Indian Institute of Technology Gandhinagar

Databases
CS 432

Report: Assignment 1

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Description of Database

The assignment aims to conduct an in-depth study of the database requirements of the Central Arcade Dispensary of IIT Gandhinagar and to design an efficient and responsive database system for the same. The first stage of the assignment was to make an E-R Diagram and a relational database to set the project's foundation.

The visits to the dispensary were conducted on the 14th and 28th of January, 2023. On 14th January, Mr Mukesh Sharma was interviewed regarding the database system employed at the dispensary. On 28th January, Mrs Parulben Christian, a pharmacist employed at the dispensary, was interviewed, in addition to Dr K.V. Mehta, the on-visit doctor present at the dispensary.

In these visits, questions were asked to the present pharmacists and doctors at the dispensary, such as

1) The purpose that the database system served for the dispensary.
2) List items and data that the dispensary had to maintain records of.
3) The stakeholders involved in the database system.
4) Current bugs/issues with the current dispensary database system.
5) Any redundancies or overlooked points in the current database system and ways to improve them.
6) Any overall improvements that they would like to see in the database system.

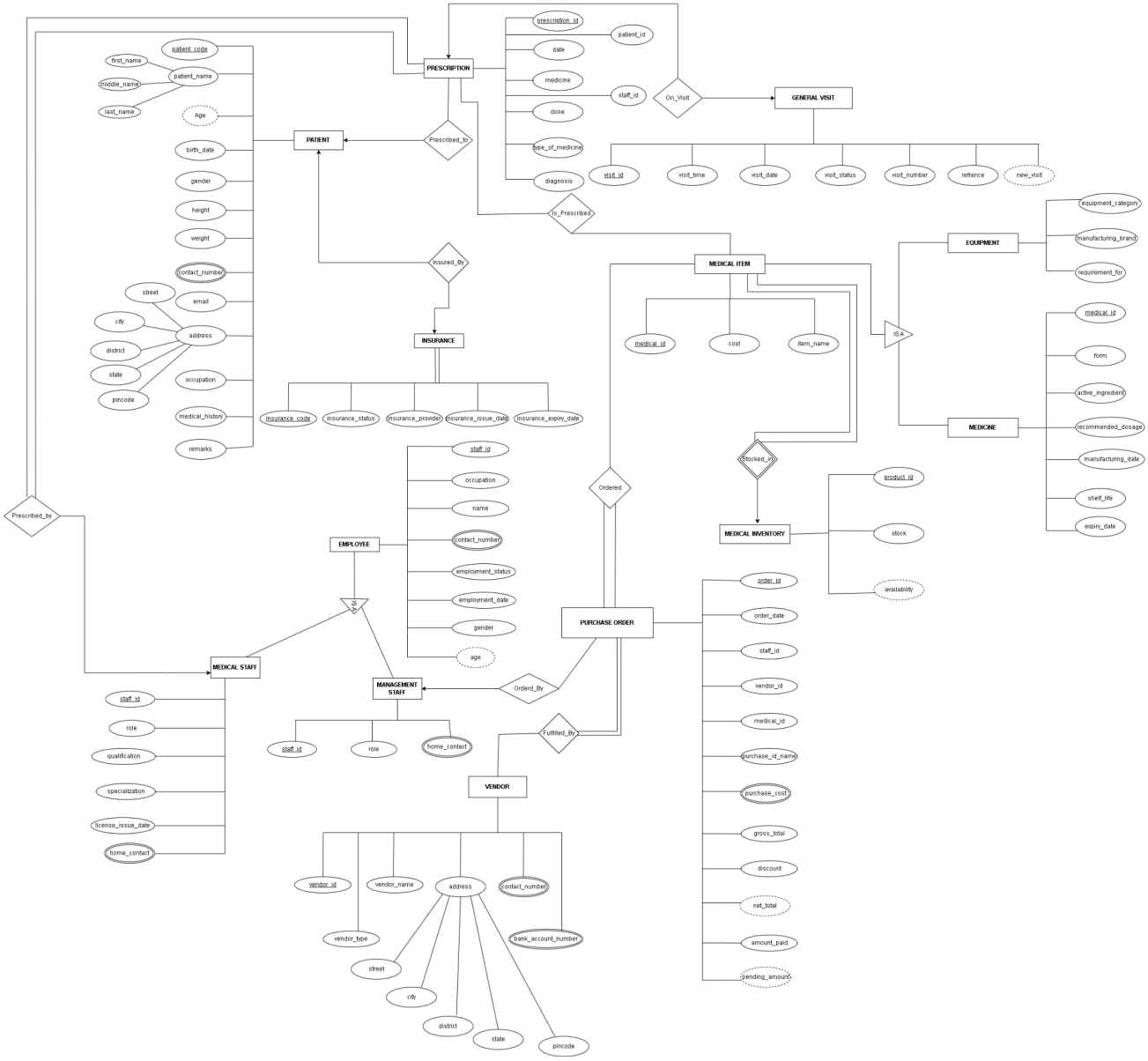
The stakeholders involved were the management staff, doctors, pharmacists, medicine vendors, and patients. The patients mainly constituted the student community at IIT Gandhinagar, the teaching and research faculty, the caretakers and other staff at the residence on the IIT Gandhinagar campus. However, the dispensary regularly receives patients not associated with the institute.

