Hospital Staff Management and Stay Records System

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A practical approach to records keeping and employee management, with a focus on accountability, clarity and accuracy.

I.   Requirement Analysis

Introduction

Purpose:

The purpose for which this application was intended is twofold. It should allow for a precise management of the resources at the hospital's disposal, with a strong focus on the manpower available. Secondly, it must allow for the precise accountability of each action, or lack thereof, as well as the identification of the source of an infection where possible. This will ensure a certain quality of service, and thereby generate confidence in the care provided by the hospital staff. Moreover, this information will give a strong measurement of the competence of the staff, which will facilitate a fair and realistic management of the staff.

Scope and special requirements:

The scope of this project lies within the bounds of only one hospital. Our implementation is general enough to satisfy the needs of most hospitals that follow the hierarchy described here. Rather than cluttering this project with concerns of inventory and material, we focus on staff, patients and the quality of care. To that end, our system gathers numeric data to build a large storage of information regarding the measurable actions that take place in the hospital.

Database Requirements

Staff: Any person working for the hospital, receiving a salary. All staff are associated with information such as last and first name, date of birth, gender, address, date of employment, phone number, biweekly hours (the cumulative number of hours over a period of two weeks; the start and end of the two weeks being fixed in advance by the system). All staff have a unique key, namely the eID (or employee ID).

Patients: A person visiting the hospital due to some illness, and staying at the hospital for whatever duration. Patients are associated with general information regarding their person, including last and first name, age, phone number, address, gender, age, blood type and emergency contact, and they are identified by a unique key, the pID. Patients are also associated with all of their stays at the hospital, be it current or past.

Stay: Each occurrence of any patient's uninterrupted stay in the hospital, identified by the stay's ID (sID), and described by the date of admission and the date of release. Many important pieces of information, including a list of the symptoms, as well as the final diagnosis are also associated with the stay.

Doctors: A member of the hospital staff who is a medical doctor or student, either at the intern, resident, fellow or permanent doctor level (the levels are, respectively, 1, 2, 3 and 4). Doctors are associated with an annual salary, a mortality rate (number of deaths per number of stays with that doctor as the primary physician), an area of research, a number of patient visits (which accumulates over the year, and is set to zero when the year ends), as well as all the other general information associated with staff. Like all staff, they are identified with a unique key, the eID. All doctors are also associated with a department, and some doctors are chief of their department. Doctors are also associated with any patient stay for which they were the primary or secondary physicians.

Nurses: A member of the staff who has a nursing degree. Nurses are hourly employees, and are associated with an hourly salary, as well as a prescription authorization (yes or no), along with

all other information associated with staff. They are identified with a unique key, the eID. All nurses are also associated with a department, and some nurses are the head nurses of their department. Nurses are associated with patient stays, as well as the vitals that they recorded for given stays.

Administrative staff: A member of the staff in charge of, or assisting with, management of the hospital at the administrative level. Generally, they do not have direct with patients. Administrative staff have an annual salary, a position, a main responsibility, as well as all other attributes associated with the staff of the hospital.

Orderlies: A member of the staff in charge of the general well being of the patients. This position does not require a nursing degree, and is limited to basic tasks. These are hourly employees, and are associated with their assigned task in the hospital. They are identified with a unique key, the eID. Orderlies are also associated with all beds that they clean.

Custodial staff: A member of the staff in charge of cleaning and maintenance of the building itself, who does not generally have direct contact with patients. They have an hourly salary, and have a floor assignment (simply the number of the floor they usually carry their cleaning/maintenance on). They are identified with a unique key, the eID.

Beds: Beds are the locations associated with a stay, and we assume that each stay must occur in a given bed. Beds are associated with the date of their last cleaning, the current room number where the bed can be found, as well as a unique key, the bedID. They are also associated to the orderly who is currently responsible for cleaning the bed.

