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DATABASE PURPOSE

This project presents a **Blood Bank Database Management System (BBDBMS)**. The system keeps track of data in all stages of blood donation from donor participation to providing blood to patients in hospitals. The system keeps a record of donor information, details of donation, properties of blood donated, results of blood testing, processed blood components, stock of blood in blood inventory/storage and data about orders placed by hospitals.

INTENDED AUDIENCE

This database is meant to be used by blood donation centers for the overall management of data pertaining to different stages in the blood donation process. Functions of the database are described in the functional requirements section.

DESIGN OF DATABASE AND CONSTRAINTS

- Each blood donation center has a unique center ID. The address and phone number of the center are also stored.

- A blood donation center employs receptionists to help with donor registration. Each receptionist has a unique employee ID, name and phone number.

- A donor registers at a specific blood donation center with the help of a receptionist. The registration ID, date of registration are stored. This is a one-time registration. The donor can donate in different locations of the blood donation center after registration. A donor must be at least 18 years of age to donate.

- The following information is stored for each donor: A unique donor ID, donor name (which consists of first name, middle name and last name), address, gender, date of birth, phone number and email address.

- A donor participates in donation at a blood donation center to donate blood. The donation starts with a mandatory health checkup. The following data is stored: Blood pressure, haemoglobin level, weight, and description of recent travel history. Constraints are as follows: Blood pressure below 180 systolic and 100 diastolic, haemoglobin above 12.5 g/dl for females and 13 g/dl for males, but less than 20 g/dl, and weight greater than 50kg. Further the donor should not have travelled to countries where mosquito-borne diseases are endemic, within the last 3 months. Date of donation is stored.

- The following information is stored about the donor's blood: Unique barcode label, blood type (ABO blood group and Rh factor), blood description, and cost. The blood is tested for various diseases including Human Immunodeficiency Virus (HIV) 1 and 2, hepatitis B and C, Human T-cell Lymphotropic Virus (HTLV) 1 and 2, and syphilis

and results of the tests are stored. The donated blood will be stored in the blood inventory only if all results are negative. The donor will be informed of the test results.

- The blood is processed to separate it into its various components, which include red blood cells (RBCs), plasma and platelets. Each component has a unique component ID, component type, standardised quantity, temperature at which it needs to be stored and maximum time it can be stored. This is metadata which is stored separately.

- After extraction, the blood components are stored in the blood inventory. The date of storage, along with a unique stock ID (derived from blood barcode and component ID), blood type and component type are stored.

- The stored blood components are ready to be distributed to hospitals as per need. A hospital places an order, which has a unique order ID, requirements (blood type, component type, quantity) and total cost. The hospital that places the order has a unique name, address and phone number.

ENTITIES AND RELATIONSHIPS

1. **Blood Donation Center:**
    - Attributes: Center ID (primary key), address (multivalued attribute), phone number.
    - Employs receptionist (binary relationship).

2. **Receptionist**
    - Attributes: Employee ID (primary key), name (composed of first name, middle name, last name), phone number.
    - Registers donor (binary relationship).

3. **Donor**
    - Attributes: Donor ID (primary key), name (composed of first name, middle name, last name), address (multivalued attribute), gender, date of birth, phone number, email address (key attribute).
    - Constraints: Age must be at least 18 years.
    - Participates in donation at blood donation center giving blood (4-way (Quaternary) relationship).

4. **Donation (weak entity)**
    - Attributes: Blood pressure, haemoglobin level, weight, travel history, date of donation.
    - Constraints: Blood pressure must be below 180 systolic and 100 diastolic, haemoglobin must be above 12.5 g/dl for females and 13 g/dl for males, but less than 20 g/dl, weight must be greater than 50kg, and the donor should not have travelled to countries where mosquito-borne diseases are endemic, within the last 3 months.
    - Identified by: Donation center ID, donor ID, unique blood barcode label (4-way (Quaternary) relationship).

5. **Blood**
    - Attributes: Unique barcode label (primary key), blood type (ABO blood group, Rh factor), description, cost.
    - Tested for diseases (binary relationship).
    - Processed and stored in inventory (binary relationship).

6. **Test Result (weak entity)**
    - Attributes: HIV 1, HIV 2, hepatitis B, hepatitis C, HTLV 1, HTLV 2, syphilis (positive/negative).
    - Identified by: Unique barcode label of blood tested.

7. **Blood Inventory**
    - Attributes: Unique stock ID (composite key derived from blood barcode and component ID), date of storage, blood type (derived from blood), component type (derived from metadata).

8. **Hospital**
    - Attributes: Name (primary key), address, phone number, email (key attribute).
    - Orders from blood inventory (binary relationship): Order ID, cost, blood type (derived from inventory), component type (derived from inventory), quantity ordered.

RELATIONSHIPS AND CONSTRAINTS

1. **Employment:** A blood donation center employs many receptionists. A receptionist works for a single blood donation center.

2. **Registration:** A receptionist can register many donors at the blood donation center. A donor is registered by a single receptionist.

3. **Participation (4-way identifying relationship):** A donor participates in donation at a particular blood donation center to give blood. A blood donation center accepts donations from many donors; a donor can participate in multiple donations; the donated blood is unique to the donor for that donation.

4. **Testing (identifying relationship):** The donated blood goes through a series of tests. Each test produces a single result. The same result can be produced by testing blood from different donors.

5. **Processing and Storage:** Donated blood is processed into 3 components, which are stored in the blood inventory. Each stored sample is obtained from a single blood donation.

6. **Order:** A hospital orders many blood samples from the inventory. Each sample is sent to a single hospital.

FUNCTIONAL REQUIREMENTS

1. **Selection queries:**

- Retrieve personal details of all donors.
- Generate a report on the current blood inventory, sorted by date of storage.

2. **Projection queries:**
    - Generate a list of daily orders from hospitals.
    - Find all donors within a certain range of age.

3. **Aggregate functions:**
    - Find the most commonly ordered blood component and blood type.
    - Calculate total stock of each blood component of each blood group in the blood inventory.

4. **Search functions:**
    - Find all donors from a particular city or state (partial text match from address).

5. **Analysis queries:**
    - Generate list of all donors having a specific blood type.
    - Select all donors with all test results negative (hence having blood eligible for future use).
    - Find all donors registered by a particular receptionist or at a particular blood bank.
    - Generate list of all expired blood components for discarding.

6. **Insertion queries:**
    - Registration of a new donor at a blood donation center. The donor must provide all required information, and must be above 18 years of age.
    - Insertion of a new blood entity for each donor, only if the donor passes the pre-screening tests, based on the constraints described above.
    - Insertion of data corresponding to each donor, in the blood inventory, only if all blood test results are negative.

7. **Update queries:**
    - Update personal details of a specific donor such as address, phone number or email address.

8. **Deletion queries:**
    - Delete registration of a particular donor.
    - Delete all samples from the blood inventory, which have been ordered or which have expired.