Faculdade de Engenharia da Universidade do Porto

Sistema de organização para os Hospitais de Portugal

ENTREGA II

Mestrado Integrado em Engenharia Informática e Computação

Bases de Dados 2020/2021

Grupo 702

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Context

The objective is to store information about the hospitals of Portugal.

For each hospital we need to know its name, the region it is in (Norte, Centro, Lisboa e Vale do Tejo, Alentejo, Algarve, Açores or Madeira), its opening date and its address. Hospitals consist of different units (pediatrics, cardiology, obstetrics, among others) and have health professionals.

Units have a name, an opening date, and a phone number through which they can be contacted (9-digit number). They also have health professionals specifically assigned to them, being one of them head of the unit, and have different occurrences.

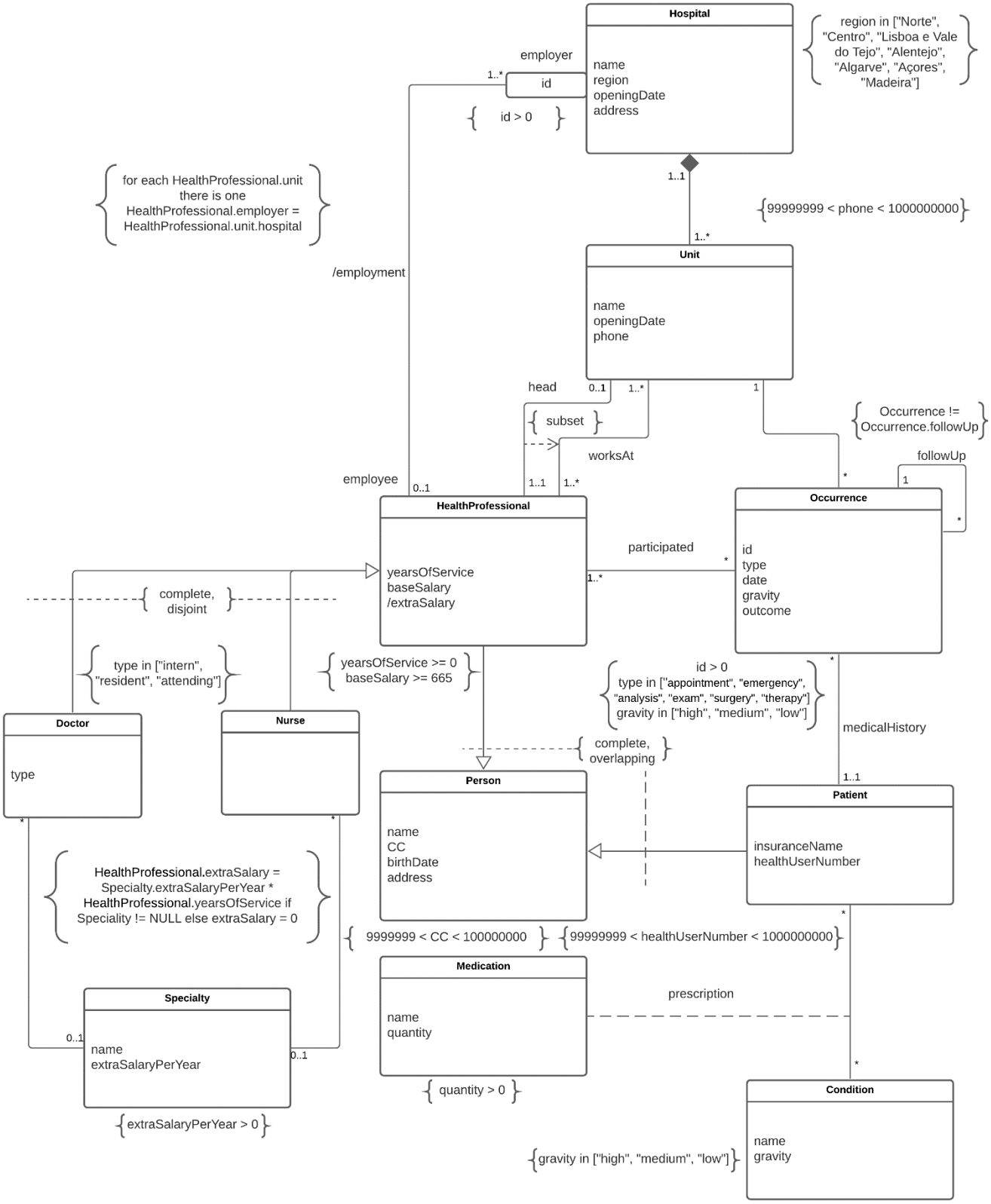
Occurrences are any kind of an event that a patient might partake in an hospital, be it a surgery or a common appointment, where they need some form of medical attention. These have a unique id, a type (appointment, emergency, analysis, exam, surgery, or therapy), a date, some type of gravity (high, medium or low) and an outcome. Some occurrences can lead to other occurrences as a follow up and all occurrences have at least one health professional assigned to them.

