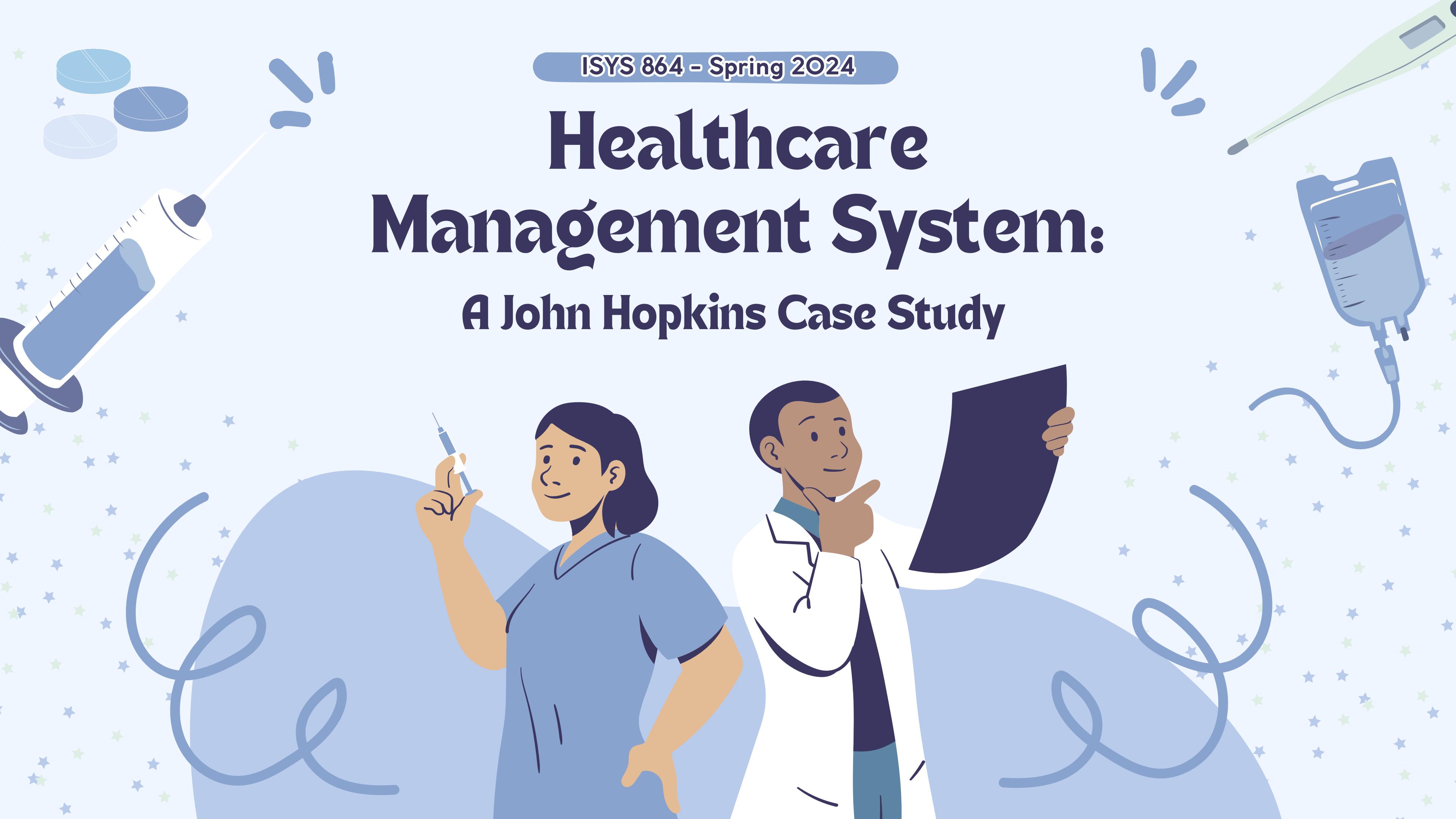


Healthcare Management System:

A John Hopkins Case Study



Database Management Team



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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.

