15) NOT NULL,
  address VARCHAR(255) NOT NULL,
  email VARCHAR(30) NOT NULL,
  Blood_type VARCHAR(4) NOT NULL,
  PRIMARY KEY (patient_ssn)
);

CREATE TABLE Doctors
(
  doctor_ssn VARCHAR(10) NOT NULL,
  dname VARCHAR(55) NOT NULL,
  DoB DATE NOT NULL,
  sex VARCHAR(5) NOT NULL,
  phoneNum VARCHAR(15) NOT NULL,
  address VARCHAR(255) NOT NULL,
  email VARCHAR(30) NOT NULL,
  specialization VARCHAR(15) NOT NULL,
  salary FLOAT NOT NULL,
  PRIMARY KEY (doctor_ssn)
);

CREATE TABLE Rooms
(
  room_num INT NOT NULL,
```

```
  rname VARCHAR(55) NOT NULL,
  type VARCHAR(55) NOT NULL,
  PRIMARY KEY (room_num)
);

CREATE TABLE Appointments
(
  appointment_num INT NOT NULL,
  adate DATE NOT NULL,
  appointment_time VARCHAR(10) NOT NULL,
  appointment_type VARCHAR(55) NOT NULL,
  room_num INT NOT NULL,
  PRIMARY KEY (appointment_num),
  FOREIGN KEY (room_num) REFERENCES Rooms(room_num)
);

CREATE TABLE Prescriptions
(
  prescription_num INT NOT NULL,
  drug_name VARCHAR(55) NOT NULL,
  active_substance VARCHAR(55) NOT NULL,
  doses VARCHAR(55) NOT NULL,
  appointment_num INT NOT NULL,
  patient_ssn VARCHAR(10) NOT NULL,
  PRIMARY KEY (prescription_num),
  FOREIGN KEY (appointment_num) REFERENCES Appointments(appointment_num),
  FOREIGN KEY (patient_ssn) REFERENCES Patients(patient_ssn)
);

CREATE TABLE assigned
(
  patient_ssn VARCHAR(10) NOT NULL,
  appointment_num INT NOT NULL,
  PRIMARY KEY (patient_ssn, appointment_num),
  FOREIGN KEY (patient_ssn) REFERENCES Patients(patient_ssn),
  FOREIGN KEY (appointment_num) REFERENCES Appointments(appointment_num)
);

CREATE TABLE is_managed
(
  doctor_ssn VARCHAR(10) NOT NULL,
  appointment_num INT NOT NULL,
  PRIMARY KEY (doctor_ssn, appointment_num),
  FOREIGN KEY (doctor_ssn) REFERENCES Doctors(doctor_ssn),
  FOREIGN KEY (appointment_num) REFERENCES Appointments(appointment_num)
```

```
);

CREATE TABLE Staff
(
  staff_ssn VARCHAR(10) NOT NULL,
  name VARCHAR(55) NOT NULL,
  DoB DATE NOT NULL,
  sex VARCHAR(10) NOT NULL,
  phoneNum VARCHAR(15) NOT NULL,
  address VARCHAR(255) NOT NULL,
  email VARCHAR(100) NOT NULL,
  position VARCHAR(55) NOT NULL,
  salary INT NOT NULL,
  appointment_num INT NOT NULL,
  PRIMARY KEY (staff_ssn),
  FOREIGN KEY (appointment_num) REFERENCES Appointments(appointment_num)
);

CREATE TABLE is_supervised
(
  room_num INT NOT NULL,
  staff_ssn VARCHAR(10) NOT NULL,
  PRIMARY KEY (room_num, staff_ssn),
  FOREIGN KEY (room_num) REFERENCES Rooms(room_num),
  FOREIGN KEY (staff_ssn) REFERENCES Staff(staff_ssn)
);
```

Data Insertion

In this step, Five experimental records have been added to every table in order to test the performance of the system:

Data insertion for Patients table:

```
INSERT INTO Patients (pname, patient_ssn, DoB, sex,
date_of_the_first_visit, phoneNum, address, email, Blood_type)
```

```
VALUES ('Sara Ahmad', '1111111111', '09-09-2001', 'male', '01-01-2023',
'0798976546', '123 Main St', 'patient1@example.com', 'O+');

INSERT INTO Patients (pname, patient_ssn, DoB, sex,
date_of_the_first_visit, phoneNum, address, email, Blood_type)
VALUES ('Dareen Abdallah', '2222222222', '09-09-2002', 'f', '01-02-2023',
'0798976540', '456 Main St', 'patient2@example.com', 'A+');