Each person has a name, CC (8-digit number), birth date, and can be either a health professional or a patient (both is possible too). Patients are further described by a health user number (9-digit number) and their insurance's name, which indicates to which degree their expenses are covered. Patients also have medical records, that list every occurrence they had to undertake. They might also have some conditions (like allergies), consisting of the unique name of the condition associated with its gravity (high, medium, or low). For each condition they have, a patient may be prescribed some form of medication, described by its name and the specified quantity for the patient.

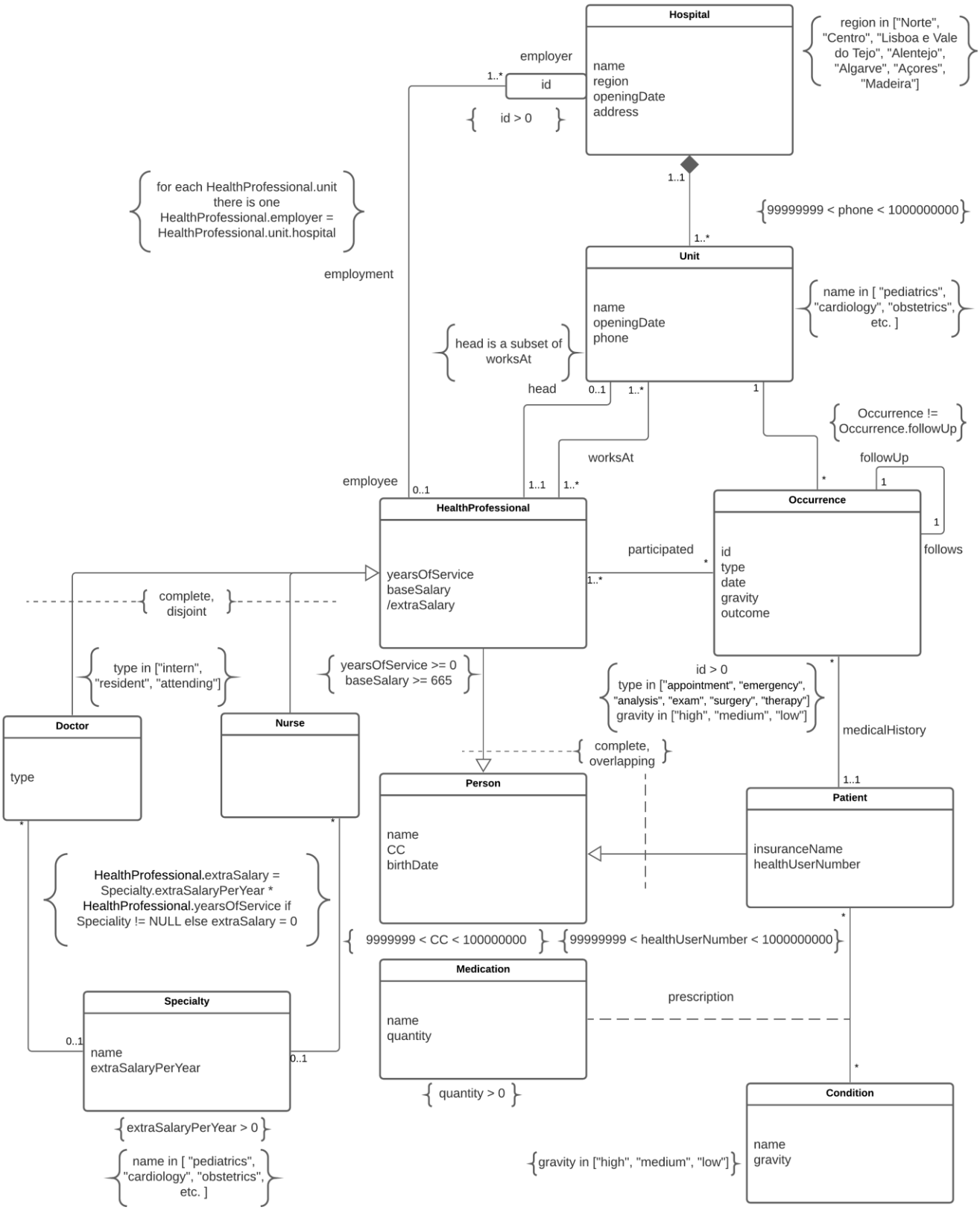
Health professionals are further described by their years of service, base salary, and extra salary (depending on if they have a specialty or not). Health professionals can be one of two: either a nurse or a doctor (not possible to be both); doctors can be either interns, residents or attending physicians. Both doctors and nurses can have at most one specialty, which has a name and the extra salary per year of service it provides.

