To showcase normalization (1NF, 2NF, and 3NF), let's start by creating a hypothetical \*\*Unnormalized Form (UNF)\*\* for the `HOSPITALDB` database with some redundant entries, then step-by-step normalize it. Each level of normalization removes redundancy or dependency issues.

### Step 1: Unnormalized Form (UNF)

In the \*\*UNF\*\*, there are no strict rules about atomic values, and repeated or grouped data might be present within a single field. Here’s an example:

| HOSPITAL\_ID | HOSPITAL\_NAME | HOSPITAL\_ADD | HOSPITAL\_PHNO | DEPT\_ID | DEPT\_NAME | STAFF\_ID | STAFF\_NAME | STAFF\_PHNO | DR\_ID | DR\_NAME | DR\_PHNO | PAT\_ID | PAT\_NAME | PAT\_PHNO | DATE | TIME | MED\_NAME | COST |

|-------------|---------------|--------------------|---------------|---------|--------------------|----------|-----------------------|--------------|-------|--------------------|-------------|--------|---------------|-------------|------------|--------|--------------------------------|-------|

| 1 | City Hospital | 123 Main St | 123-456-7890 | 101 | Cardiology | 1001 | Dr. Alice Johnson | 555-1111 | 201 | Dr. Bob Smith | 555-2222 | 301 | John Doe | 555-3333 | 2024-11-10 | 10:00 | Aspirin, Ibuprofen | 50.00 |

| 1 | City Hospital | 123 Main St | 123-456-7890 | 102 | Neurology | 1002 | Nurse Lily Anderson | 555-4444 | 202 | Dr. Eva Green | 555-5555 | 302 | Jane Roe | 555-6666 | 2024-11-11 | 11:30 | Paracetamol, Amoxicillin | 80.00 |

| 2 | General Clinic| 456 Maple Ave | 987-654-3210 | 201 | Orthopedics | 1003 | Dr. Charlie Brown | 555-7777 | 203 | Dr. Dave Wilson | 555-8888 | 301 | John Doe | 555-3333 | 2024-11-12 | 09:30 | Ibuprofen, Diclofenac | 45.00 |

In this UNF:

- Data is not atomic: `MED\_NAME` contains multiple medications in a single field.

- Redundancies are present: Hospital, department, staff, doctor, and patient information is repeated across multiple rows.

### Step 2: First Normal Form (1NF)

In \*\*1NF\*\*, all attributes should contain \*\*atomic values\*\*, and there should be no repeating groups or arrays. Let’s break down each repeating group into separate rows.

| HOSPITAL\_ID | HOSPITAL\_NAME | HOSPITAL\_ADD | HOSPITAL\_PHNO | DEPT\_ID | DEPT\_NAME | STAFF\_ID | STAFF\_NAME | STAFF\_PHNO | DR\_ID | DR\_NAME | DR\_PHNO | PAT\_ID | PAT\_NAME | PAT\_PHNO | DATE | TIME | MED\_NAME | COST |

|-------------|---------------|--------------------|---------------|---------|--------------------|----------|-----------------------|--------------|-------|--------------------|-------------|--------|---------------|-------------|------------|--------|--------------|-------|

| 1 | City Hospital | 123 Main St | 123-456-7890 | 101 | Cardiology | 1001 | Dr. Alice Johnson | 555-1111 | 201 | Dr. Bob Smith | 555-2222 | 301 | John Doe | 555-3333 | 2024-11-10 | 10:00 | Aspirin | 25.00 |

| 1 | City Hospital | 123 Main St | 123-456-7890 | 101 | Cardiology | 1001 | Dr. Alice Johnson | 555-1111 | 201 | Dr. Bob Smith | 555-2222 | 301 | John Doe | 555-3333 | 2024-11-10 | 10:00 | Ibuprofen | 25.00 |

| 1 | City Hospital | 123 Main St | 123-456-7890 | 102 | Neurology | 1002 | Nurse Lily Anderson | 555-4444 | 202 | Dr. Eva Green | 555-5555 | 302 | Jane Roe | 555-6666 | 2024-11-11 | 11:30 | Paracetamol | 40.00 |

