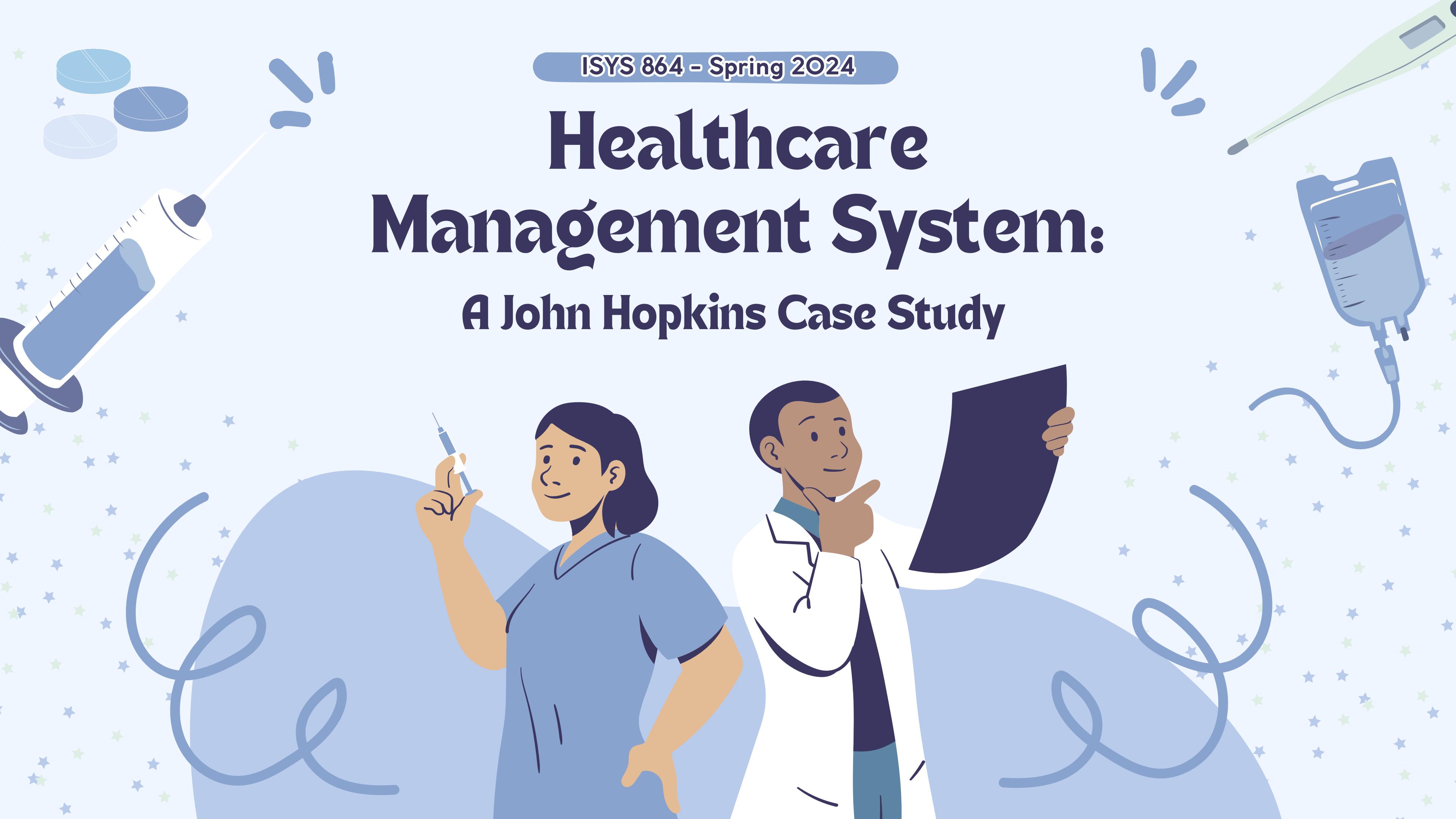
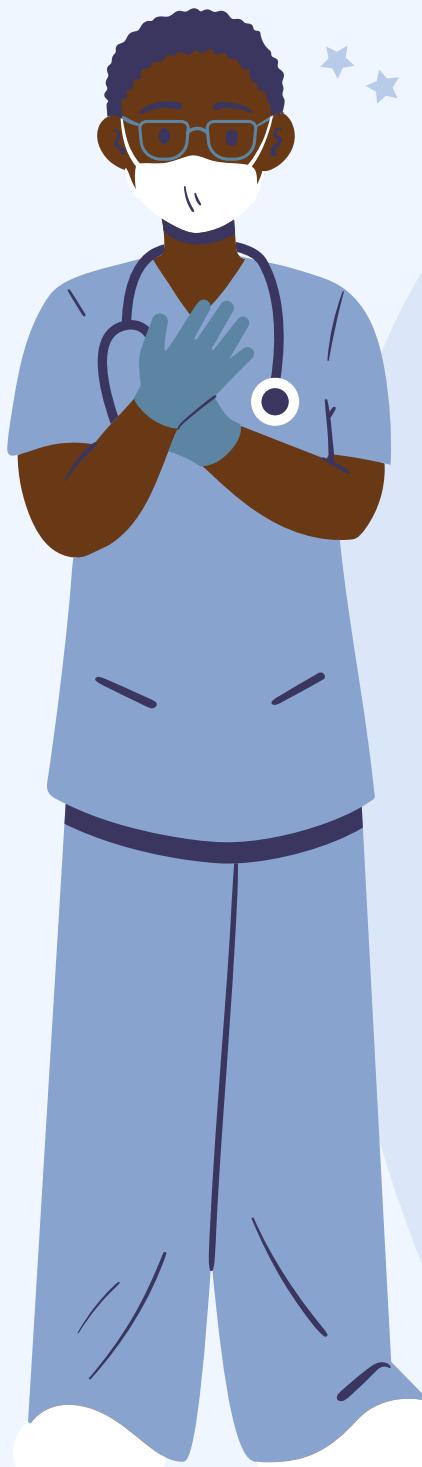