Health professionals can work in more than one hospital and have a unique id (for each hospital) that helps identifying them as a member of the hospital's staff. Furthermore, health professionals can work in more than one unit but can only be the head of at most one.

UML Conceptual Model



Revised UML Conceptual Model



Relational Model

Hospital (name, region, openingDate, address)

- name -> region, openingDate, address
- address -> name

Unit (name, hospital -> Hospital, openingDate, phone, head -> HealthProfessional)

- name, hospital -> openingDate, phone, head
- phone, hospital -> name
- head -> name, hospital

Person (name, CC, birthDate)

- CC -> name, birthdate

Patient (CC->Person, insuranceName, healthUserNumber)

- CC -> insuranceName, healthUserNumber
- healthUserNumber -> CC

HealthProfessional (CC->Person, yearsOfService, baseSalary)

- CC -> yearsOfService, baseSalary

Note: /extraSalary from UML conceptual model will be implemented using the view concept in the third delivery.

EmployedAt (healthProfessional->HealthProfessional, hospitalName->Hospital, id)

- heatlhProfessional, hospitalName -> id
- id, hospitalName -> healthProfessional

WorksAt (healthProfessional->HealthProfessional, unitName->Unit, hospitalName->Unit)

Ocurrence (id, type, date, gravity, outcome, unit -> Unit, patient->Patient, followUp->Ocurrence)

- id -> type, date, gravity, outcome, unit, patient, followUp
- patient, date -> id, type, date, gravity, outcome, unit, followUp

Participated (ocurrence->Ocurrence, healthProfessional-> HealthProfessional)

Condition (name, gravity)

- name -> gravity

Prescription (patient->Patient, condition->Condition, drugName, quantity)

- patient, condition -> name, quantity

Doctor (healthProfessionalCC->HealthProfession, type, specialty-> Specialty)

- healthProfessionalCC -> type, specialty

Nurse (healthProfessionalCC->HealthProfessional, specialty-> Specialty)

- healthProfessionalCC -> specialty

Specialty (name, extraSalaryPerYear)

- name -> extraSalaryPerYear

Note on generalization involving HealthProfessional, Doctor and Nurse: although a disjoint generalization usually calls for an Object-Oriented approach, the E/R style was adopted to avoid repeating relations that were, instead, only implemented for HealthProfessional, thus removing some redundancy.

Functional dependencies analysis and Normal Forms

All relations are in **BCNF** because for each FD $\bar{A}$ -> B, either the FD is trivial or $\bar{A}$ is a super key of the relation. This section covers this analysis for all relations.

Hospital:
{name} is primary key and {address} is a super key: {address}$^+$ = {name, region, openingDate, address}.

Unit:
{name, hospital} is primary key and both {phone, hospital} and {head} are super keys: {phone, hospital}$^+$ = {head}$^+$ = {name, hospital, openingDate, phone, head}.

Person:
{CC} is primary key.

Patient:
{CC} is primary key and {healthUserNumber} is a super key: {healthUserNumber}$^+$ = {CC, insuranceName, healthUserNumber}.

HealthProfessional:
{CC} is primary key.