Major requirements of the database system included:

1) Managing patient information. The purpose of maintaining patient records was to study the history of the patient’s diagnosis so that doctors could access any required health details of the patient with minimal effort. The patient information must account for all people visiting the dispensary, whether associated with the institute or not.
2) Generating patient health reports and prescriptions. The database must be able to provide all the required information for the health report and prescription so that a comprehensive health report can be generated.
3) Maintaining records of enrolled staff to help schedule shifts and maintain attendance records to allocate their salaries.

4) Tracking medicine and equipment inventory for timely maintenance and restocking. The status of the medicines (expiry dates, current price) had to be maintained as well, in addition to any other miscellaneous requirements.
5) List of medicine and equipment vendors. Although the dispensary operates on a non-profit basis, a detailed record of the vendors, the transactions and the selling price of the medical items had to be maintained to help secure the required drugs at minimal prices and generate receipts for remuneration.

ER Diagram



Link: [ER-Diagram.drawio]

Entities, Relationships and Attributes used

Entities and attributes involved

1. **Patient** - patient_code, patient_name(first_name,middle_name,last_name), age,Birth_date, gender, height,weight,contact_number, email, address(street, city, district, state, pincode), occupation, medical_history, remarks
2. **Insurance**- insurance_code, insurance_status, insurance_provider, insurance_issue_date, insurance_expiry_date, status
3. **Employee**- staff_id, occupation, name, contact_number, emplomen_status, gender, emplomen_date,
    a. Medical Staff- staff_id, role, qualification, specialization, liscense_issue_date, home_contact
    b. Management Staff- staff_id, role, qualification, specialization, liscense_issue_date, home_contact
4. **Prescription** - prescription_id, date, medicine, dose, type_of_medicine, diagnosis
5. **General Visit**- visit_id, visit_time, visit_date, visit_status, visit_number, reference, new_visit
6. **Medical Product**- medical_id, cost, item_name
    a. Medicine - medical_id, form, active_ingredients, recommended_dosage, manufacturing_date, shelf_life, expiry_date
    b. Equipment- equipment_category, manufacturing_brand, requirment_for
7. **Inventory**- product_id, stock, availability
8. **Purchase Order**- order_id, order_date, staff_id, vendor_id, medical_id, purchase_id_name, purchase_cost, gross_total, discount, net_total, amount_paid, pending_amount
9. **Vendor**- vendor_id, vendor_type, vendor_name, address(street, city, district, state, pincode), contact_number, bank_account_number

