Databases
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Vaccination Monitoring Programme

A Research and Application on a Minimal Vaccination Campaign Database

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1. Context

Nowadays, vaccination presents itself as one of the most critical problems in modern society. Many countries, over the years, have developed a National Vaccination Programme to prevent epidemics and improve citizens' health care. Portugal has had one since 1965, where a universal and free programme was born. Programmes like these require large amounts of data and adequate data structures to store reliable information. This project aims to describe a minimal vaccination campaign database.

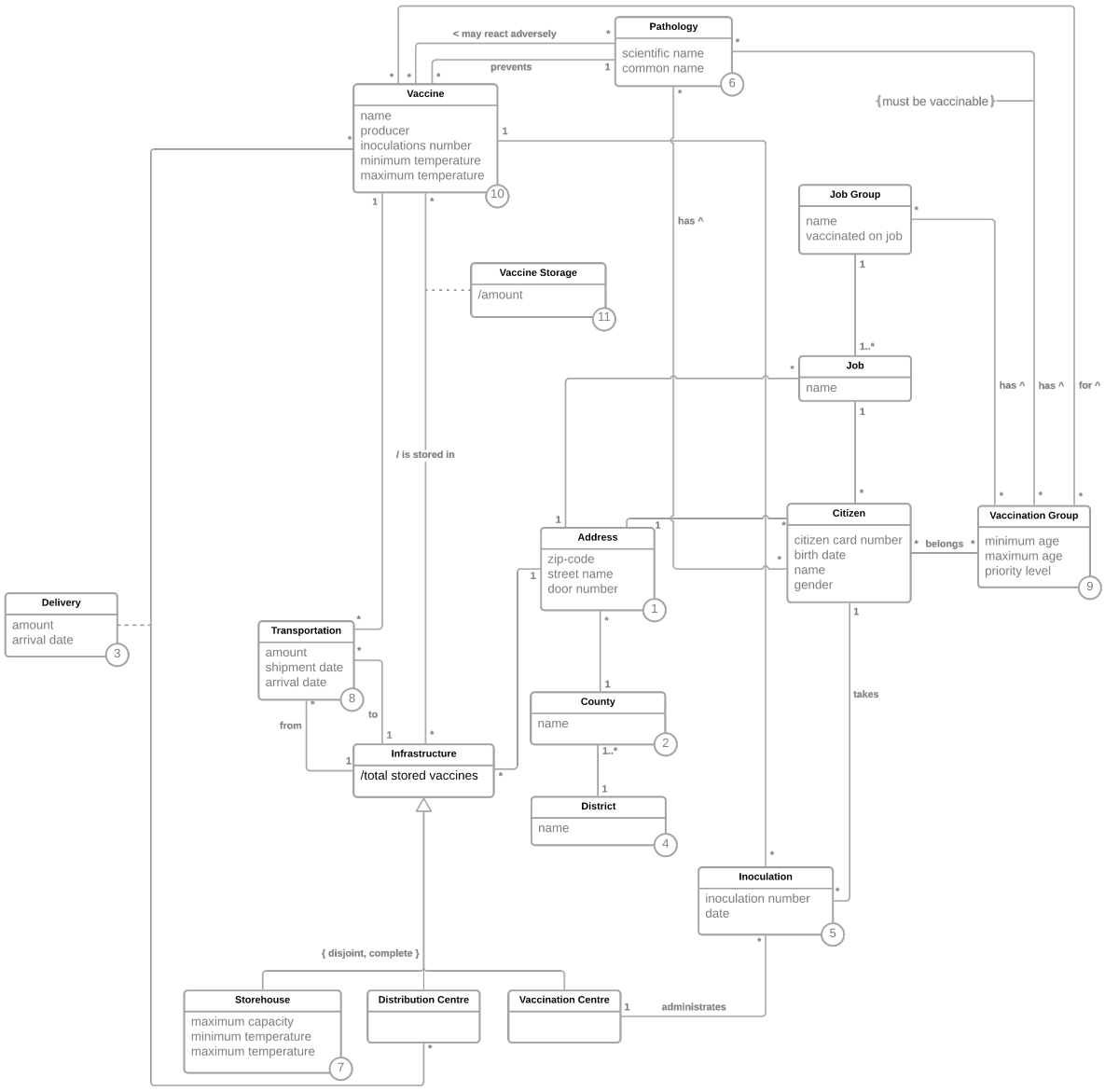
In this vaccination campaign database, citizens and vaccines are central entities. Citizens are identified by their citizen card number and hold sociodemographic data. On the other hand, vaccines provide information about the pathology it prevents and the ones it might react adversely to. Distributions centres store produced vaccines. Later, transportations between distribution centres and storehouses or vaccination centres may occur. These transportations only carry a single type of vaccine due to conservation restrictions (*e.g.* storage temperature range). After arriving at a storehouse, vaccines remain preserved in their storage conditions. Storehouses act as a middleware between a distribution centre and a vaccination centre. However, transportations may occur directly between a distribution centre and a vaccination centre. As some shipments have a long route, vaccine packages might travel between multiple storehouses to reach the final destination, allowing transportations to arise between two storehouses.