INSERT INTO Patients (pname, patient_ssn, DoB, sex,
date_of_the_first_visit, phoneNum, address, email, Blood_type)
VALUES ('Samia luma', '3333333333', '09-08-2002', 'male', '02-02-2023',
'0798976541', '789 Main St', 'patient3@example.com', 'B+');

INSERT INTO Patients (pname, patient_ssn, DoB, sex,
date_of_the_first_visit, phoneNum, address, email, Blood_type)
VALUES ('jouhn mcdonalds', '4444444444', '09-07-2002', 'f', '03-02-2023',
'0798976542', '321 Main St', 'patient4@example.com', 'AB+');

INSERT INTO Patients (pname, patient_ssn, DoB, sex,
date_of_the_first_visit, phoneNum, address, email, Blood_type)
VALUES ('anas muhammad', '5555555555', '09-06-2002', 'male', '04-02-2023',
'0798976545', '654 Main St', 'patient5@example.com', 'O-');
```

PNAME	PATIENT_SSN	DOB	SEX	DATE_OF_THE_FIRST_VISIT	PHONENUM	ADDRESS	EMAIL	BLOOD_TYPE
Dareen Abdallah	2222222222	09/09/2002	f	01/02/2023	0798976540	456 Main St	patient2@example.com	A+
jouhn mcdonalds	4444444444	09/07/2002	f	03/02/2023	0798976542	321 Main St	patient4@example.com	AB+
Sara Ahmad	1111111111	09/09/2001	male	01/01/2023	0798976546	123 Main St	patient1@example.com	O+
Samia luma	3333333333	09/08/2002	male	02/02/2023	0798976541	789 Main St	patient3@example.com	B+
anas muhammad	5555555555	09/06/2002	male	04/02/2023	0798976545	654 Main St	patient5@example.com	O-

5 rows returned in 0.01 seconds Download

Data insertion for Doctors table:

```
INSERT INTO Doctors (doctor_ssn, dname, DoB, sex, phoneNum, address,
email, specialization, salary)
VALUES ('0111111111', 'Anas', '04-02-1997', 'm', '0771234567', '123 Main
St', 'doctor1@example.com', 'Surgery', 100000);

INSERT INTO Doctors (doctor_ssn, dname, DoB, sex, phoneNum, address,
email, specialization, salary)
VALUES ('0222222222', 'hamzeh', '04-02-1998', 'f', '0771234567', '456 Main
St', 'doctor2@example.com', 'Pediatrics', 80000);

INSERT INTO Doctors (doctor_ssn, dname, DoB, sex, phoneNum, address,
email, specialization, salary)
```

```
VALUES ('0333333333', 'saeed', '04-02-1996', 'm', '0771234566', '789 Main
St', 'doctor3@example.com', 'OB/GYN', 90000);

INSERT INTO Doctors (doctor_ssn, dname, DoB, sex, phoneNum, address,
email, specialization, salary)
VALUES ('0444444444', 'salma', '04-07-1997', 'f', '0771234565', '321 Main
St', 'doctor4@example.com', 'Cardiology', 110000);

INSERT INTO Doctors (doctor_ssn, dname, DoB, sex, phoneNum, address,
email, specialization, salary)
VALUES ('0555555555', 'basema', '04-02-1996', 'm', '0771234564', '654 Main
St', 'doctor5@example.com', 'Dermatology', 95000);
```

DOCTOR_SSN	DNAME	DOB	SEX	PHONENUM	ADDRESS	EMAIL	SPECIALIZATION	SALARY
0111111111	Anas	04/02/1997	m	0771234567	123 Main St	doctor1@example.com	Surgery	100000
0222222222	hamzeh	04/02/1998	f	0771234567	456 Main St	doctor2@example.com	Pediatrics	80000
0333333333	saeed	04/02/1996	m	0771234566	789 Main St	doctor3@example.com	OB/GYN	90000
0444444444	salma	04/07/1997	f	0771234565	321 Main St	doctor4@example.com	Cardiology	110000
0555555555	basema	04/02/1996	m	0771234564	654 Main St	doctor5@example.com	Dermatology	95000

Data insertion for Rooms table:

```
INSERT INTO Rooms (room_num, rname, type)
VALUES (1, 'Room 1', 'Private');

INSERT INTO Rooms (room_num, rname, type)
VALUES (2, 'Room 2', 'Private');