# Healthcare Management System:

## A John Hopkins Case Study



# Database Management Team



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# John Hopkins Hospital

A non-profit academic medical center in Baltimore, Maryland

## Area of focus

- **Patient care**
  - Patients, Medical Records, Departments, Employees, Physicians, Nurses, Billing & Insurance
- **Pharmacy operations**
  - Medicine, Prescriptions, Inventory, Transactions



# Patient care: Patients

## Entity

- Stores information about individuals receiving medical care.
- Includes details like a unique patient identifier, first and last name, date of birth, contact information.

## Attributes

- PatientID
- PatientName
- DateOfBirth
- Address
- Phone



# Employees

## Attributes

- EmployeeID
- EmployeeName
- Specialization
- Salary
- EmployeeType



## Entity

- Represents general staff within a healthcare organization.
- Captures details like a unique employee identifier, full name, their area of specialization, and salary.
- Employee type acts as a subtype, allowing for categorization as either "physician" or "nurse".

# Physicians and Nurses

## Entity

- The "physicians" entity inherits all attributes from its supertype "employee".
- Includes a unique identifier, full name, area of specialization, and salary.

## Attributes

- PhysicianID
- EmployeeName
- Specialty
- Salary

## Entity

- The "nurses" entity inherits all attributes from the "employee" supertype.
- This entity has its own unique attribute namely LicenseNumber.

## Attributes

- NurseID
- EmployeeName
- Specialization
- Salary
- LicenseNumber



# Entity

- Tracks financial transactions for patient care.
- Uses a unique identifier and links to a specific patient.
- Captures details about the service rendered, including the procedure code and the date of service.
- Financial information includes the total charge for the service and the insurance provider involved.
- Tracks the claim status with the insurer, indicating if it's pending, approved, denied, or requires further action.