EmployedAt:
{healthProfessional, hospitalName} is primary key and {id, hospitalName} is a super key: {id, hospitalName}$^+$ = {healthProfessional, hospitalName, id}.

WorksAt:
There are only trivial FD's.

Ocurrence:
{id} is primary key and {patient, date} is a super key: {patient, date}$^+$ = {id, type, date, gravity, outcome, unit, patient, followUp}.

Participated:
There are only trivial FD's.

Condition:
{name} is primary key.

Prescription:
{patient, condition} is primary key.

Doctor:
{healthProfessionalCC} is primary key.

Nurse:
{healthProfessionalCC} is primary key.

Specialty:

{name} is primary key.

Implemented constraints

Hospital:

1. A hospital must have a name.
    - NOT NULL

2. Two hospitals cannot have the same name.
    - PRIMARY KEY

3. A hospital must belong to one of the following regions: Norte, Centro, Lisboa e Vale do Tejo, Alentejo, Algarve, Açores or Madeira.
    - CHECK
    - NOT NULL

4. The opening date of a hospital, if known, must come before the current date.
    - CHECK

5. A hospital must have an address.
    - NOT NULL

6. Two hospitals cannot have the same address.
    - UNIQUE

Unit:

1. A unit's name must be one of the following: Cardiology, Pediatrics, Neurology, Obstetrics, Urgencies, Intensive Care, Radiology, Oncology, General Medicine, Allergology, Internment, Dermatology, Urology, Gynaecology, or Psychiatry.
    - CHECK
    - NOT NULL

2. A unit belongs to one hospital.
    - FOREIGN KEY
    - NOT NULL

3. The opening date of the unit, if known, must come before the current date.
    - CHECK

4. The phone number of a unit must be a 9-digit natural number.
    - CHECK
    - NOT NULL

5. Two units cannot have the same phone number.
    - UNIQUE

6. Two units cannot have the same head.
    - UNIQUE

7. Two units cannot have both the same name and hospital.
    - PRIMARY KEY

Person:

1. Two persons cannot have the same cc number.
    - PRIMARY KEY

2. The cc of a person must be an 8-digit natural number.
    - CHECK
    - NOT NULL

3. A person must have a name.
    - NOT NULL

4. The birthdate of a person must come before the current date.
    - CHECK

5. A person must have a birthdate.
    - NOT NULL

Patient:

1. Two patients cannot have the same cc number.
    - PRIMARY KEY

2. A patient must be a person.
    - FOREIGN KEY
    - NOT NULL

3. Two patients cannot have the same health user number.
    - UNIQUE

4. The health user number is a 9-digit natural number.
    - CHECK

5. A patient must have a health user number.
    - NOT NULL

HealthProfessional:

1. Two health professionals cannot have the same cc number.
    - PRIMARY KEY

2. A health professional must be a person.
    - FOREIGN KEY
    - NOT NULL

3. A health professional must have years of service.
    - NOT NULL

4. Years of service must be a non-negative integer number.
    - CHECK

5. A health professional must have a base salary.
    - NOT NULL

6. The base salary must be a natural number greater or equal than 665 (minimum wage).
    - CHECK

EmployedAt:

1. healthProfessional must be the cc number of a Health Professional.
    - FOREIGN KEY
    - NOT NULL

2. hospitalName must be the name of a hospital.
    - FOREIGN KEY
    - NOT NULL

3. EmployedAt must have an id.
    - NOT NULL

4. A health professional can only be employed one time per hospital.
    - PRIMARY KEY

5. The id and hospital name identify the name of the health professional.
    - UNIQUE

WorksAt:

1. healthProfessional must be the cc number of a Health Professional.
    - FOREIGN KEY
    - NOT NULL

2. unitName must be the name of a unit.
    - FOREIGN KEY
    - NOT NULL

3. hospitalName must be the name of a hospital.
    - FOREIGN KEY
    - NOT NULL

4. There cannot be two equal instances of worksAt.
    - PRIMARY KEY

Ocurrence:

1. Two Ocurrences cannot have the same id.
    - PRIMARY KEY

2. If an id is not given, it increments itself.
    - AUTOINCREMENT

3. typeOfOcurrence must be one of the following: appointment, surgery, emergency, analysis, exam, or therapy.
    - CHECK
    - NOT NULL