Relationships and their cardinalities

Sr. No.	Relationship	Relating Entities	Cardinalities	Participation Constraints
1	Insured_by	Patient → Insurance	One to one	Patient: Partial Insurance: Total
2	Prescribed_to	Prescription → Patient	Many to one	Prescription: Total Medical Staff: Partial
3	On_visit	General visit → Prescription	One to one	General Visit: Total Prescription: Partial
4	Fulfilled_by	Purchase Order → Vendor	Many to Many	Vendor: Partial Purchase Order: Total
5	Stocked_in	Medical Item → Medical Inventory	Many to one	Medical Product: Total Inventory: Total
6	Ordered_by	Management Staff→Purchase Order	One to many	Management Staff: Partial Purchase Order: Total
7	Is_prescribed	Prescription → Medical Item	Many to many	Prescription: Total Medical Product: Partial
8	Ordered	Purchase Order → Medical Item	Many to many	Purchase Order: Total Medical Item: Total
9	Prescribed_by	Medical Staff → Prescription	One to many	Medical Staff: Partial Prescription: Total

Justification

1) **Insured By:**
    a) **Cardinality:** One person can be insured by at most one insurance, and one insurance cannot be shared among people, the cardinality is One to one.
    b) **Participation Constraints:** Not every person coming to the dispensary shall have insurance. Insurance is exclusive to people associated with IIT Gandhinagar or people who have opted for an external insurance agency. This person shall have partial participation. However, each insurance entry has to have a person associated with it. Thus it shall have total participation.
2) **Prescribed_to:**
    a) **Cardinality:** One patient can be issued multiple prescriptions, but one prescription cannot be shared among multiple patients. Thus cardinality is Many to one.
    b) **Participation Constraints:** Medical staff must issue each Prescription, thus total participation. However, it is possible for medical staff not to have issued a prescription if they have newly joined; thus, partial participation.

3) **On_visit:**
    a) **Cardinality:** Since one and only one prescription can be issued during a general visit, the relation is one to one.
    b) **Participation Constraints:** Every general visit may not lead to a prescription, so partial participation in prescription. However, a prescription will only be issued after a general visit. Thus, it will have total participation.

4) **Fulfilled_by:**
    a) **Cardinality:** According to the dispensary information, a single purchase order can involve multiple vendors. So, one vendor can be sent multiple purchase orders, and there can be many vendors for a single order. Thus it is a many-to-many relationship.
    b) **Participation Constraints:** All vendors need not have a purchase order associated with them, as we might just maintain a record of vendors. Thus vendors have partial participation. However, Each purchase order must have an associated vendor, and thus it has total participation.
5) **Stocked_in:**
    a) **Cardinality:** Management staff can order many products, but all of which will be stored in inventory. So this is many to one relationship.
    b) **Participation:** All the purchased products will be stored in inventory. So there is total participation from both entities.
6) **Ordered_by:**

a) **Cardinality:** At the dispensary, the orders are sent by a single person at a time from the management staff. However, a single staff member can send multiple orders, and thus it is a one-to-many relationship.
b) **Participation:** The purchase order has to be issued by at least one staff member, and thus it has total participation. However, a purchase order must not be issued by every staff member, and thus the staff members partially participate.

7) **Is_prescribed:**
   a) **Cardinality:** A single prescription can contain multiple medical items, and multiple different prescriptions can issue a single medical item. Thus the relation is many to many.
   b) **Participation:** A prescription need not include medicines. For example, physiotherapy prescriptions involve just a list of exercises. Thus, each prescription doesn't need to have a medicine, and so medicines have partial participation. However, medicines can only be issued after a prescription, so each prescription must have at least one medicine. Thus it has total participation.
8) **Ordered:**
   a) **Cardinality:** One medical item can be ordered in many different purchase orders, while a single purchase order can contain multiple medical items. Thus the relation is many to many.
   b) **Participation:** Every purchase order must be associated with a medical item, as it could not be empty.
9) **Prescribed_by:**
   a) Cardinality: One medical staff can issue multiple prescriptions, however every prescription has to be issued by a single medical staff. Thus the relation is one to many.
   b) Participation Constraints: Every prescription has to be issued by a medical staff, however there is a chance that there is a new staff member that has not issued a prescription. Thus, the medical staff has partial participation, while the prescription has total participation.

Relational Schema

For Relationship sets, the following rules were followed for the relational schema:

- For an ER diagram with a binary many-to-many relationship set, the union of the primary-key attributes from the participating entity sets is taken as the primary key.
- For a binary one-to-one relationship set, the primary key of any one of the entity sets can be chosen as the primary key.
- For a binary many-to-one or one-to-many relationship set, the primary key of the entity set on the "many" side of the relationship is considered the primary key.