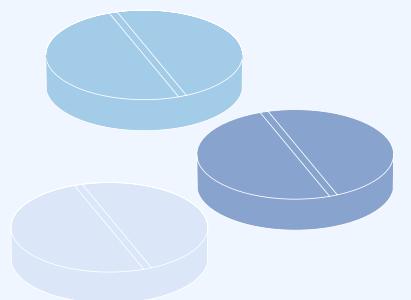


## Attributes

- BillingInsuranceID
- ServiceProcedureCode
- ServiceDate
- ChargeAmount
- InsuranceProvider
- InsuranceClaimStatus

# Billing & Insurance

# Pharmacy: Prescriptions



## Attributes

- PrescriptionID
- DosageInstructions
- PrescriptionDate
- PrescribingPhysicianID

## Entity

- Manages medication orders within a healthcare system.
- Uses a unique identifier and links to the specific patient, the medication that they are receiving and the transactions involved for a prescription.
- The record also includes the doctor who prescribed the medication along with dosage instructions and the date the prescription was written.
- This entity provides a vital link between patients, physicians, and dispensed medications.

# Medical Supplies

## Entity

- Forms the core of a pharmacy management system.
- Holds information about individual medications using a unique identifier.
- Each record contains the medication name, its strength, and the dosage form (e.g., tablet, capsule, syrup).
- Information about the manufacturer is also stored.
- Tracks the medication's expiration date to ensure patient safety and proper inventory management.

## Attributes

- MedicineID
- MedicationName
- Strength
- Type
- Manufacturer
- ExpiryDate

## Entity

- Serves as an important part of pharmacy stock management.
- Tracks vital inventory details such as the current quantity of medication units available, unit price, minimum stock level prompting reorders when inventory falls below, and the date of the last medication reorder.
- Prevents stock outs and ensuring patients can receive their prescriptions without delays.



## Attributes

- InventoryID
- QuantityOnHand
- UnitPrice
- ReorderLevel
- LastReorderDate

# Inventory

# Pharmacists

## Entity

- Stores information about licensed pharmacy professionals.
- Each record has a unique identifier, full name, license number, contact number, experience level and any certifications they hold that demonstrate their expertise in specific areas of pharmacy practice.

## Attributes

- PharmacistID
- PharmacistName
- LicenseNumber
- ContactNo
- YearsOfExperience
- Certifications