4. Must have a date and it must come before the present date.
    - CHECK
    - NOT NULL

5. gravity must be one of the following: high, medium, or low.
    - CHECK
    - NOT NULL

6. patient must be a Patient.
    - FOREIGN KEY
    - NOT NULL

7. There cannot be two Ocurrences with the same followUp.
    - UNIQUE

8. Can have a followUp.
    - FOREIGN KEY

9. An Occurrence cannot have itself as a followUp.
    - CHECK

10. Two Ocurrences cannot have the same patient and date.
    - UNIQUE

11. unit must belong to the hospital and hospital must be a Hospital.
    - FOREIGN KEY

Participated:

1. ocurrence must be a Ocurrence.
    - FOREIGN KEY
    - NOT NULL

2. HealthProfessional must be a HealthProfessional.
    - FOREIGN KEY
    - NOT NULL

3. Two Participations cannot have both the same ocurrence and healthProfessional.
    - PRIMARY KEY

Condition:

1. Two conditions cannot have the same name.
    - PRIMARY KEY

2. Must have a name.
    - NOT NULL

3. gravity must be one of the following: high, medium, or low.
    - CHECK
    - NOT NULL

Prescription:

1. Prescription's patientCC must be the cc of a Patient.
    - FOREIGN KEY
    - NOT NULL

2. Prescription's condition must be the name of a Condition.
    - FOREIGN KEY
    - NOT NULL

3. Prescription's quantity, if not null, must be a positive integer.
    - CHECK

4. If either drugName or quantity is null, the other must also be null.
    - CHECK

Doctor:

1. No two doctors can have the same healthProfessionalCC.
    - PRIMARY KEY

2. Doctor's healthProfessionalCC must be the cc of a HealthProfessional.
    - FOREIGN KEY
    - NOT NULL

3. Doctor's type must be one of the following: intern, resident or attending.
    - CHECK
    - NOT NULL

4. Doctor's type is intern by default.
    - DAFAULT

5. Doctor's specialty must be the name of a Specialty.
    - FOREIGN KEY
    - NOT NULL

6. Doctor does not have a specialty by default.
    - DEFAULT

Nurse:

1. No two nurses can have the same healthProfessionalCC.
    - PRIMARY KEY
2. Nurse's healthProfessionalCC must be the cc of a HealthProfessional.
    - FOREIGN KEY
    - NOT NULL

3. Nurse's specialty, if exists, must be the name of a Specialty.
    - FOREIGN KEY

4. Nurse does not have a specialty by default.
    - DEFAULT

Specialty:

1. No two specialties can have the same name.
    - PRIMARY KEY

2. Specialty name must be one of the following: Cardiology, Pediatrics, Neurology, Obstetrics, Urgencies, Intensive Care, Radiology, Oncology, General Medicine, Allergology, Internment, Dermatology, Urology, Gynaecology, or Psychiatry.
    - CHECK
    - NOT NULL

3. Specialty extraSalaryPerYear must be a positive value.
    - CHECK

4. Specialty extraSalaryPerYear is 1 by default.
    - DEFAULT

Not implemented constraints

1. For each unit where a HealthProfessional works, there is an employer equal to the hospital's unit - needs a trigger to be implemented.

2. head is a subset of worksAt - needs a trigger to be implemented.

3. The generalization involving Doctors, Nurses and HealthProfessionals being complete and disjoint - disjoint needs a trigger to be implemented.

4. The generalization involving HealthProfessionals, Patients and Persons being complete and overlapping.

5. The extraSalary of a HealthProfessional being equal to his/her speciality extraSalaryPerYear * his/her years of service, or equal to 0, if no speciality is attributed – needs the concept of view to be implemented.

6. date of the followUp being posterior the first ocurrence's date - needs a trigger to be implemented.

7. openingDate of a unit being equal or posterior to its hospital openingDate - needs a trigger to be implemented.

8. Enforcing that an hospital has at least one unit - needs a trigger to be implemented.

9. A healthProfessional being unable to participate in an occurrence where he/she is also the patient - needs a trigger to be implemented.

10. The yearsOfService of a HealthProfessional being inferior to currenteDateYear - birthDateYear - 25, which would imply that a HealthProfessional may only start to work at 25 and that he/she would only be able to have as many years of service as years that have passed since their 25th birthday.