University
Mohammed VI
Polytechnic

College of Computing

Deliverable #: Title of Lab/Project here (e.g.: Conceptual Design ....)

Data Management Course

UM6P College of Computing

Professor: Karima Echihabi **Program:** Computer Engineering

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Team Information

Team Name	Sekel
Member 1	MAHDAD Anass
Member 2	MOUJAHED Rania
Member 3	NANA Mohammed Idriss
Member 4	LAGHMAM Haitam
Member 5	OUAZZANI Youssef
Member 6	LABRIGUI Abdelmoughit
Repository Link	`https://github.com/Data-Project-Hierarchy/Data-Project`

1 Introduction

We need to create a database model to process and manage the usual multiple tasks needed in real-world organizations, such as **The Moroccan National Health Services (MNHS)**, which manages *patients, staff, hospitals, departments, appointments, prescriptions, medications, insurance, billing, and emergencies.* This deliverable covers the conceptual design phase, focusing on identifying entities, attributes, relationships, and constraints, as well as creating an ER diagram to develop a high-level description of the data and its constraints.

2 Requirements

Requirements analysis:

- **Patients:** identified by their **CIN** with attributes (full name,date of birth,sex,blood group,phone).Can have multiple contact locations (street, city, province, postal code, optional phone).
- **Staff:** work in departments , interact with patients , divided into:
  - Practitioners: license number, specialty.
  - Caregiving staff: grade, ward.
  - Technical staff: equipment, certifications.
- **Hospitals & Departments:** Hospitals have name, city, region. The departments belong to one hospital. Staff are assigned to departments.
- **Appointments:** record date,time,reason and status(Scheduled,Completed,Canceled).Each links exactly one patient to one staff and occurs in a department.
- **Prescriptions & Medications:** a prescription (date, staff, patient) can include multiple medications (with dosage, duration). Medications possesses **DrugID**, name, form, strength, manufacturer, therapeutic class, and active ingredient.
- **Insurance & Billing:** different coverage types: CNOPS,CNSS,RAMED. A patient may have several insurances. Bills are linked to one insurance and tied to clinical activities (consultations/prescriptions).
- **Emergencies:** links patients and optionally the staff member who handled (triage / attendance) and store admission timestamp, triage level, result.
- **Pharmacy Inventory:** track each hospital medication : quantity, recorder level, last restock timestamp and unit price per medication.

3 Methodology

- **Patient & Location:**
  - Linked through lives relation.
  - Each Patient may have a contact location **(1 to Many)**.

  - Each location may have an associated patient **(0 to many)**.

- **Staff:** We use an ISA structure because of the 3 types of staff:
  - Practioners.
  - Caregiving staff.
  - Technical staff.

- **Appointments & [Patient,Staff]:** considered as a weak entity of the couple (patient,staff)
  - We link appointments to a combination of one patient and one staff member through an **aggregation**, using the relation links **1 to 1**.
  - We chosed to link patient and staff via interacts to make the aggregation possible.
  - A combination of a patient and a staff member may be linked to an appointment.

- **Staff & Department:**
  - Linked through works relation.
  - Each staff member works in at least one department **(1 to Many)**.
  - Each department may have staff members working for it **(0 to Many)**.

- **Hospital & Department:**
  - Linked through belong relation.
  - Each department must belong to only one hospital **(1 to 1)**.
  - Each hospital can have numerous departments **(0 to Many)**.

- **Appointments & Departments:**
  - Linked through occurs relation.
  - Each appointment occurs in exactly one department **(1 to 1)**.
  - A department may have appointments **(0 to Many)**.

- **Prescription:** weak entity with patient as an owner
  - We chose to model prescription as an entity rather than as a relationship , because a prescription is also linked to medications. If it were modeled only as a relationship, this would lead to redundancy.