# Business Rules



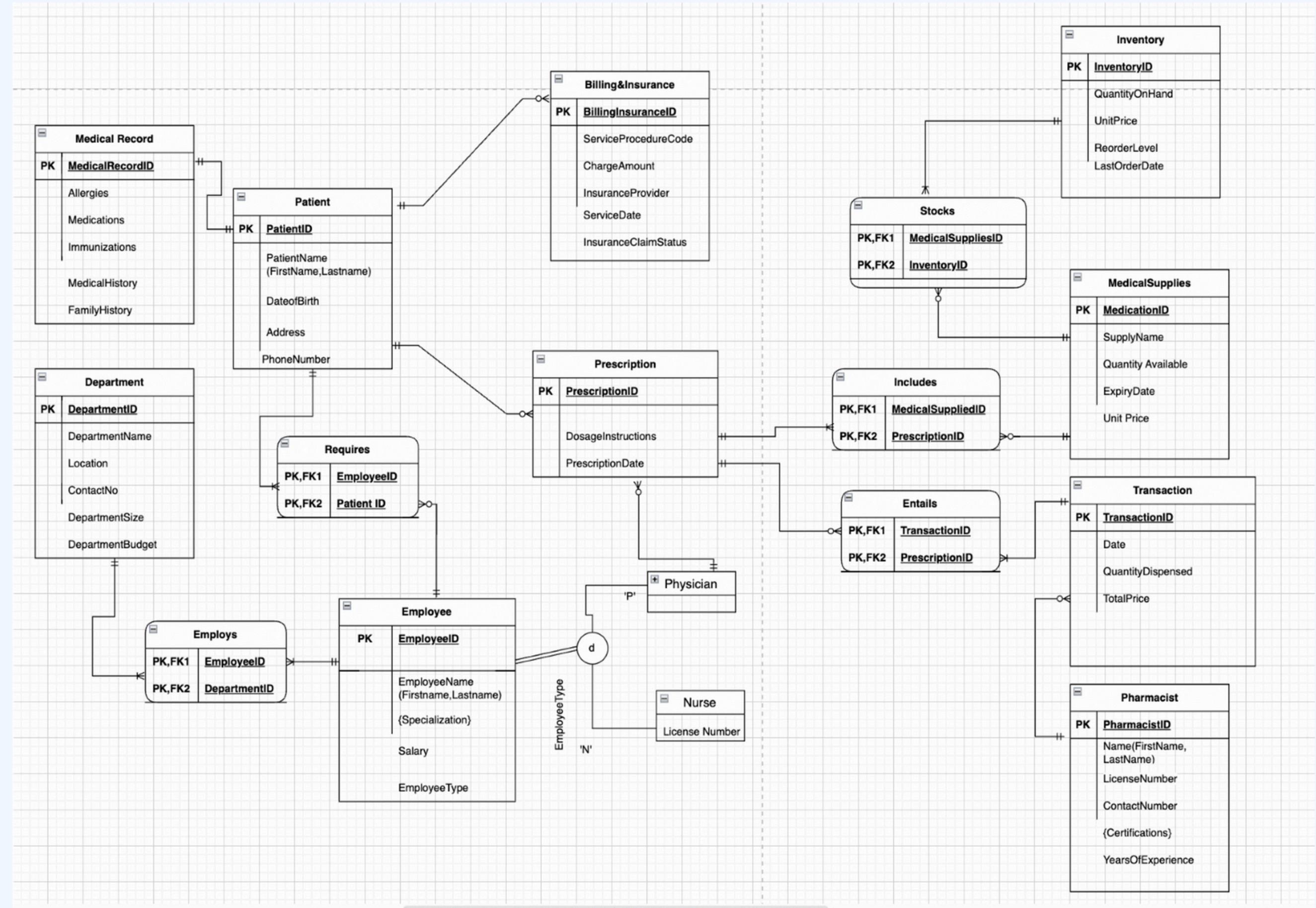
- A Patient must have one and only one Medical Record (1:1)
- A Medical Record must belong to one and only one Patient (1:1)
- A Patient can have zero or more Billing & Insurance entries (1:M)
- A Billing & Insurance entry must belong to one and only one Patient (1:1)
- A Physician must belong to at least one Department (1:M)
- A Department must have one or more Physicians (1:M)
- A Department must have one or more Nurses (1:M)
- A Nurse must belong to at least one Department (1:M)
- A Prescription must be assigned to one and only Patient (1:M)
- A Patient can have zero or more Prescriptions (1:M)
- A Prescription must be written by one Physician (1:1)
- A Physician can write zero or more Prescriptions (1:M)