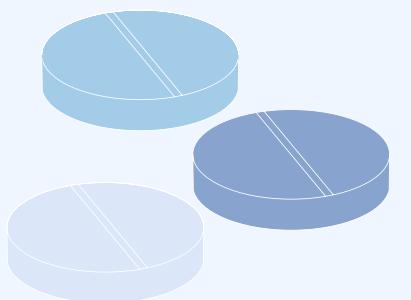


Attributes

- 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



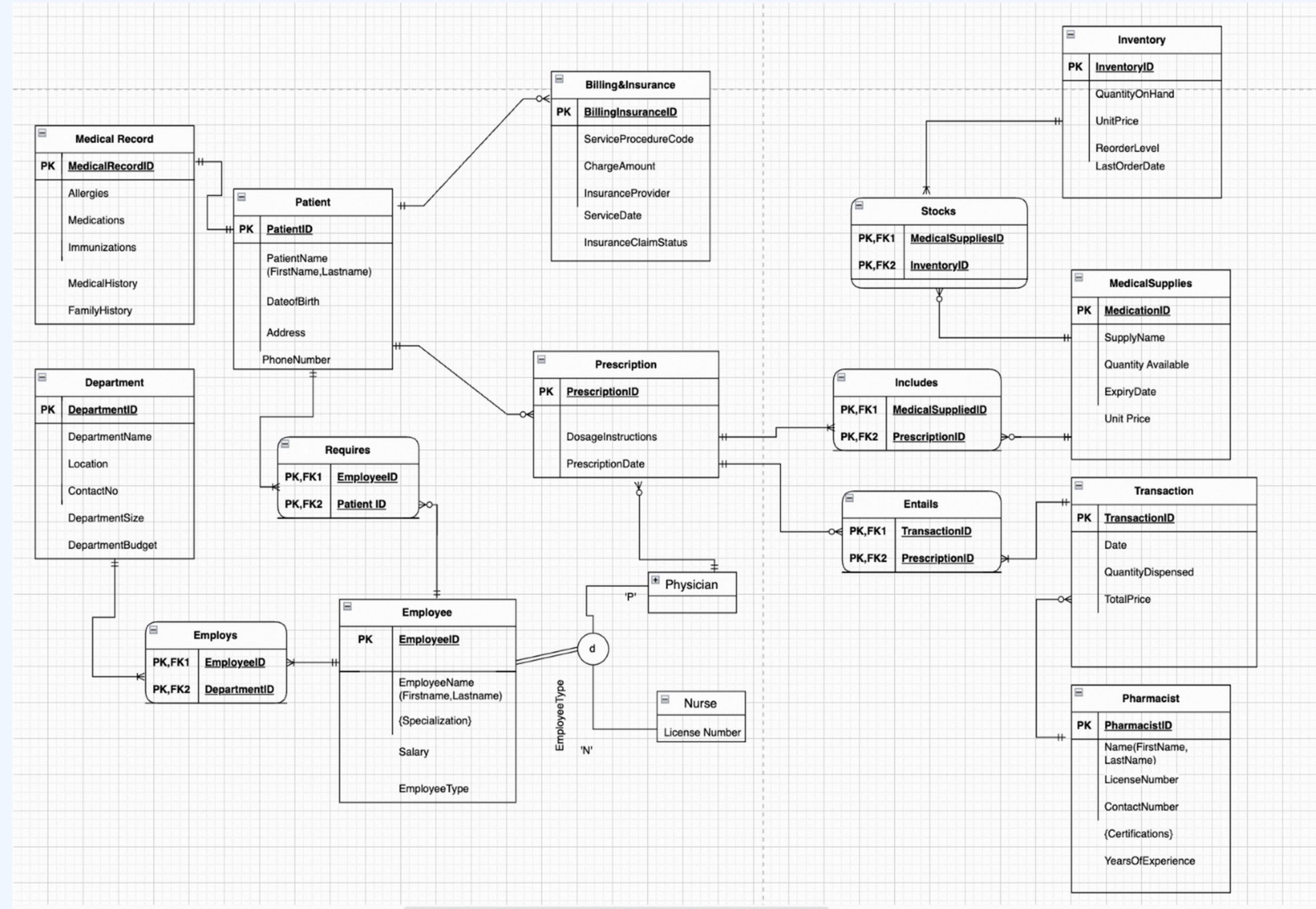
- A Patient must have one and only one Medical Record (1:1)
- A Medical Record must belong to one and only one Patient (1:1)
- A Patient can have zero or more Billing & Insurance entries (1:M)
- A Billing & Insurance entry must belong to one and only one Patient (1:1)
- A Physician must belong to at 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.)