INSERT INTO Rooms (room_num, rname, type)
VALUES (3, 'Room 3', 'Semi-Private');

INSERT INTO Rooms (room_num, rname, type)
VALUES (4, 'Room 4', 'Semi-Private');

INSERT INTO Rooms (room_num, rname, type)
VALUES (5, 'Room 5', 'Public');
```

ROOM_NUM	RNAME	TYPE
1	Room 1	Private
2	Room 2	Private
3	Room 3	Semi-Private
4	Room 4	Semi-Private
5	Room 5	Public

5 rows returned in 0.02 seconds Download

Data insertion for Appointments table:

```
INSERT INTO Appointments (appointment_num, adate, appointment_time,
appointment_type, room_num)
VALUES (1, '04-02-2022', '09:00', 'Check-up', 1);

INSERT INTO Appointments (appointment_num, adate, appointment_time,
appointment_type, room_num)
VALUES (2, '04-03-2022', '10:00', 'Surgery', 2);

INSERT INTO Appointments (appointment_num, adate, appointment_time,
appointment_type, room_num)
VALUES (3, '08-02-2022', '11:00', 'Physical Therapy', 3);

INSERT INTO Appointments (appointment_num, adate, appointment_time,
appointment_type, room_num)
VALUES (4, '04-05-2022', '12:00', 'Consultation', 4);

INSERT INTO Appointments (appointment_num, adate, appointment_time,
appointment_type, room_num)
VALUES (5, '04-02-2023', '13:00', 'Follow-up', 5);
```

APPOINTMENT_NUM	ADATE	APPOINTMENT_TIME	APPOINTMENT_TYPE	ROOM_NUM
1	04/02/2022	09:00	Check-up	1
2	04/03/2022	10:00	Surgery	2
3	08/02/2022	11:00	Physical Therapy	3
4	04/05/2022	12:00	Consultation	4
5	04/02/2023	13:00	Follow-up	5

5 rows returned in 0.01 seconds Download

Data insertion for Staff table:

```
INSERT INTO Staff (staff_ssn, name, DoB, sex, phoneNum, address, email,
position, salary, appointment_num)
VALUES ('1111111111', 'Staff 1', '04-02-2000', 'm', '1111111111', '123
Main St', 'staff1@example.com', 'Nurse', 60000, 1);

INSERT INTO Staff (staff_ssn, name, DoB, sex, phoneNum, address, email,
position, salary, appointment_num)
VALUES ('2222222222', 'Staff 2', '04-02-2001', 'f', '2222222222', '456
Main St', 'staff2@example.com', 'Receptionist', 40000, 2);

INSERT INTO Staff (staff_ssn, name, DoB, sex, phoneNum, address, email,
position, salary, appointment_num)
VALUES ('3333333333', 'Staff 3', '04-08-2000', 'm', '3333333333', '789
Main St', 'staff3@example.com', 'Lab Technician', 50000, 3);
```

```
INSERT INTO Staff (staff_ssn, name, DoB, sex, phoneNum, address, email,
position, salary, appointment_num)
VALUES ('4444444444', 'Staff 4', '09-02-2001', 'f', '4444444444', '321
Main St', 'staff4@example.com', 'Janitor', 30000, 4);

INSERT INTO Staff (staff_ssn, name, DoB, sex, phoneNum, address, email,
position, salary, appointment_num)
VALUES ('5555555555', 'Staff 5', '04-05-2000', 'm', '5555555555', '654
Main St', 'staff5@example.com', 'Billing Specialist', 45000, 5);
```

STAFF_SSN	NAME	DOB	SEX	PHONENUM	ADDRESS	EMAIL	POSITION	SALARY	APPOINTMENT_NUM
1111111111	Staff 1	04/02/2000	m	1111111111	123 Main St	staff1@example.com	Nurse	60000	1
2222222222	Staff 2	04/02/2001	f	2222222222	456 Main St	staff2@example.com	Receptionist	40000	2
3333333333	Staff 3	04/08/2000	m	3333333333	789 Main St	staff3@example.com	Lab Technician	50000	3
4444444444	Staff 4	09/02/2001	f	4444444444	321 Main St	staff4@example.com	Janitor	30000	4
5555555555	Staff 5	04/05/2000	m	5555555555	654 Main St	staff5@example.com	Billing Specialist	45000	5

5 rows returned in 0.08 seconds Download

Data insertion for Prescriptions table:

```
INSERT INTO Prescriptions (prescription_num, drug_name, active_substance,
doses, appointment_num, patient_ssn)
VALUES (1, 'Ibuprofen', 'Ibuprofen', '200mg', 1, '123-45-6789');