Departments: These are the divisions within the hospital for the staff that has contact with the patients. Departments are associated with the number of employees that are currently employed in it (nurses and doctors alike), as well as the wing in which the department is located. The unique key for each department is its name, or dName. Departments are associated with each nurse and each doctor who works there, as well as with the head nurses and chiefs of each given department.

Medication: All medication that the hospital has access to. Each medication is associated to the company that currently provides the medication to the hospital, the cost per gram of the medication, as well as the scientific name of the medication, which is also the unique key for identifying it. Medication that has been administered is also associated to every stay that has used or is using the medication.

<u>*Weak entities:*</u>

Vitals: These are the measurements regarding the current physical state of patients staying in the hospital. Vitals are associated with the value of the measurement (the units of which are pre-defined in the system for each vital), as well as the type of the vital (i.e. blood pressure, heart rate …) and the date and time of the measurement. The two latter attributes together form the key to identify each vital. However, since they are not unique, we must also consider the stay with which they were associated in order to identify the vitals uniquely. They are also associated to the staff (nurse) who took the measurements.

<u>*Relationships:*</u>

Note: In order to keep records of events described in the following relationships, most of the relationships associated with a stay do not have key constraints. This allows, for example, the same bed to be associated to more than one stay. However, using the end time of the date, we can decide which beds are currently available.

Cared for: This represents the responsibility of a given doctor with regards to caring for a patient staying or having stayed at the hospital. Exactly one doctor is the primary physician associated with each stay, but there can be more than one secondary doctor associated with a stay.

Watched over: This represents the responsibility of a nurse towards a patient staying, or having stayed at the hospital. Each stay is associated with at least one nurse. This responsibility is

limited by the duration of each nurse's shift, after which another nurse takes charge of a patient stay.

Doctor in: This is a relationship between a doctor and the department where the doctor is employed. It is intended to clarify the authority to which the doctor answers, as well as the doctor's area of specialization or current study in the hospital. Every doctor belongs to at least one department, but there may be interdepartmental doctors with more than one area of specialization.

Nurse in: This is a relationship between a nurse and the department where the nurse is employed. It is intended to clarify the authority to which the nurse answers, as well as the nurse's area of experience in the hospital. Every nurse belongs to at least one department, but there may be nurses working in more than one department, with experience doing tasks required specifically by each department.

Chief doctor of: Each department has one doctor at the head of its medical hierarchy, charged with supervision and discipline, in order to ensure the quality of the services given by each doctor in the department. Every department has exactly one chief, in order to faithfully represent current hospital hierarchies.

Head nurse of: Each department has one nurse at the head of its nursing hierarchy, charged with supervision and discipline, in order to ensure the quality of the services given by each nurse in the department. Every department has exactly one head nurse.

Occurred in: Every stay occurs in exactly one bed at any given time, in order to facilitate locating the patients associated with a stay. The information about the bed in which a stay occurred is kept in case of discovery of infectious disease.

Cleans: Every bed is associated to the orderly in charge of cleaning it, in order to hold the orderly accountable, and in case of discovery of infectious disease.

Recorded: Vitals are associated with both the stay (and by extension, the patient) that the measurements were taken for, as well as the nurse that took the measurements, in order to hold

nurses accountable for lack of accuracy or timeliness. Each measurement of a given vital at a given time is associated with one stay, in order to keep clear records of the patient's condition.

