# Hospital Management System

## Introduction

The Hospital Management System is a relational database designed to simplify and automate hospital operations.
This system manages hospital departments, doctors, patients, appointments, and medical records.
The goal of this project is to demonstrate a well-organized, normalized SQL schema that supports crud operations and advanced data retrieval using joins, aggregation, and constraints.

## Project Objectives

The main objectives of this database project are:

- To design a structured database for hospital operations.
- To enforce data integrity using primary keys, foreign keys, and constraints.
- To implement crud (Create, Read, Update, Delete) operations.
- To perform analytical queries using SQL joins and aggregate functions.
- To insert real-world sample data representing hospital functionality.
- To show advanced operations such as salary analysis, appointment statistics, and medical record tracking.

## Database Design

The system consists of five core entities**:**

### Department**:**

Stores information about hospital departments such as Cardiology, Neurology, Pediatrics, etc.
Each department optionally has a Head Doctor.

### Doctor**:**

Contains doctor details including specialization, department association, phone number, and salary.

**Patient:**

Stores personal information of patients such as name, gender, age, and address.

**Appointment:**

Handles scheduling between patients and doctors, including appointment dates, times, status, and reason.

**Medical Record:**

Maintains diagnosis and treatment details for each completed appointment.

## SQL Schema Implementation

Below is a summary of key SQL design decisions:

**Primary Keys:**

Every table uses an AUTO_INCREMENT primary key for unique identification.

**Foreign Keys:**

Foreign keys ensure valid references—for example:

- doctor.departmentId → department.departmentId
- appointment.patientId → patient.patientId
- medicalRecord.doctorId → doctor.doctorId

**Data Types:**

- Textual values use VARCHAR and TEXT
- Dates use DATE / TIME
- Gender uses ENUM
- Salary uses DECIMAL

**Constraints:**

- Unique department names
- Appointment status allowed values: Scheduled, Completed, Cancelled, No-Show
- NOT NULL used for required fields

These constraints prevent invalid data entry.

**Data Insertion Strategy**

The insertion order follows dependency rules:

1. **Departments** – no dependencies
2. **Doctors** – depends on departments
3. **Patients** – no dependencies
4. **Appointments** – depends on doctors + patients
5. **Medical Records** – depends on appointments

This ensures smooth insertion and no foreign key errors.

## CRUD Operations

**CREATE**

Adding new patients and scheduling appointments:

INSERT INTO patient (...) VALUES (...);

INSERT INTO appointment (...) VALUES (...);

**READ**

Examples:

- Search patients by name
- View all scheduled appointments
- Get appointments for a specific doctor using JOIN

These SELECT queries enable fast data retrieval.

**UPDATE**

Examples:

- Change appointment status
- Update patient phone number
- Increase doctor salary

  These queries demonstrate database modification capabilities

**DELETE**

Removing/canceling appointments:

DELETE FROM appointment WHERE appointmentId = 4;

## Advanced SQL Functionalities

**Appointment Count per Doctor**

Counts how many patients each doctor is attending. Uses LEFT JOIN so doctors with zero appointments are also included.