INSERT INTO Prescriptions (prescription_num, drug_name, active_substance,
doses, appointment_num, patient_ssn)
VALUES (2, 'Amoxicillin', 'Amoxicillin', '500mg', 2, '234-56-7890');

INSERT INTO Prescriptions (prescription_num, drug_name, active_substance,
doses, appointment_num, patient_ssn)
VALUES (3, 'Acetaminophen', 'Acetaminophen', '325mg', 3, '345-67-8901');

INSERT INTO Prescriptions (prescription_num, drug_name, active_substance,
doses, appointment_num, patient_ssn)
VALUES (4, 'Lisinopril', 'Lisinopril', '10mg', 4, '456-78-9012');

INSERT INTO Prescriptions (prescription_num, drug_name, active_substance,
doses, appointment_num, patient_ssn)
VALUES (5, 'Atorvastatin', 'Atorvastatin', '20mg', 5, '567-89-0123');
```

PRESCRIPTION_NUM	DRUG_NAME	ACTIVE_SUBSTANCE	DOSES	APPOINTMENT_NUM	PATIENT_SSN
1	Ibuprofen	Ibuprofen	200mg	1	1111111111
2	Amoxicillin	Amoxicillin	500mg	2	2222222222
3	Acetaminophen	Acetaminophen	325mg	3	3333333333
4	Lisinopril	Lisinopril	10mg	4	4444444444
5	Atorvastatin	Atorvastatin	20mg	5	5555555555

Data insertion for assigned table:

```
INSERT INTO assigned (patient_ssn, appointment_num) VALUES
('2222222222',1);
INSERT INTO assigned (patient_ssn, appointment_num) VALUES
('3333333333',2);
INSERT INTO assigned (patient_ssn, appointment_num) VALUES
('4444444444',3);
INSERT INTO assigned (patient_ssn, appointment_num) VALUES
('5555555555',4);
INSERT INTO assigned (patient_ssn, appointment_num) VALUES
('1111111111',5);
```

PATIENT_SSN	APPOINTMENT_NUM
1111111111	1
2222222222	2
3333333333	3
4444444444	4
5555555555	5

5 rows returned in 0.01 seconds Download

Data insertion for is_managed table:

```
INSERT INTO is_managed (doctor_ssn, appointment_num) VALUES ('0111111111',
5);
INSERT INTO is_managed (doctor_ssn, appointment_num) VALUES ('0555555555',
4);
INSERT INTO is_managed (doctor_ssn, appointment_num) VALUES ('0444444444',
3);
INSERT INTO is_managed (doctor_ssn, appointment_num) VALUES ('0333333333',
2);
INSERT INTO is_managed (doctor_ssn, appointment_num) VALUES ('0222222222',
1);
```

DOCTOR_SSN	APPOINTMENT_NUM
0111111111	5
0222222222	1
0333333333	2
0444444444	3
0555555555	4

5 rows returned in 0.01 seconds Download

Data insertion for is_supervised table:

```
INSERT INTO is_supervised (room_num, staff_ssn) VALUES (1, '1111111111');
INSERT INTO is_supervised (room_num, staff_ssn) VALUES (2, '2222222222');
INSERT INTO is_supervised (room_num, staff_ssn) VALUES (3, '3333333333');
INSERT INTO is_supervised (room_num, staff_ssn) VALUES (4, '4444444444');
```

```
INSERT INTO is_supervised (room_num, staff_ssn) VALUES (5, '5555555555');
```

ROOM_NUM	STAFF_SSN
1	1111111111
2	2222222222
3	3333333333
4	4444444444
5	5555555555

5 rows returned in 0.01 seconds Download

Data Deletion

In this step, Five experimental records have been deleted:

```
DELETE FROM  Prescriptions
WHERE drug_name='Atorvastatin';
```

PRESCRIPTION_NUM	DRUG_NAME	ACTIVE_SUBSTANCE	DOSES	APPOINTMENT_NUM	PATIENT_SSN
1	Ibuprofen	Ibuprofen	200mg	1	1111111111
2	Amoxicillin	Amoxicillin	500mg	2	2222222222
3	Acetaminophen	Acetaminophen	325mg	3	3333333333
4	Lisinopril	Lisinopril	10mg	4	4444444444