Administered: Medication that a patient has been administered is associated with the stay, and the duration and frequency of the intake (grams per intake per day, usually described in words) of the administration advised are also indicated. Because the primary physician must approve all medication, there is no need to associate physicians with the administration directly. This serves as a reference for the staff to administer the medications necessary, and also helps keep track of the treatment course.
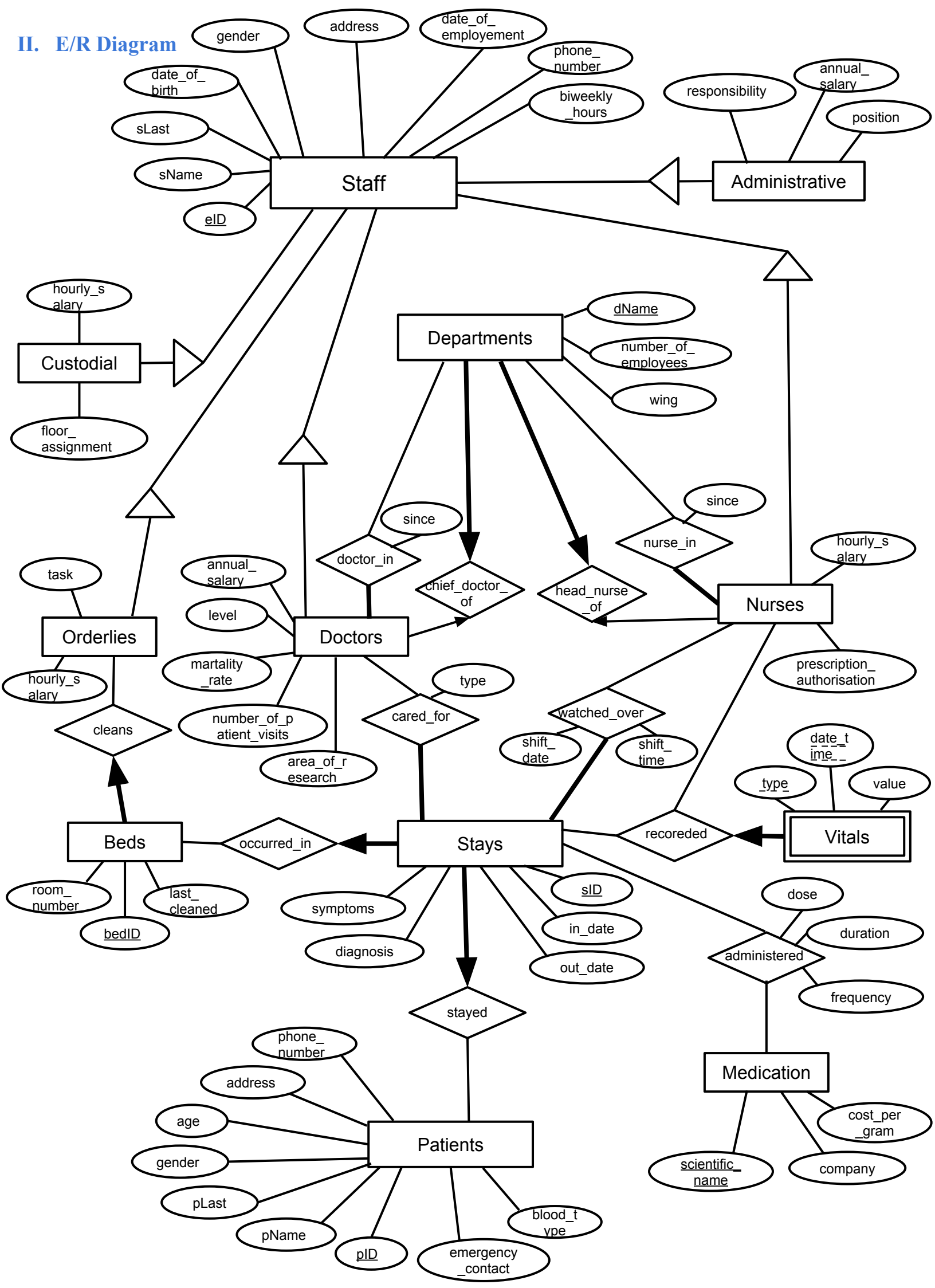
III. Relations