# Business Rules (cont.)

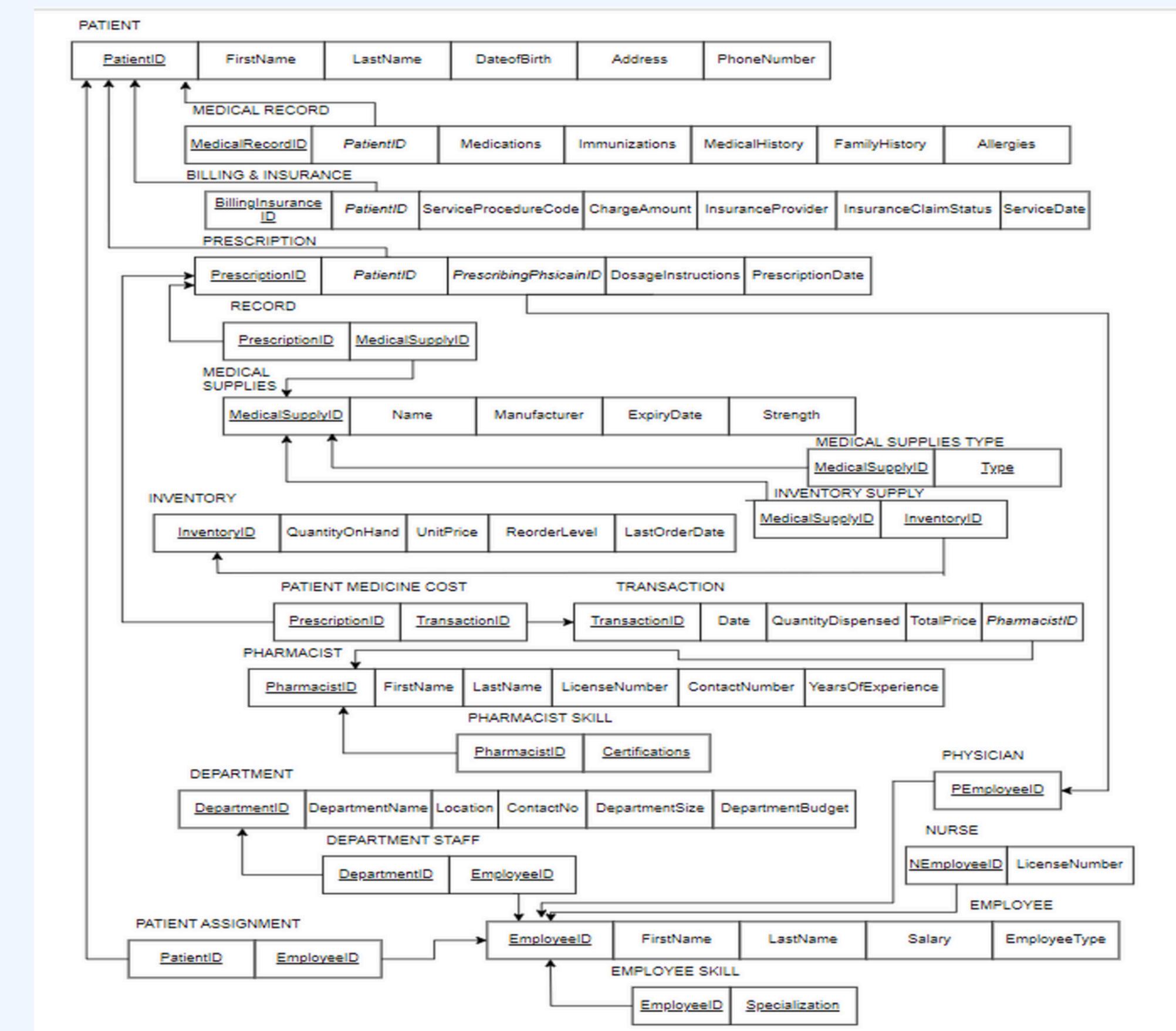
- A Prescription must have one or more MedicalSupplies (1:M)
- A MedicalSupply can be associated with zero or more Prescriptions (1:M)
- A Prescription can have zero or more Transactions (1:M)
- A transaction must be associated with at least one prescription (1:M)
- An inventory must have one or more medical supplies (1:M)
- A medical supply can be in zero or more inventory (1:M)
- A Transaction must be processed by only one Pharmacist (1:1)
- A pharmacist can process zero or more transactions(1:M)
- A physician can have zero or more patients (1:M)
- A patient must be associated with at least one physician (1:M)
- A nurse can have zero or more patients (1:M)
- A patient must be associated with at least one nurse (1:M)