Relationship sets used:

Insured_by (patient_code, insurance_code)

Stocked_in (medical_id, product_id)

On_visit (visit_id,prescription_id)

Prescribed_by (prescription_id, staff_id)

Ordered_by(order_id, staff_id)

Ordered(order_id, medical_id)

Fulfilled_by(order_id, vendor_id)

Prescribed_to (prescription_id, patient_code)

is_prescribed(prescription_id, medical_id):

Explanation:

Insured_by is a one-to-one relationship with one descriptive attribute as status, so primary key of this relation would be the primary key of either of the participating entity sets. In this case, we have taken the patient code as the primary key.

Stocked_in is a binary many-to-one relationship. So the primary key of the entity set on the "many" side of the relationship set serves as the primary key. Here "medical item" is on many sides.

On-visit is a binary one-to-one relationship. the primary key of either entity set can be chosen as the primary key. The choice can be made arbitrarily. We are choosing "visit_id" as the primary key.

Prescribed_by is a binary one-to-may relationship. So the primary key for this relation would be the primary key of the entity set on the many sides, which means "prescription_id" will serve as the primary key

Ordered_by is a binary one-to-many relationship, so the primary key for this relation would be the primary key of the entity set on the many sides, which means ordered_id will serve as the primary key

Ordered is a binary many-to-many relationship. So the union of the primary-key attributes from the participating entity sets becomes the primary key.

Fulfilled_by is a binary many-to-many relationship. So the union of the primary-key attributes from the participating entity sets becomes the primary key.

Prescribed_to is a binary one-to-many relationship, so the primary key of the entity set on the "many" side of the relationship set serves as the primary key. Here "prescription" is on many sides.
Is_prescribed is a binary many-to-many relationship, so the union of the primary-key attributes from the participating entity sets becomes the primary key.

Entity Sets

Note: FK stands for Foreign key

Patient (patient_code, first_name, middle_name, last_name, age, birth_date, gender, height, weight, contact number, email, street, city, district, state, Pincode, occupation, medical_history, remarks, insurance_code (FK) **)**

Patient_contact_number (patient_code (FK), contact_number **)**

Note:For multivalued attributes, when forming relational schema, the convention is to form separate relational schema for the entity set containing multivalued attributes, with the primary key equal to the primary key of the original entity set and attribute having the multivalued characteristic. Reference

Prescription (prescription_id, patient_code (FK), staff_id (FK), date, medicine, type_of_medicine **)**

In the Prescription entity set, presecription_id ensures that each record in the table is uniquely identified. Therefore, it is a primary key.
Also, patient_code and staff_id are the foreign keys in this entity set as they are the primary keys of the Patient and Medical_staff entity sets, respectively.
In this entity set, the Date is NOT NULL.

General_visit (visit_id, prescription_id (FK), visit_time, visit_date, visit_status, visit_number, reference, new_visit **)**

In the General_visit entity set, visit_id ensures that each record in the table is uniquely identified. Hence, a primary key.

Also, presecription_id is the foreign key in this entity set as it is the primary key Prescription entity set.
In this entity set, the rest of the attributes are NOT NULL.
Moreover, the visit_status attribute enforces a CHECK constraint on the data that in a column that the data value can only be either “Yes” or “No”.

Insurance (insurace_code, insurance_status, insurance_provider, insurace_issue_date, insurace_expiry_date**)**

In the Insurance entity set, insurance_code ensures that each record in the table is uniquely identified. Hence, a primary key.
In this entity set, the rest of the attributes are NOT NULL.
Moreover, the insurance_status attribute enforces a CHECK constraint on the data that in a column that the data value can only be either “Yes” or “No.”

Medical_inventory (product_id, stocks, availability**)**

In the Medical_inventory entity set, product_id ensures that each record in the table is uniquely identified. Hence, a primary key.
In this entity set, the rest of the attributes are NOT NULL.
Moreover, the availability attribute enforces a CHECK constraint on the data that in a column that the data value can only be either “Yes” or “No”.
Furthermore, stocks attribute enforces a CHECK constraint on the data that in a column that the input data value can only be a non-negative integer.