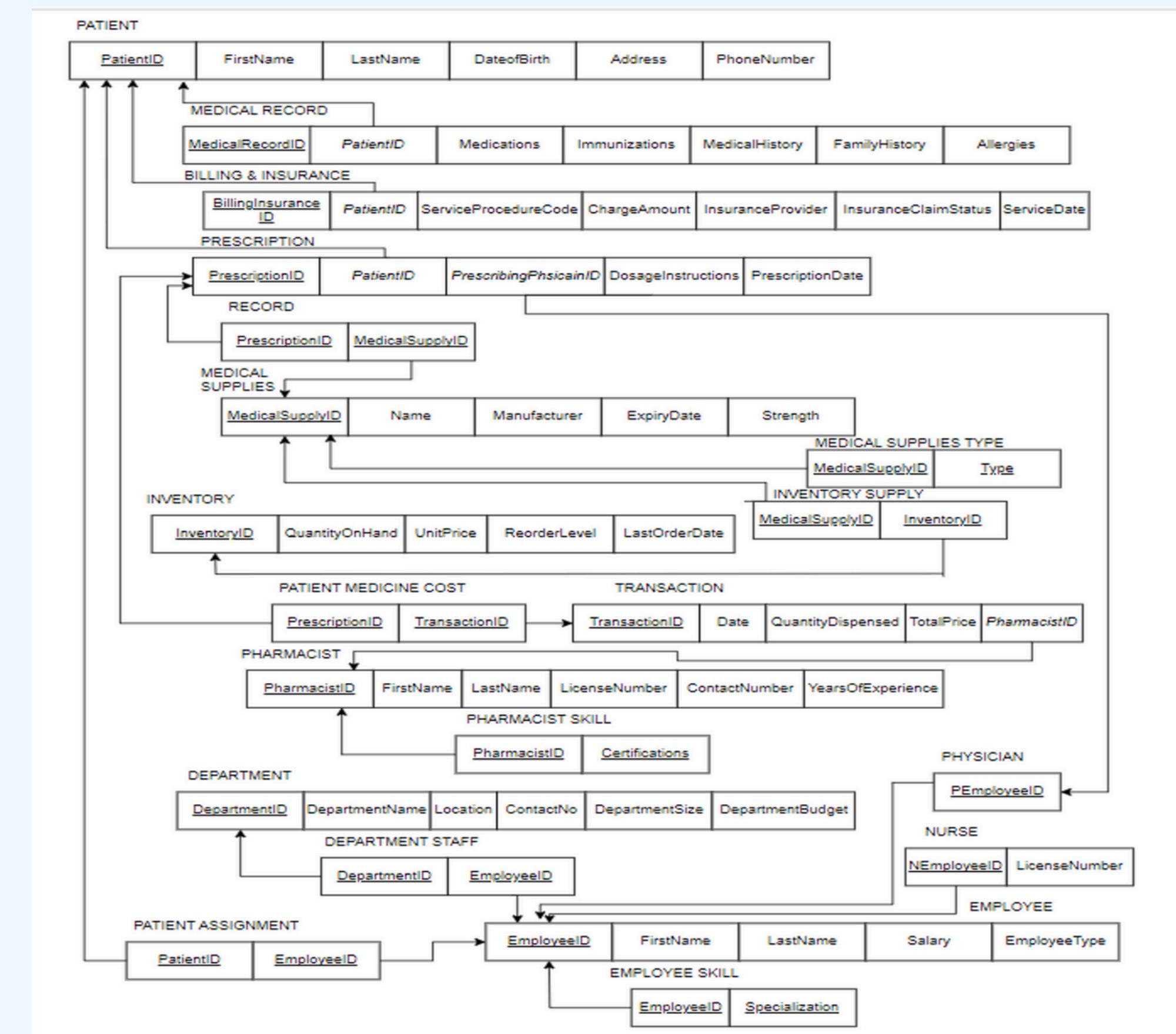
- A Prescription must have one or more MedicalSupplies (1:M)
- A MedicalSupply can be associated with zero or more Prescriptions (1:M)
- A Prescription can have zero or more Transactions (1:M)
- A transaction must be associated with at least one prescription (1:M)
- An inventory must have one or more 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	TotalQuantityDispens...	AverageQuantityAvaila...	InventoryTurnoverRa...
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