# CCR diagram



# 3NF Relational Model



# Our Data

| EmployeeID | Department ID | EmployeeName     | Specialization |
|------------|---------------|------------------|----------------|
| 1          | 101           | John Doe         | Cardiology     |
| 2          | 102           | Jane Smith       | Pediatrics     |
| 3          | 103           | Alice Johnson    | Orthopedics    |
| 4          | 104           | Michael Williams | Neurology      |
| 5          | 105           | Sarah Brown      | Oncology       |
| 6          | 106           | David Lee        | Psychiatry     |

| InventoryID | QuantityOnHand | UnitPrice | ReorderLevel |
|-------------|----------------|-----------|--------------|
| INV-001     | 100            | \$25.00   | 50           |
| INV-002     | 75             | \$18.50   | 40           |
| INV-003     | 200            | \$10.00   | 100          |
| INV-004     | 50             | \$30.00   | 20           |
| INV-005     | 150            | \$12.75   | 80           |
| INV-006     | 90             | \$22.00   | 60           |

| MedicalRecordID | Allergies   | Medications     | Immunizations |
|-----------------|-------------|-----------------|---------------|
| 15235           | Penicillin  | Aspirin         | MMR           |
| 23405           | Sulfa Drugs | Ibuprofen       | Influenza     |
| 33457           | Peanuts     | Acetaminophen   | Tetanus       |
| 34512           | Shellfish   | Naproxen        | Hepatitis B   |
| 52358           | Pollen      | Loratadine      | HPV           |
| 64596           | Dust        | Diphenhydramine | Varicella     |
| 73402           | Cat Hair    | Cetirizine      | Pneumococcal  |
| 82409           | Dog Dander  | Ranitidine      | Hepatitis A   |

# 1. Calculate the average transaction amount (total price paid) per patient, sorted in descending order

```
SELECT  
    PatientID,  
    PatientName,  
    (SELECT AVG(ChargeAmount)  
     FROM BillingInsurance  
     WHERE PatientID = p.PatientID) AS AvgTransactionAmount  
FROM  
    Patients p  
ORDER BY  
    AvgTransactionAmount DESC;
```

Query

Output

|   | PatientID | PatientName        | AvgTransactionAmount |
|---|-----------|--------------------|----------------------|
| ▶ | 10005     | David Miller       | 1875.125000          |
|   | 10001     | John Smith         | 1500.000000          |
|   | 10008     | Amanda Lee         | 1375.850000          |
|   | 10010     | Ashley Clark       | 1350.750000          |
|   | 10002     | Emily Johnson      | 1200.500000          |
|   | 10003     | Michael Williams   | 800.750000           |
|   | 10009     | Daniel Taylor      | 600.250000           |
|   | 10006     | Jessica Davis      | 300.000000           |
|   | 10004     | Sarah Brown        | NULL                 |
|   | 10007     | Christopher Wilson | NULL                 |

2. Retrieve the top 3 physicians with the highest total salary, along with the number of prescriptions they have written.

```
SELECT p.PhysicianID,  
       p.EmployeeName,  
       COUNT(pr.PrescriptionID) AS NumberOfPrescriptions,  
       p.Salary AS TotalSalary  
  FROM Physician p  
LEFT JOIN Prescriptions pr ON p.PhysicianID = pr.PrescribingPhysicianID  
 GROUP BY p.PhysicianID, p.EmployeeName  
 ORDER BY TotalSalary DESC  
 LIMIT 3;
```

Query

Output

|   | PhysicianID | EmployeeName     | NumberOfPrescriptions | TotalSalary |
|---|-------------|------------------|-----------------------|-------------|
| ▶ | 10          | Mark Wilson      | 1                     | 125000.00   |
|   | 1           | John Doe         | 2                     | 120000.00   |
|   | 4           | Michael Williams | 1                     | 118000.00   |

### 3. Retrieve the names and specialties of physicians along with the department they belong to

```
SELECT  
    p.EmployeeName AS PhysicianName,  
    p.Specialization,  
    (SELECT d.DepartmentName  
     FROM Departments d  
     WHERE d.DepartmentID = p.DepartmentID) AS DepartmentName  
  
FROM  
    Physician p;
```