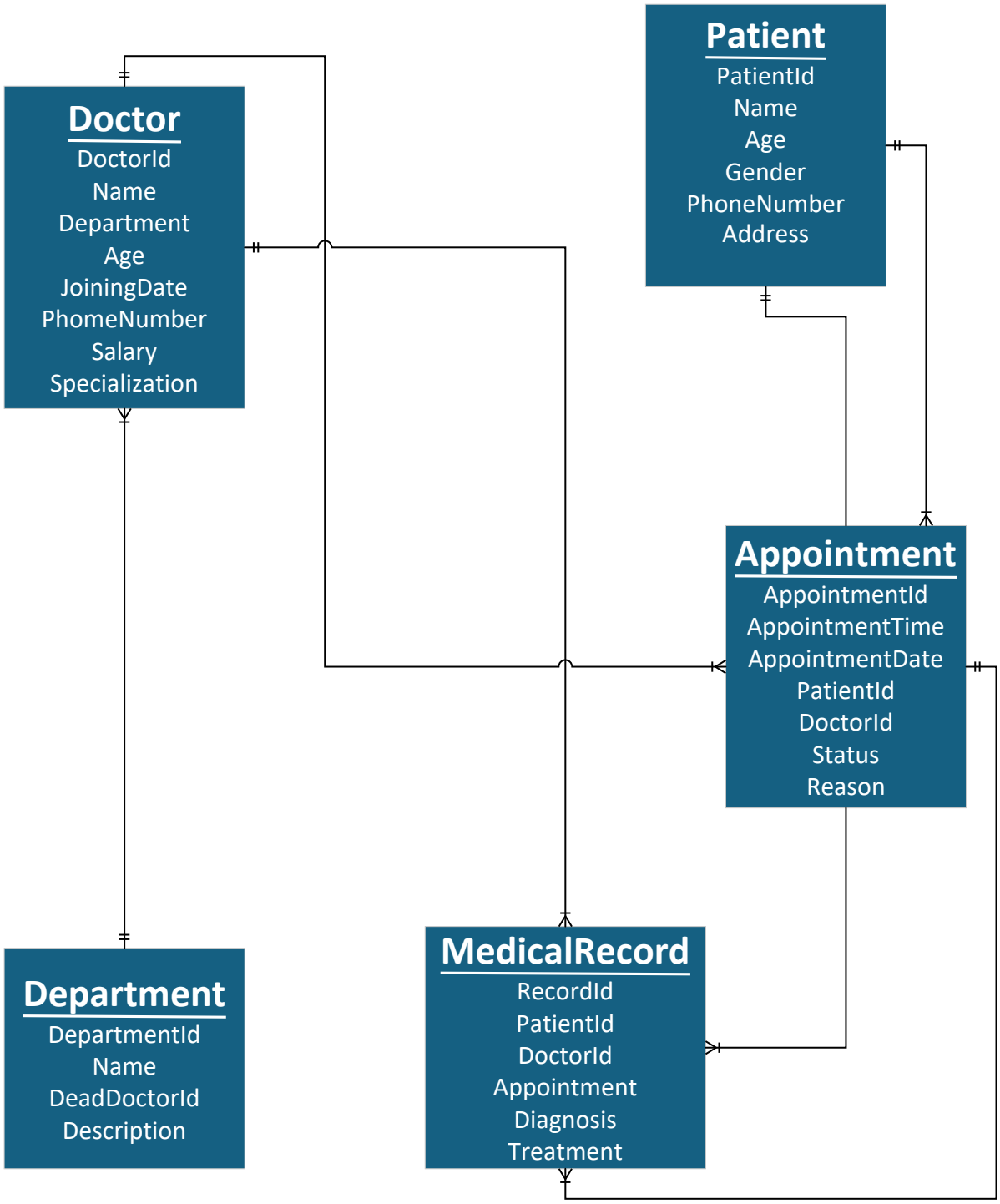
**Average Salary per Department**
Useful for financial analysis.
**Patient Count by Gender**
Basic demographic statistics.
**Full Appointment Schedule (JOIN QUERY)**
Shows:

- Appointment date & time
- Patient name
- Doctor name
- Department
- Status

This is ideal for generating daily/weekly hospital schedules.
**Medical Record Summary**
Displays doctor and patient information along with diagnosis and treatment.

## Conclusion

The Hospital Management System SQL project achieves all goals of a professional, well-structured relational database.
It organizes hospital operations efficiently, supports complex queries, maintains data integrity, and provides clear relationships among entities.
By applying principles of SQL, normalization, relationship mapping, and CRUD operations, this project serves as a practical example of real-world database design and implementation.


