BLOOD PLASMA BANK MODEL FOR COVID-19

Team: Quirky Queries

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A. Mini World:

In the wake of the current pandemic of COVID-19, we have tried to construct a database model for a local blood plasma bank. The model mainly focuses on the storage of donated plasma and to cater to viable blood plasma orders. This database is to be used and accessed for plasma orders and delivery of plasma samples within the range of the plasma bank.

The model has three types of users - hospital, donor and staff.

A hospital signs up to place an order on behalf of a patient. The order is processed and according to the viability, the hospital receives the message whether the order has been accepted or not. If the order is accepted, the hospital receives an acknowledgment mentioning the expected date of delivery.

A donor needs to sign up to make a plasma donation. The database only stores details of valid donors, i.e, individuals between the age of 18 and 50 who have had a prior diagnosis of COVID-19 documented by a laboratory test and meet other donor qualifications.The details of his/her plasma sample can be accessed after donation with their unique login_id and password. A donor can donate every 56 days. A whole blood donation from one donor generates 2 plasma samples.

The donated plasma samples are stored in inventories, each with a unique inventory ID and a fixed capacity.

The staff-specific updates and changes are handled by the staff accounts of the plasma bank.

Things the user can do:

1. Donate: If id exists then the DONOR table is updated, else insert_donor is called. This automatically calls insert_plasma and either insert_inventory or update_inventory by which the plasma sample details are stored and the suitable inventory's count of corresponding samples is updated.

2. Place order/Supply: This calls insert_order, then based on LOGISTICS table, update_plasma and update_inventory are called.
   On the basis of the availability of a vehicle suitable for the delivery distance mentioned in the order, the plasma inventory is checked for the sample of required blood type. If it is available, a suitable plasma sample is chosen from the plasma

table and marked as used and order is accepted after updating the logistics and the plasma inventory. The user(Hospital) is shown if the order can be fulfilled or not and if it can be fulfilled, approximate delivery time and the vehicle details are displayed.

3. Manage Logistics: User(Staff) can choose to call insert_vehicle or update_vehicle_availability.

4. Manage Staff: User(Staff in Admin role) can choose to call insert_staff, update_staff or delete_staff.

5. Update_dept

Each function is described in the Functional Requirements section.

Entity-Attribute Description

ENTITY	***ATTRIBUTE***	***DESCRIPTION***
Order	plasma_id(alphanumeric)	Unique ID for plasma sample if supplied; else NULL
	hospital_id (alphanumeric)	Unique ID of hospital for whom the order was placed
	blood_type (A+, A-, B+, B-, O+, O-, AB+, AB-)	Blood group of the sample required by the patient for whom the order is placed
	date(composite: date, month and year)	Date the order was placed
	distance(numeric; in km)	Distance from Plasma Inventory to delivery location
	accepted(boolean)	Whether or not the order can be successfully fulfilled
	vehicle_id(alphanumeric)	Unique ID of vehicle used to deliver plasma sample if supplied; else NULL
	order_id(alphanumeric)	Unique ID of the order
Plasma	plasma_id; (composite:donor_id + donation_date + sample_no)	Unique ID of plasma sample which is a composite key made up of donor_id,donation_date and sample_no

	blood_type (A+, A-, B+, B-, O+, O-, AB+, AB-)	Blood group of the sample
	donation_date(composite: date, month and year)	Date of blood sample donation
	donor_id(alphanumeric)	Unique ID of donor who donated sample
	Inventory_id (alphanumeric)	Unique ID of inventory where plasma sample is being stored
	sample_no(numeric)	Sample no. 1 or 2 donated by donor
	used(boolean)	Whether or not the sample has been used
User	address(alphanumeric)	Address of user
	login_id (alphanumeric)	Unique ID for every user
	password (alphanumeric)	Password of user account
	contact (numeric with space and {+,-,(,)})	Contact number of the user
Staff(subclass of user)	staff_id (alphanumeric)	Unique ID of plasma bank staff member
	name(alphabets and spaces; composite: first name and last name)	Name of staff
	date_of_joining(valid date)	Date the staff member joined
	skills (multivalued, alphanumeric)	Skills of the staff member
	department_id (alphanumeric)	To specify which department the staff member belongs to. Same as the department_id attribute of Department entity.
	salary(numeric)	Annual salary amount of staff member
	supervisor (alphanumeric)	Staff_id of the supervisor of the staff; null if not applicable
	age(numeric)	Age of Staff member