Query

Output

|   | PhysicianName    | Specialization | DepartmentName |
|---|------------------|----------------|----------------|
| ▶ | John Doe         | Cardiology     | Cardiology     |
|   | Jane Smith       | Pediatrics     | Pediatrics     |
|   | Alice Johnson    | Orthopedics    | Orthopedics    |
|   | Michael Williams | Neurology      | Neurology      |
|   | Sarah Brown      | Oncology       | Oncology       |
|   | David Lee        | Psychiatry     | Psychiatry     |
|   | Emily Taylor     | Gynecology     | Gynecology     |
|   | Robert Clark     | Urology        | Urology        |
|   | Laura Anderson   | Dermatology    | Dermatology    |
|   | Mark Wilson      | Ophthalmology  | Ophthalmology  |

#### 4. How many patients have allergies to either Aspirin or Penicillin, and what are their names and corresponding allergies?

```
SELECT COUNT(p.PatientID) AS PatientCount, p.PatientID, p.PatientName, m.Allergies  
FROM Patients p  
JOIN MedicalRecords m ON p.PatientID = m.PatientID  
WHERE m.Allergies LIKE '%Aspirin%' OR m.Allergies LIKE '%Penicillin%'  
GROUP BY p.PatientID, p.PatientName, m.Allergies;
```

Query

Output



|   | PatientCount | PatientID | PatientName | Allergies  |
|---|--------------|-----------|-------------|------------|
| ▶ | 1            | 10001     | John Smith  | Penicillin |

## 5. Calculate the inventory turnover rate for each medication based on transactions

```
SELECT
    ms.MedicalSupplyID,
    ms.SupplyName,
    SUM(t.QuantityDispensed) AS TotalQuantityDispensed,
    AVG(i.QuantityOnHand) AS AverageQuantityAvailable,
    CASE
        WHEN AVG(i.QuantityOnHand) > 0 THEN
            SUM(t.QuantityDispensed) / AVG(i.QuantityOnHand)
        ELSE
            0
    END AS InventoryTurnoverRate
FROM
    Transactions t
JOIN |
    PrescriptionMedicalSupplies pms ON t.PrescriptionID = pms.PrescriptionID
JOIN
    MedicalSupplies ms ON pms.MedicalSupplyID = ms.MedicalSupplyID
JOIN
    Inventory i ON ms.MedicalSupplyID = i.MedicalSupplyID
GROUP BY
    ms.MedicalSupplyID, ms.SupplyName;
```

Output

Query

| MedicalSupplyID | SupplyName        | TotalQuantityDispensed | AverageQuantityAvailable | InventoryTurnoverRate |
|-----------------|-------------------|------------------------|--------------------------|-----------------------|
| MS3001          | Penicillin        | 3                      | 100.0000                 | 0.0300                |
| MS3002          | Aspirin           | 5                      | 75.0000                  | 0.0667                |
| MS3003          | Ibuprofen         | 1                      | 200.0000                 | 0.0050                |
| MS3004          | Influenza Vaccine | 4                      | 50.0000                  | 0.0800                |
| MS3005          | Loratadine        | 2                      | 150.0000                 | 0.0133                |
| MS3006          | Diphenhydramine   | 3                      | 90.0000                  | 0.0333                |
| MS3007          | Cetirizine        | 1                      | 120.0000                 | 0.0083                |
| MS3008          | Ranitidine        | 2                      | 180.0000                 | 0.0111                |
| MS3009          | Omeprazole        | 3                      | 40.0000                  | 0.0750                |
| MS3010          | Metformin         | 4                      | 80.0000                  | 0.0500                |

## 8.Retrieve the medication names and expiration dates of medical supplies expiring in first 6 months of 2O25

```
SELECT  
    SupplyName,  
    DATE_FORMAT(ExpiryDate, '%Y-%m-%d') AS ExpiryDate  
FROM MedicalSupplies  
WHERE YEAR(ExpiryDate) = 2025 AND MONTH(ExpiryDate) BETWEEN 1 AND 6;
```

Query



|   | SupplyName | ExpiryDate |
|---|------------|------------|
| ▶ | Penicillin | 2025-06-30 |
|   | Ibuprofen  | 2025-06-30 |

Output

# Conclusion



# Thank you for your attention