| 1 | City Hospital | 123 Main St | 123-456-7890 | 102 | Neurology | 1002 | Nurse Lily Anderson | 555-4444 | 202 | Dr. Eva Green | 555-5555 | 302 | Jane Roe | 555-6666 | 2024-11-11 | 11:30 | Amoxicillin | 40.00 |

| 2 | General Clinic| 456 Maple Ave | 987-654-3210 | 201 | Orthopedics | 1003 | Dr. Charlie Brown | 555-7777 | 203 | Dr. Dave Wilson | 555-8888 | 301 | John Doe | 555-3333 | 2024-11-12 | 09:30 | Ibuprofen | 22.50 |

| 2 | General Clinic| 456 Maple Ave | 987-654-3210 | 201 | Orthopedics | 1003 | Dr. Charlie Brown | 555-7777 | 203 | Dr. Dave Wilson | 555-8888 | 301 | John Doe | 555-3333 | 2024-11-12 | 09:30 | Diclofenac | 22.50 |

### Step 3: Second Normal Form (2NF)

In \*\*2NF\*\*, we remove \*\*partial dependencies\*\*—attributes that depend only on part of a composite primary key. To achieve this, split the table based on primary keys.

#### Separate Tables in 2NF

1. \*\*HOSPITAL Table\*\*

| HOSPITAL\_ID | HOSPITAL\_NAME | HOSPITAL\_ADD | HOSPITAL\_PHNO |

|-------------|---------------|--------------------|---------------|

| 1 | City Hospital | 123 Main St | 123-456-7890 |

| 2 | General Clinic| 456 Maple Ave | 987-654-3210 |

2. \*\*DEPT Table\*\*

| DEPT\_ID | DEPT\_NAME | HOSPITAL\_ID |

|---------|--------------|-------------|

| 101 | Cardiology | 1 |

| 102 | Neurology | 1 |

| 201 | Orthopedics | 2 |

3. \*\*STAFF Table\*\*

| STAFF\_ID | STAFF\_NAME | STAFF\_PHNO | DEPT\_ID |

|----------|---------------------|------------|---------|

| 1001 | Dr. Alice Johnson | 555-1111 | 101 |

| 1002 | Nurse Lily Anderson | 555-4444 | 102 |

| 1003 | Dr. Charlie Brown | 555-7777 | 201 |

4. \*\*DOCTOR Table\*\*

| DR\_ID | DR\_NAME | DR\_PHNO | DEPT\_ID |

|-------|---------------|-----------|---------|

| 201 | Dr. Bob Smith | 555-2222 | 101 |

| 202 | Dr. Eva Green | 555-5555 | 102 |

| 203 | Dr. Dave Wilson| 555-8888 | 201 |

5. \*\*PATIENT Table\*\*

| PAT\_ID | PAT\_NAME | PAT\_PHNO |

|--------|------------|-----------|

| 301 | John Doe | 555-3333 |

| 302 | Jane Roe | 555-6666 |

6. \*\*APPOINTMENT Table\*\*

| APPT\_ID | PAT\_ID | DR\_ID | DATE | TIME |

|---------|--------|-------|------------|--------|

| 1 | 301 | 201 | 2024-11-10 | 10:00 |

| 2 | 302 | 202 | 2024-11-11 | 11:30 |

| 3 | 301 | 203 | 2024-11-12 | 09:30 |

7. \*\*PRESC Table\*\*

| PRES\_NO | PAT\_ID | MED\_NAME | DATE | COST |

|---------|--------|-------------|------------|-------|

| 1 | 301 | Aspirin | 2024-11-10 | 25.00 |

| 2 | 301 | Ibuprofen | 2024-11-10 | 25.00 |

| 3 | 302 | Paracetamol | 2024-11-11 | 40.00 |

| 4 | 302 | Amoxicillin | 2024-11-11 | 40.00 |

| 5 | 301 | Ibuprofen | 2024-11-12 | 22.50 |

| 6 | 301 | Diclofenac | 2024-11-12 | 22.50 |

### Step 4: Third Normal Form (3NF)

To achieve \*\*3NF\*\*, we remove \*\*transitive dependencies\*\*, ensuring that non-key attributes are dependent only on the primary key.

In this example, since all tables already only contain attributes that depend on the primary key, we have reached \*\*3NF\*\*. Each table's attributes are either primary keys or directly related to the primary key without transitive dependencies.