Patient
PatientId
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Age
Gender
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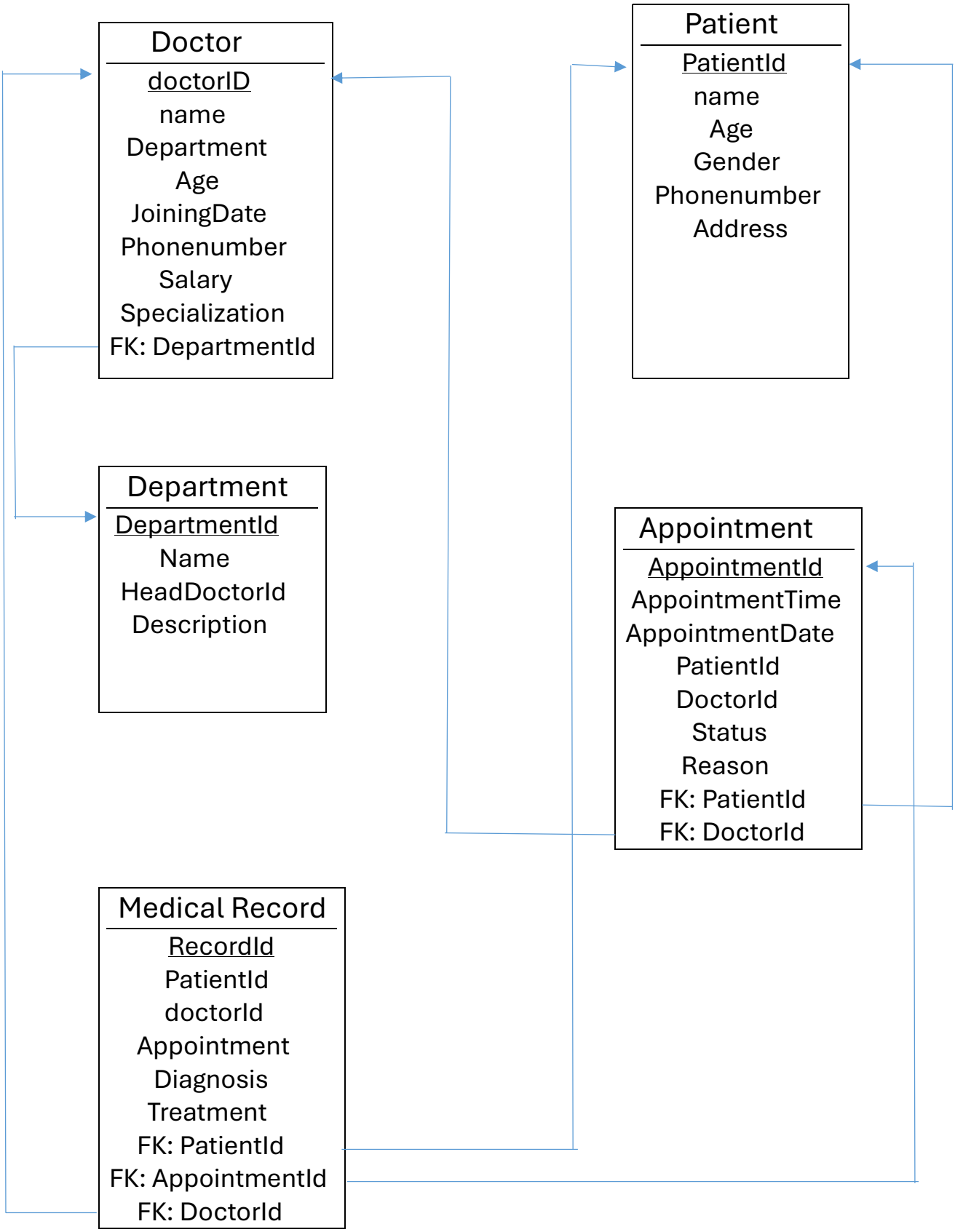
AppointmentTime
AppointmentDate
PatientId
DoctorId
Status
Reason
MedicalRecord
RecordId
PatientId
DoctorId
Appointment
Diagnosis
Treatment
Department
DepartmentId
Name
DeadDoctorId
Description


Doctor
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FK: DepartmentId
Patient
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DepartmentId
Name
HeadDoctorId
Description
Appointment
AppointmentId
AppointmentTime
AppointmentDate
PatientId
DoctorId
Status
Reason
FK: PatientId
FK: DoctorId
Medical Record
RecordId
PatientId
doctorId
Appointment
Diagnosis
Treatment
FK: PatientId
FK: AppointmentId
FK: DoctorId