	birth_date(valid date)	Birthdate of Staff member
Dependent (weak entity of staff)	name(alphabets and space) (partial key) (composite: first name + last name)	Name of the dependent
	age(numeric)	Age of the dependent
	gender (M,F,T,O)	Gender of the dependent
	relation (alphanumeric)	Relationship of the Dependent with the Staff member
Donor(subclass of user)	donor_id (alphanumeric)	Unique ID for every donor
	name(alphabets and spaces; composite: first name and last name)	Name of donor
	aadhar_num (16-digit number)	Aadhar card number of the donor
	blood_type (A+, A-, B+, B-, O+, O-, AB+, AB-)	Blood group of the Donor
	number_of_donations (numeric)	Number of plasma donations by the donor
	age(numeric; derived from birth_date)	Age of Donor
	birth_date(valid date)	Birthdate of Donor
Hospital(subclass of user)	Hospital_id (alphanumeric)	Unique ID for every hospital that places orders for its patients
	Hospital_name(alphanumeric)	Name of hospital
	distance(numeric; in km)	Distance from Plasma Bank location to hospital location
Patient (weak entity for Hospital)	patient_id (alphanumeric) (partial key)	The id of the patient assigned by the hospital
	name(alphabets and space)	Name of Patient
	age(numeric; derived from birth_date)	Age of Patient
	allergies(alphabets and space; multivalued)	Allergy information of Patient

	birth_date(valid date)	DOB of Patient
	blood_type (A+, A-, B+, B-, O+, O-, AB+, AB-)	Blood type of Patient
Department	department_id (alphanumeric)	Unique ID of every department
	manager(alphanumeric)	Staff_id of manager of the department
	description (alphanumeric)	Short description about the work of the department
	number_of_employees (numeric)	Number of employees in the department
	remark (alphanumeric)	Any remarks related to the working of the department
Logistics(subclass of Dept.)	vehicle_id (alphanumeric)	Unique ID of delivery vehicle(license plate number)
	vehicle_type (alphanumeric)	Type of vehicle
	vehicle_availability (boolean)	Checking whether the vehicle is available or not
	max_dist (numeric; in km)	Maximum distance the vehicle can cover
	deliveries (numeric)	Number of deliveries done by the vehicle
	speed (numeric; in kmph)	Average speed at which the vehicle can travel. Used to calculate approximate time for an order to be delivered.
Plasma Inventory (subclass of Dept.)	inventory_id (alphanumeric)	Unique ID of the Plasma Inventory
	no_of_A+ (numeric)	Number of samples of A+ blood group in the inventory
	no_of_A- (numeric)	Number of samples of A- blood group in the inventory
	no_of_B+ (numeric)	Number of samples of B+ blood group in the inventory
	no_of_B- (numeric)	Number of samples of A- blood group in the inventory

	no_of_AB+ (numeric)	Number of samples of AB+ blood group in the inventory
	no_of_AB- (numeric)	Number of samples of AB- blood group in the inventory
	no_of_O+ (numeric)	Number of samples of O+ blood group in the inventory
	no_of_O- (numeric)	Number of samples of O- blood group in the inventory
	capacity (numeric)	Maximum number of samples the inventory can store
	vacancy (numeric)	Current vacancy in the inventory

Constraints:

- A manager can manage maximum one department
- 2 dependents for the same employee do not have the same name(first name and last name)
- A hospital can ask for only one plasma sample in one order
- Each plasma inventory cannot have more blood samples than its capacity

B. Database Requirements:

1. At least five entity types(not considering subclasses)

- Order
- Plasma
- Department
- Dependent
- User
- Patient

2. At least one entity with two key attributes

- Plasma:plasma id(donor_id, sample_no, donation_date)

3. At least two weak-entity types

- Patient for Hospital : patient_id is a partial key since it is irrelevant without the hospital
- Dependent for Staff : name is a partial key since we assume that no two dependents of a single staff member have the same name