```
DELETE FROM  Prescriptions
WHERE drug_name='Amoxicillin';
```

PRESCRIPTION_NUM	DRUG_NAME	ACTIVE_SUBSTANCE	DOSES	APPOINTMENT_NUM	PATIENT_SSN
1	Ibuprofen	Ibuprofen	200mg	1	1111111111
3	Acetaminophen	Acetaminophen	325mg	3	3333333333
4	Lisinopril	Lisinopril	10mg	4	4444444444

3 rows returned in 0.01 seconds Download

```
DELETE FROM is_managed
WHERE appointment_num=2;
```

DOCTOR_SSN	APPOINTMENT_NUM
0111111111	5
0222222222	1
0444444444	3
0555555555	4

4 rows returned in 0.01 seconds Download

```
DELETE FROM assigned
```

```
WHERE appointment_num=2;
```

PATIENT_SSN	APPOINTMENT_NUM
1111111111	1
3333333333	3
4444444444	4
5555555555	5

4 rows returned in 0.01 seconds Download

```
DELETE FROM Appointments
WHERE appointment_num=2;
```

APPOINTMENT_NUM	ADATE	APPOINTMENT_TIME	APPOINTMENT_TYPE	ROOM_NUM
1	04/02/2022	09:00	Check-up	1
3	08/02/2022	11:00	Physical Therapy	3
4	04/05/2022	12:00	Consultation	4
5	04/02/2023	13:00	Follow-up	5

4 rows returned in 0.01 seconds Download

Data Modification

In this step, Three experimental records have been modified:

Salary update for the doctor with SSN='0111111111'

```
UPDATE Doctors
SET salary=9000
WHERE doctor_ssn='0111111111';
```

DOCTOR_SSN	DNAME	DOB	SEX	PHONENUM	ADDRESS	EMAIL	SPECIALIZATION	SALARY
0111111111	Anas	04/02/1997	m	0771234567	123 Main St	doctor1@example.com	Surgery	9000
0222222222	hamzeh	04/02/1998	f	0771234567	456 Main St	doctor2@example.com	Pediatrics	80000
0333333333	saeed	04/02/1996	m	0771234566	789 Main St	doctor3@example.com	OB/GYN	90000
0444444444	salma	04/07/1997	f	0771234565	321 Main St	doctor4@example.com	Cardiology	110000
0555555555	basema	04/02/1996	m	0771234564	654 Main St	doctor5@example.com	Dermatology	95000

Appointment time update for Appointment number 1:

```
UPDATE Appointments
SET appointment_time='10:30'
WHERE appointment_num=1;
```

APPOINTMENT_NUM	ADATE	APPOINTMENT_TIME	APPOINTMENT_TYPE	ROOM_NUM
1	04/02/2022	10:30	Check-up	1
3	08/02/2022	11:00	Physical Therapy	3
4	04/05/2022	12:00	Consultation	4
5	04/02/2023	13:00	Follow-up	5

4 rows returned in 0.01 seconds Download

Table Joins

This join query will retrieve the patients' names, the doctors' names, and the date of the appointment for each patient, where the join conditions are met.

```
SELECT patients.pname, doctors.dname, appointments.adate
FROM patients
JOIN assigned ON patients.patient_ssn = assigned.patient_ssn
JOIN appointments ON assigned.appointment_num =
appointments.appointment_num
JOIN is_managed ON appointments.appointment_num =
is_managed.appointment_num
JOIN doctors ON is_managed.doctor_ssn = doctors.doctor_ssn;
```

PNAME	DNAME	ADATE
anas muhammad	Anas	04/02/2023
Sara Ahmad	hamzeh	04/02/2022
Samia luma	salma	08/02/2022
jouhn mcdonalds	basema	04/05/2022

4 rows returned in 0.14 seconds Download

This join query will retrieve the total salaries of the doctors and the staff.

```
SELECT sum(Staff.salary) as Total_Staff_Salary,sum(Doctors.salary) as
Total_Doctors_Salary
FROM Staff
FULL OUTER JOIN Doctors
ON Doctors.salary =  Staff.salary;
```

TOTAL_STAFF_SALARY	TOTAL_DOCTORS_SALARY
225000	384000

1 rows returned in 0.01 seconds Download

Conclusion

While working on this project, we have gained hands-on experience with SQL and Oracle APEX as a cloud-based DBMS, as well as designing and implementing relational databases. We'd like to thank our supervisors for this opportunity which enhanced our learning experience.

Notes

1. All query results are screenshots from Oracle APEX.
2. All data used in this project is randomly generated and doesn't belong to any real-world person or organization.