## CODE:

```
DROP DATABASE IF EXISTS HospitalManagementSystem;
CREATE DATABASE HospitalManagementSystem;
USE HospitalManagementSystem;

CREATE TABLE department (
    departmentId INT PRIMARY KEY AUTO_INCREMENT,
    name VARCHAR(50) NOT NULL UNIQUE,
    HeadDoctorID INT,
    Description TEXT
);

CREATE TABLE doctor (
doctorId INT PRIMARY KEY AUTO_INCREMENT,
name VARCHAR(50) NOT NULL,
departmentId INT,
age INT,
joiningDate DATE,
phoneNumber VARCHAR(15),
salary DECIMAL(10,2),
specialization VARCHAR(50),
FOREIGN KEY (departmentId) REFERENCES department(departmentId)
);

CREATE TABLE patient (
    patientId INT PRIMARY KEY AUTO_INCREMENT,
    name VARCHAR(50) NOT NULL,
    age INT,
    Gender ENUM('Male', 'Female', 'Other'),
    phoneNumber VARCHAR(15),
    address TEXT
);
```

```
CREATE TABLE appointment (
    appointmentId INT PRIMARY KEY AUTO_INCREMENT,
    appointmentDate DATE NOT NULL,
    appointmentTime TIME NOT NULL,
    patientId INT NOT NULL,
    doctorId INT NOT NULL,
    Status ENUM('Scheduled', 'Completed', 'Cancelled', 'No-Show') DEFAULT 'Scheduled',
    Reason VARCHAR(255),
    FOREIGN KEY (patientId) REFERENCES patient(patientId),
    FOREIGN KEY (doctorId) REFERENCES doctor(doctorId)
);

CREATE TABLE medicalRecord (
    recordId INT PRIMARY KEY AUTO_INCREMENT,
    patientId INT NOT NULL,
    doctorId INT NOT NULL,
    appointmentId INT,
    diagnosis TEXT,
    treatment TEXT,
    FOREIGN KEY (patientId) REFERENCES patient(patientId),
    FOREIGN KEY (doctorId) REFERENCES doctor(doctorId),
    FOREIGN KEY (appointmentId) REFERENCES appointment(appointmentId)
);

INSERT INTO department (name, Description) VALUES
('Cardiology', 'Specializes in heart and cardiovascular diseases'),
('Neurology', 'Deals with brain and nervous system disorders'),
('Pediatrics', 'Medical care for children and adolescents'),
('Orthopedics', 'Focuses on musculoskeletal system');

INSERT INTO doctor (name, departmentId, age, joiningDate, phoneNumber, salary, specialization) VALUES
('Dr. AhsanUllah', 1, 45, '2018-03-15', '111-222-3333', 145000.00, 'Cardiologist'),
('Dr. DaniyalKhalil', 2, 52, '2015-07-20', '111-222-3334', 155000.00, 'Neurologist'),
```

('Dr. Huzaifa', 3, 38, '2020-11-10', '111-222-3335', 125000.00, 'Pediatrician'),
('Dr. Zain', 4, 41, '2019-05-30', '111-222-3336', 135000.00, 'Orthopedic Surgeon');

UPDATE department SET HeadDoctorID = 1 WHERE departmentId = 1;
UPDATE department SET HeadDoctorID = 2 WHERE departmentId = 2;
UPDATE department SET HeadDoctorID = 3 WHERE departmentId = 3;
UPDATE department SET HeadDoctorID = 4 WHERE departmentId = 4;

INSERT INTO patient (name, age, Gender, phoneNumber, address) VALUES
('Balaj', 35, 'Male', '444-555-6666', '123 Main St, Cityville'),
('Fatima', 28, 'Female', '444-555-6667', '456 Oak Ave, Townsville'),
('Atta', 42, 'Male', '444-555-6668', '789 Pine Rd, Villagetown'),
('Kinza', 65, 'Female', '444-555-6669', '321 Elm St, Cityville');

INSERT INTO appointment (appointmentDate, appointmentTime, patientId, doctorId, Status, Reason) VALUES
('2024-01-15', '10:00:00', 1, 1, 'Completed', 'Routine heart checkup'),
('2024-01-15', '11:30:00', 2, 2, 'Scheduled', 'Headache and dizziness'),
('2024-01-16', '09:15:00', 3, 3, 'Scheduled', 'Child vaccination'),
('2024-01-16', '14:00:00', 4, 4, 'Cancelled', 'Knee pain consultation'),
('2024-01-17', '13:45:00', 1, 1, 'Scheduled', 'Follow-up for heart condition');

INSERT INTO medicalRecord (patientId, doctorId, appointmentId, diagnosis, treatment) VALUES
(1, 1, 1, 'Hypertension Stage 1', 'Prescribed medication and lifestyle changes'),
(2, 2, 2, 'Migraine diagnosed', 'Prescribed pain management and follow-up'),
(3, 3, 3, 'Routine child checkup - Healthy', 'Administered required vaccinations');