4. At least five relationship types (which should include cardinality ratios and participation constraints)

S No.	Relations-hip Type	Entities	Structural Constraints (min, max)	Degree and other features	Cardinality Ratio	Participation Constraints	Recursive
1	donate	Donor	(1,N)	binary many-one	1:N	Total participation	NO
		Plasma	(1,1)				
2	supply	Plasma	(0,1)	quaternary	1:1:1:1	Partial participation	NO
		Plasma Inventory	(0,1)				
		Logistics	(0,1)				
		Order	(1,1)			Total participation	
3	places	Hospital	(1,N)	binary, many-one	1:N	Total participation	NO
		Order	(1,1)				
4	works_for	Staff	(1,N)	binary, many-many	M:N	Total participation	NO
		Department	(1,N)				
5	manages	Staff	(0,1)	binary, one-one	1:1	Partial participation	NO
		Department	(1,1)			Total participation	
6	supervises	Staff	(0,N) for supervisor (0,1) for supervisee	binary, many-one	1:N	Partial participation	YES
7	update	Plasma Inventory	(0,N)	binary, many-one	1:N	Partial participation	NO
		Plasma	(1,1)			Total participation	
8	dependent	Staff	(0,N)	binary,	1:N	Partial	NO

	_of			many-one		participation	
		Dependents	(1,1)			Total participation	
9	admitted_to	Hospital	(1,N)	binary, many-one	1:N	Total participation	NO
		Patient	(1,1)			Total participation	

5. At least one (n > 3) degree relationship type.
- Supply: Order, Plasma Inventory, Logistics, Plasma

6. At least one subclass
- Department: Logistics, Plasma Inventory
- User: Staff, Donor, Hospital

7. Few composite, multi-valued, derived attributes

a) Multivalued:
- Entity: Staff
  Attribute: skills
- Entity: Patient
  Attribute: allergies

b) Derived:
- Entity: Donor
  Attribute: birth_date
  Derived attribute: age

c) Composite:
- Entity: Staff
  Attribute: name (first name and last name)
- Entity: Donor
  Attribute: name (first name and last name)
- Entity: Dependent
  Attribute: name (first name and last name)

- Entity: Order
  Attribute: date (date,month and year)
- Entity: Plasma
  Attribute: donation_date (date,month and year)

C. Functional Requirements:

1. Retrieval

a) Query function:

i. Selection:

- Retrieve complete data tuples of plasma of a particular blood type

ii. Projection Query :

- Get the names of all donors with greater than x donations
- Get the vehicle type from logistics depending on the distance in an order

iii. Aggregate function (SUM, MAX, MIN, AVG).

- Get the name of the donor with maximum number of donations
- Get average salary of staff members
- Get the average number of donations per month for a particular year
- Get the average number of orders placed per month for a particular year

iv. Search:

- Searching for a staff name(by first name or last name)
- Searching for a donor name(by first name or last name)
- Searching for hospital name

b) Analysis:

- Get the donor details for a particular order (relationship between order and donor)
- Get all successful orders that are completed by a particular vehicle type (relationship between logistics and order)
- Get donors in a particular age group whose plasmas have been successfully delivered to a patient (this shows relationship between donor, plasma, order ,hospital and patient)

2. Modification:

A. Insert:

- Manage staff:
  Insert_staff :Insert new staff into STAFF table(manual*)

- Donate:
  Insert_donor :insert donor details into DONOR table(manual)
  - Corresponding insert_plasma happens into PLASMA table(not manual)
  - Corresponding insert_inventory happens into INVENTORY table(not manual) if previous inventories are all full

- Manage logistics:
  Insert_vehicle :add new vehicle details into LOGISTICS table

- Supply/Place order:

Insert_order :enter order details into ORDER table, and corresponding hospital and patient details into HOSPITAL and PATIENT tables

B. Update:
   - Manage logistics:
     Update_vehicle_availability(manual): in LOGISTICS table

   - Donate:
     Update_donor :if donor id already exists, then number of donations for existing donor increases in DONOR table
     Update_inventory(not manual) :update number of samples in first inventory of the INVENTORY table that has space based on the entry in the PLASMA table

   - Manage staff:
     Update_staff_details (manual): update salary/dept/contact/supervisor/address/skills

   - Supply/Place order :
     Update_plasma(not manual):update plasma sample as used when a plasma is supplied for an order