Vaccinating a population is particularly challenging. To ease the vaccination process, citizens have a defined vaccination group. A group for a vaccine is responsible for delineating its allocation criteria and its priority. After having a correctly structured collection of vaccination groups, the vaccination process starts. During the vaccination process, groups might suffer changes, allowing large groups to split into smaller ones.

The vaccination of a citizen takes place at a vaccination centre. The vaccination centre assigned to a citizen is dependent on sociodemographic data. For general purposes, the vaccination centre of a citizen is the closest to their address. However, the allocation criteria change according to the citizen vaccination group. An inoculation registry is maintained, holding information about the citizen, the vaccine and the vaccination centre.

2. Conceptual Modeling

2.1 UML Diagram



2.2 Class Definition and Restrictions

Name	Definition	Restrictions
Vaccine	Defines a vaccine by its name, producer, the number of inoculations it requires and the temperature range at which it must be reserved. The pathology it prevents, as well as the pathologies it may react adversely to, are also defined.	(10) a) inoculations num > 0 b) maximum temperature $\geq$ minimum temperature
Infrastructure	Defines an infrastructure by its address and the total (calculated) amount of vaccines it stores. It also keeps track of all of its vaccines' stock. It may receive or deliver transportations of vaccines.	None
Storehouse	It is a generalization of an Infrastructure. Represents a storehouse and, as such, has a given max capacity. It also defines at what temperature range vaccines can be stored.	(7) a) maximum temperature $\geq$ minimum temperature
Distribution Centre	It is a generalization of an Infrastructure. Represents a main centre of distribution and, as such, holds the first stop for all vaccines.	None
Vaccination Centre	It is a generalization of an Infrastructure. Defines the place where inoculations are taken.	None
Vaccine Storage	Defines the stock of a given vaccine in a given infrastructure.	(11) a) amount ≥ 0
Transportation	Defines the amount of vaccines that are being transported, as well as the shipment and arrival date, the vaccine being transported and the infrastructure from which they are being taken and to which they are to be delivered.	(8) a) amount > 0 b) Transportation can't be held to Distribution Centre

Delivery	Defines a shipment to a distribution centre of a certain vaccine. It holds the amount delivered and the date of arrival.	(3) a) amount > 0
Inoculation	Defines a given inoculation of a certain vaccine of a citizen in a certain vaccination centre. It is also described by its number (first, second (...) take of a given vaccine) and the date.	(4) a) $1 \leq$ inoculation number $\leq$ inoculations num of the associated Vaccine
Pathology	Defines a pathology, which is defined by its scientific name and common name. It may be prevented by or it may react adversely to a vaccine.	(6) a) scientific name must be unique
Vaccination Group	Defines a group by the minimum and maximum ages, as well as its priority level, represented by a number. The lower that number is, the higher the priority of that group. It is formed for a given vaccine and contains citizens with a certain job group and a certain set of pathologies.	(9) a) $0 \leq$ minimum age $\leq$ maximum age b) priority ≥ 0
Job Group	Defines a job group. A job group contains jobs of the same area (medical job group $\rightarrow$ nurse, doctor..). It is defined by its name and whether or not citizens that belong to it should be vaccinated in their job place (nursing homes, for example).	None
Job	Defines a job by its name.	None
Citizen	Defines a citizen by their citizenship card number, birth date, name and gender. His address is also defined, as well as his job and the group he belongs to (might not belong to any group).	None
Address	Defines the address of a given place with its zip-code, street name, door number and county.	(1) a) door number ≥ 1

County	Defines a county by its name.	(2) a) name must be unique for a specific District
District	Defines a district by its name.	(4) a) name must be unique