I. _Entities:_

- _Departments_ (dName, number_of_employees, wing, chief_doctor, head_nurse)
- _Staff_ (eID, sName, sLast, date_of_birth, gender, address, phone_number, hourly_salary, date_of_employement, biweekly_hours)
- _Nurses_ (prescription_authorisation, hourly_salary, in_department, since)
- _Doctors_ (level, mortality_rate, number_of_patient_visits, annual_salary, area_of_research, in_department, since)
- _Orderlies_ (task, hourly_salary)
- _Administrative_ (responsibility, position, annual_salary)
- _Custodial_ (floor_assignment, hourly_salary)
- _Stays_ (sID, in_date, out_date, symptoms, diagnosis, pID)
- _Patient_ (pID, pName, pLast, address, age, gender, phone_number, emergency_contact, blood_type)
- _Beds_ (bedID, room_number, last_cleaned, sID, eID)
- _Medication_ (scientific_name, company, cost_per_gram)

II. _Weak Entities:_

- _Vitals_ (date_time, type, value, sID, eID)

III. _Relationships:_

- _Administered_ (sID, medication, dose, duration, frequency)
- _Watched_over_ (eID, sID, shift_date, shift_time)
- _Cared_for_ (eID,sID,type)

<u>Justifications:</u>

In order to avoid redundancies in our database each of the following relationships was merged into one of its corresponding entities depending on the case. Notice that in a many-to-many relationship, it is not efficient to merge the relationship table with one of the entities since it will create multiple repetitions of the same values. A description of each case can be found below.

➢ *Head_nurse_of* (<u>eID</u>, <u>dName</u>)

This relationship can be included in the department table by adding an attribute head_nurse in the Department entity. By doing so we avoid having a table with all nurses that are head of a department and the department they are responsible for; instead, we only need one column in the department table associating every department to its head nurse.

➢ *Chief_doctor_of* (<u>eID</u>, <u>dName</u>)

Similarly to the head_nurse relationship to the departments, we can add an attribute Chief_doctor in the Department entity to avoid a redundant table with only eID's and the associated department in addition to the original department table.

➢ *Stayed* (<u>pID,sID</u>)

In this case, by adding a pID attribute to the stay entity we avoid a table of redundant sID cells associated to a specific pID. Since this in a one-to-many relationship (one patient → many stays, we add a pID for every stay)

➢ *Recorded* (<u>sID</u>, <u>eID</u>)

This data can simply be added as attributes the weak entity "vitals" in the database. The sID is also used along with the "date_time" and "type" as a unique key for this entity.

➢ *Occurred_in* (<u>sID</u>, <u>bedID</u>)

This relationship will be represented in the beds entity, which will have an attribute sID which will be changed when a patient is released and an other admitted and assigned to the bed. Alternatively, we could add a bedID to every stay but this will require a bigger storage space since the same bed is reused a great number of times for a great number of patients and, as far as accuracy of the database goes, it is not essential to knw which stay occurred in which bed after the patient is dismissed.

- ➢ *Cleans* (<u>eID</u>, <u>bedID</u>)

  An attribute "eID" will be added to each bedID to identify who is responsible of cleaning it, again this avoids redundancies since every bedID is already listed in the beds entity.

- ➢ *Nurse_in* (<u>eID</u>, <u>dName</u>, since)

  Since every nurse is in at least one department, this relationship table will list all eIDs with there associated department and the date they were hired; however all nurse eIDs are already listed in the nurse entity table and thus the relationship attributes for department name and hiring date can be added to the nurse entity table.

- ➢ *Doctor_in* (<u>eID</u>, <u>dName</u>, since)

  Similarly to nurse_in, doctor_in attributes can be merged into the doctors entity table in the database to avoid redundancies.

As you can see, almost all one-to-one, many-to-one and one-to-many relationships have been merged into one of the entities they are associated with to reduce the complexity of the database, increase query speed by reducing the number of intermediate tables needed and finally decrease significantly redundancies in the database.

IV. Reference Websites

1. Healthcare Management Hierarchy:

http://www.hierarchystructure.com/healthcare-management-hierarchy/

2. Bayanno Hospital Management System:

http://codecanyon.net/item/bayanno-hospital-management-system/5814621