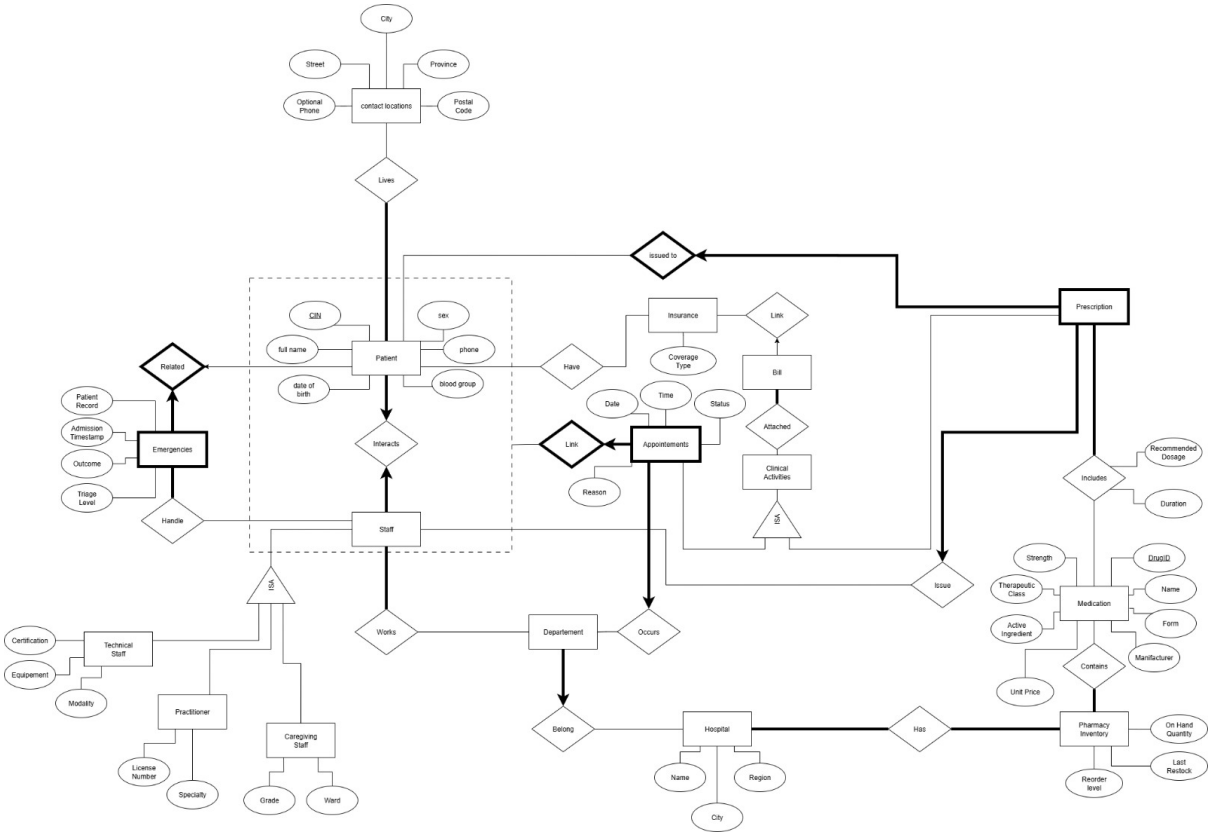
- **Prescription & Patient:**
  - Linked through issued to relation.
  - Each patient can have a number of prescriptions liked to it **(0 to Many)**.
  - Each prescription must include a patient and can not exist without it **(1 to 1)**.

- **Prescription & Staff:**
  - Linked through issue relation.
  - Each staff can issue many prescriptions **(0 to Many**.
  - Each prescription is issued by one staff member **(1 to 1)**.
- **Prescription & Medication:**
  - Linked through includes relation.
  - Each prescription includes at least one medicament **(1 to Many)**.
  - Each medication may be included in many prescriptions **(0 to Many)**.
- **Patient & insurance:**
  - Linked through have relation.
  - Each patient can have a number of insurances **(0 to Many)**.
  - Each insurance can have a number of patients linked to it **(0 to Many)**.
- **Bill & Insurance:**
  - Linked through link relation.
  - A bill is linked to at most one insurance **(0 to 1)**.
  - Each insurance may have a number of bills **(0 to Many)**.
- **Clinical activities:** we used an ISA structure:
  - If we had separated appointment from prescription, we would have lost the ability to express the rule that each bill must be linked to at least one clinical activity (either appointment or prescription). By introducing the superclass clinical activities, we can directly state this business rule: every Bill must be attached to a clinical activity : some bills are generated after consultations (considered equivalent to appointments here), others after prescriptions.
- **Medication & Pharmacy inventory:**
  - Linked through contains relation.
  - Each medication may appear in the pharmacy inventory of the hospital **(0 to Many)**.
  - Each pharmacy inventory contains at least one medication **(1 to Many)**.
- **Hospital & Pharmacy inventory:**
  - Linked through has relation.
  - Each hospital has at least a pharmacy inventory and vice versa **(1 to Many)**.
- **Emergencies:** weak entity with patient as an owner because there is no emergency without a patient.
- **Patient & Emergency:**

- Linked through related relation.
- Each patient can have a number of emergencies linked to it **(0 to Many)**.
- Each emergency must include only one patient (based on the patient record attribute) and can not exist without it **(1 to 1)**.

- **Staff & Emergency:**
  - Linked through handle relation.
  - Each staff can handle a number of emergencies **(0 to Many)**.
  - Each emergency requires the existence of at least one staff member **(1 to Many)**.

4 Implementation & Results



5 Discussion

- **Challenges faced** :
  - The first challenge was identifying entities, relationships, and a weak entities. Some entities may be considered weak based on our understanding.
  - The second challenge involved chosing the appropriate type of relationship according to the requirements. Many relationships include three entities, so we discussed whether to use a ternary relationship, aggregation (Appointment), or simply multiple binary relationships (Emergency, Pharmacy inventory).

  - We also encountered requirements that were difficult to represent clearly. The usual ways to translate them into the ER diagram (through basic relationships) weren't enough and we had to use ISA structure (Bills to Clinical Activities).

- Observations : We believe the requirements could be more precise. Sometimes, the information provided is incomplete or ambiguous, which leads to multiple interpretations and causes confusion, like in a real world scenario !

- Lessons learned. We learned that designing a relationship diagram depends heavily on our understanding of the requirements. Different interpretations can lead to different designs for the same concept. Sometimes, requirements lack precision, so we must rely on real-world knowledge to remain accurate. Before choosing a representation, it is important to ask key questions to ensure the design reflects reality accurately.

6 Conclusion

In conclusion, through this lab, we applied conceptual design to **The Moroccan National Health Services (MNHS)** scenario. This work wasn't just about translating intructions into the ER diagram, but involved identifying the entities, the attributes, relationships, along with the nature of each link. This lab is crucial for us to be able to implement it fully, since mistakes in the conceptual design lead to worst mistakes further down the road. Overall, we have successfully created the backbone of our DBMS, the ER model will impact the data efficiency, integrity, and will hopefully reduce our application development time.