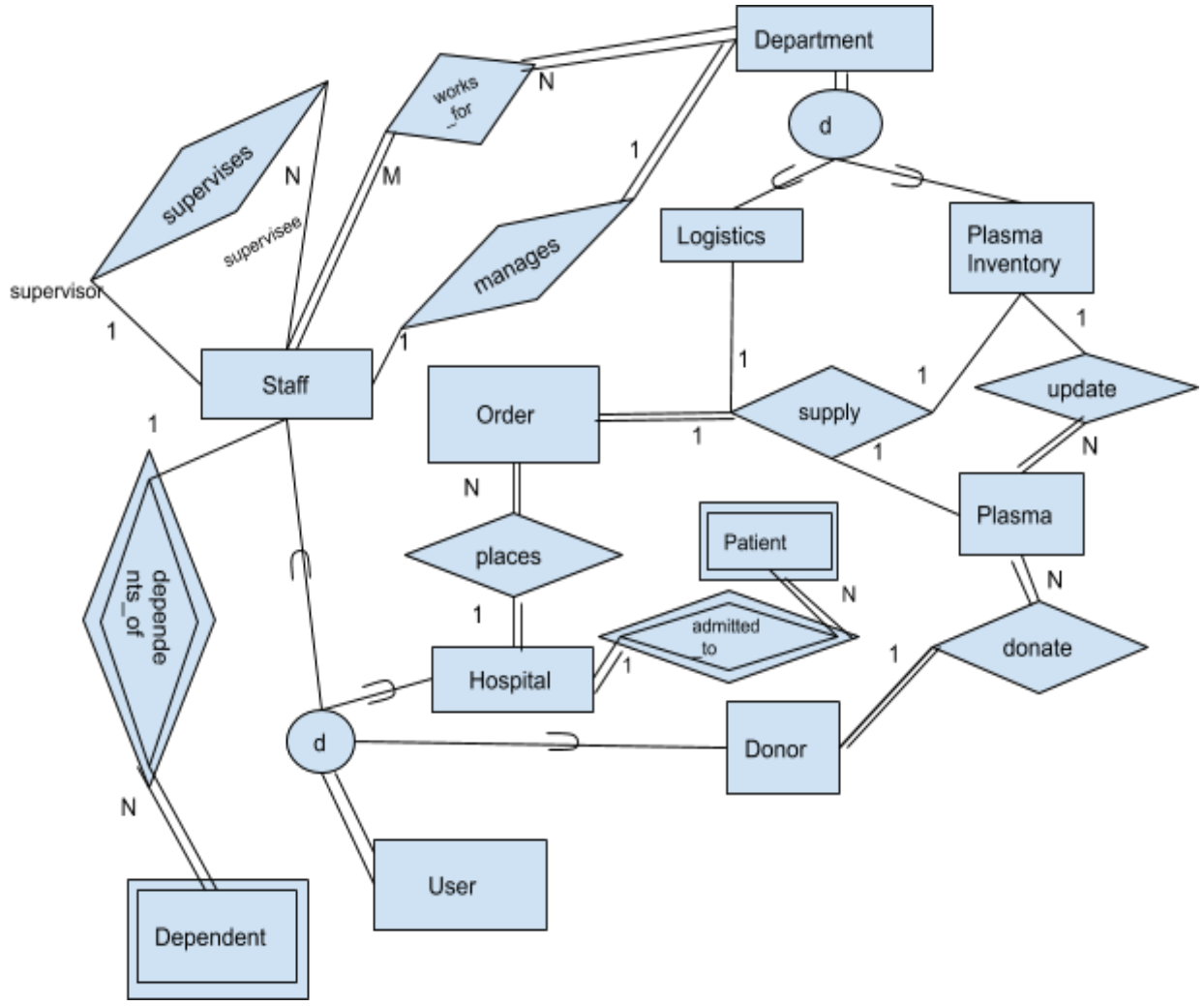
   - Update_dept(manual): update manager/description/remark
     Update no_of_employees if insert_staff or delete_staff is called

   - Update_age: Compares birth_date of entity(staff,donor,patient and dependent) with system date and updates age when required(function must be called once everyday)

C. Delete:
   - Manage staff:
     Delete_staff(manual)

(:'manual' refers to the fact that the user must choose to call the function for its execution, as opposed to the 'not manual' functions that are called in the other functions automatically)*

ER Diagram (attributes not included) below for reference: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