-- PERFORMING CRUD

```
-- CREATE
INSERT INTO patient (name, age, Gender, phoneNumber, address)
VALUES ('Lisa Wang', 29, 'Female', '444-555-6670', '159 Maple Dr, Cityville');
INSERT INTO appointment (appointmentDate, appointmentTime, patientId, doctorId, Reason)
VALUES ('2024-01-18', '15:30:00', 5, 2, 'Neurological consultation');

-- READ
SELECT * FROM patient WHERE name LIKE '%Balaj%';
SELECT * FROM appointment WHERE Status = 'Scheduled';

SELECT a.appointmentDate, a.appointmentTime, p.name as PatientName, a.Reason
 FROM appointment a
JOIN patient p   ON a.patientId = p.patientId
WHERE a.doctorId = 1;

UPDATE appointment SET Status = 'Completed' WHERE appointmentId = 2;
UPDATE patient SET phoneNumber = '444-555-6677' WHERE patientId = 1;
UPDATE doctor SET salary = salary * 1.1 WHERE departmentId = 1;

DELETE FROM appointment WHERE appointmentId = 4;

SELECT d.name AS DoctorName, COUNT(a.appointmentId) AS AppointmentCount
FROM doctor d
LEFT JOIN appointment a ON d.doctorId = a.doctorId
GROUP BY d.doctorId;

SELECT d.name AS DepartmentName, AVG(doctor.salary) AS AverageSalary
FROM department d
JOIN doctor ON d.departmentId = doctor.departmentId
GROUP BY d.departmentId;
```

```
SELECT Gender, COUNT(*) AS PatientCount
FROM patient
GROUP BY Gender;

SELECT
    a.appointmentDate,
    a.appointmentTime,
    p.name AS PatientName,
    d.name AS DoctorName,
    dep.name AS Department,
    a.Status,
    a.Reason
FROM appointment a
JOIN patient p ON a.patientId = p.patientId
JOIN doctor d ON a.doctorId = d.doctorId
JOIN department dep ON d.departmentId = dep.departmentId
WHERE a.Status = 'Scheduled';

SELECT
    p.name AS PatientName,
    d.name AS DoctorName,
    mr.diagnosis,
    mr.treatment
FROM medicalRecord mr
JOIN patient p ON mr.patientId = p.patientId
JOIN doctor d ON mr.doctorId = d.doctorId;
```

## Some Taken OutPuts:

| patientId | name | age | Gender | phoneNumber | address |
|---|---|---|---|---|---|
| 1 | Balaj | 35 | Male | 444-555-6666 | 123 Main St, Cityville |
| NULL | NULL | NULL | NULL | NULL | NULL |

| appointmentId | appointmentDate | appointmentTime | patientId | doctorId | Status | Reason |
|---|---|---|---|---|---|---|
| 2 | 2024-01-15 | 11:30:00 | 2 | 2 | Scheduled | Headache and dizziness |
| 3 | 2024-01-16 | 09:15:00 | 3 | 3 | Scheduled | Child vaccination |
| 5 | 2024-01-17 | 13:45:00 | 1 | 1 | Scheduled | Follow-up for heart condition |
| 6 | 2024-01-18 | 15:30:00 | 5 | 2 | Scheduled | Neurological consultation |
| NULL | NULL | NULL | NULL | NULL | NULL | NULL |

| appointmentDate | appointmentTime | PatientName | Reason |
|---|---|---|---|
| 2024-01-15 | 10:00:00 | Balaj | Routine heart checkup |
| 2024-01-17 | 13:45:00 | Balaj | Follow-up for heart condition |

| DoctorName | AppointmentCount |
|---|---|
| Dr. AhsanUllah | 2 |
| Dr. DaniyalKhalil | 2 |
| Dr. Huzaifa | 1 |
| Dr. Zain | 0 |

| DepartmentName | AverageSalary |
|---|---|
| Cardiology | 159500.000000 |
| Neurology | 155000.000000 |
| Pediatrics | 125000.000000 |
| Orthopedics | 135000.000000 |

| Gender | PatientCount |
|---|---|
| Male | 2 |
| Female | 3 |

| appointmentDate | appointmentTime | PatientName | DoctorName | Department | Status | Reason |
|---|---|---|---|---|---|---|
| 2024-01-16 | 09:15:00 | Atta | Dr. Huzaifa | Pediatrics | Scheduled | Child vaccination |
| 2024-01-17 | 13:45:00 | Balaj | Dr. AhsanUllah | Cardiology | Scheduled | Follow-up for heart condition |
| 2024-01-18 | 15:30:00 | Lisa Wang | Dr. DaniyalKhalil | Neurology | Scheduled | Neurological consultation |

| PatientName | DoctorName | diagnosis | treatment |
|---|---|---|---|
| Balaj | Dr. AhsanUllah | Hypertension Stage 1 | Prescribed medication and lifestyle changes |
| Fatima | Dr. DaniyalKhalil | Migraine diagnosed | Prescribed pain management and follow-up |
| Atta | Dr. Huzaifa | Routine child checkup - Healthy | Administered required vaccinations |