Equipment (medical_id, cost, item_name, equipment_category, manufacturing_brand, requirement_for, staff_id (FK), vendor_id (FK) **)**

In the Equipment entity set, medical_id ensures that each record in the table is uniquely identified. Hence, a primary key.
Also, staff_id and vendor_id are the foreign keys in this entity set as they are the primary keys of the Medical_staff and Vendor entity sets, respectively.
In this entity set, rest of the attributes are NOT NULL.
Moreover, the cost attribute enforces a CHECK constraint on the data that in a column that the data value can only be a non-negative float.

Medicine (medical_id, cost, item_name, form, active_ingredients, recommended_dosage, manufacturing_date, shelf_life, expiry_date, staff_id(FK), vendor_id(FK) **)**

In the Medicine entity set, medical_id ensures that each record in the table is uniquely identified. Hence, a primary key.
Also, staff_id and vendor_id are the foreign keys in this entity set as they are the primary keys of the Medical_staff and Vendor entity sets, respectively.
In this entity set, the rest of the attributes are NOT NULL.
Moreover, the cost attribute enforces a CHECK constraint on the data that in a column that the data value can only be a non-negative float.

Vendor (vendor_id, order_id (FK), vendor_type, vendor_name, street, city, district, state, pincode, bank_account_number **)**

In the Vendor entity set, vendor_id ensures that each record in the table is uniquely identified. Hence, a primary key.
Also, order_id is the foreign key in this entity set as it is the primary key of the Purchase_order entity set.
In this entity set, rest of the attributes are NOT NULL.
Moreover, cost attribute enforces a CHECK constraint on the data that in a column that the data value can only be non-negative float.

Vendor_contacts (vendor_id (FK), contact**)**

Purchase_order (order_id, order_date, staff_id (FK), vendor_id (FK), medical_id (FK), purchase_cost, gross_total, purchase_id_name, discount, net_total, amount_paid, pending_amount)

In the Purchase_order entity set, order_id ensures that each record in the table is uniquely identified. Hence, a primary key.
Also, staff_id, vendor_id, medical_id are the primary keys in this entity set as it is the primary keys of the Medical_staff, Vendor, and Medicine entity set respectively.
In this entity set, rest of the attributes are NOT NULL.

Moreover, net_total, gross_total, purchase_cost, amount_paid, discount attributes enforce a CHECK constraint on the data that in a column that the data value can only be a non-negative float.

Medical_staff (staff_id, role, qualification, specialization, liscence_issue_date, home_contact)

In the Medical_staff entity set, staff_id ensures that each record in the table is uniquely identified. Hence, a primary key.
In this entity set, rest of the attributes are NOT NULL.
Moreover, home_contact attribute enforces a CHECK constraint on the data that in a column that the data value can only be a non-negative integer.

Work Distribution

Team Member	Contribution
1. Aishwarya Omar	Conversion of ER diagram to relational schema, mapping cardinalities, Description of the database system, Relationship justification
2. Akshat Shrivastava	Dispensary visit and enquiry details, Identification of entity sets, attributes and relationships for ER diagram, Report compilation
3. Amaan Ansari	Dispensary visit and enquiry details, Identification of entity sets, attributes and relationships for ER diagram
4. Mahesh Dange	Created ER diagram, Dispensary visit and enquiry details, Description of the database system, and Report proof-reading
5. Dhakad Bhagat Singh	Dispensary visit and enquiry details, Identification of entity sets, attributes and relationships for ER diagram, Report documentation
6. Govardhan Ingale	Dispensary visit and enquiry details, Identification of entity sets, attributes and relationships for ER diagram, Report formatting
7. Ronak Hingonia	Conversion of ER diagram to relational schema, mapping cardinalities
8. Ojas Washimkar	Dispensary visit and enquiry details, Identification of entity sets, attributes and relationships for ER diagram, Report proofreading
9. Yash Adhiya	Conversion of ER diagram to relational schema, mapping cardinalities
10. Yash Kokane	Dispensary visit and enquiry details, mapping cardinalities, Description of the database system, Report documentation, Relationship justification
11. Shubham Kumar	Created ER diagram, mapping cardinalities, Description of the database system, Report proof-reading

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