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 date of registration is 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. A unique donation ID and date of donation are stored. The following data is also stored for each donation: 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.

- The following information is stored about the donor's blood: Unique barcode label and blood description (optional). 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. Blood type (ABO blood group and Rh factor) is also mentioned in the test results. The cost for each blood type is stored separately.

- 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.

- After extraction, the blood components are stored in the blood inventory. The date of storage and date of expiry (calculated from date of storage and max storage duration of component) are stored. Each item in the inventory is identified by a unique stock ID (derived from blood barcode and component ID).

- 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, date of order, requirements (blood type, component type, quantity) and total cost. The hospital that places the order has a unique hospital ID, name, address, email address and phone number.

ENTITIES AND RELATIONSHIPS

1. **Blood Donation Center:**
    - Attributes: Center ID (primary key), address, 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.
    - Constraints: Age must be at least 18 years.
    - Participates in donation at blood donation center giving blood (Quaternary relationship).

4. **Donation**
    - Attributes: Donation ID (primary key), blood pressure, haemoglobin level, weight, travel history, date of donation.
    - Constraints: mentioned above.

5. **Blood**
    - Attributes: Unique barcode label (primary key), description, test result.
    - Tested for diseases (binary relationship).
    - Processed into components and stored in inventory (ternary relationship).

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

7. **Component**
    - Attributes: Component ID (primary key), component type, standardized quantity, storage temperature, maximum storage duration.

8. **Blood Inventory (weak entity)**
    - Attributes: Date of storage, date of expiry (derived).
    - Identified by: Unique barcode label of blood, component ID.

9. **Hospital**
    - Attributes: Hospital ID (primary key), name, address, phone number, email address.
    - Orders from blood inventory (binary relationship): Order ID, cost, blood type, component type, 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 (Quaternary 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 (Binary identifying relationship):** The donated blood goes through a series of tests. The same result can be produced by testing blood from different donors. Each result is identified by the blood tested and all blood has to be tested.

5. **Processing and Storage (Ternary identifying relationship):** Donated blood is processed into 3 components, which are stored in the blood inventory. Each stored sample is obtained from a single blood donation and consists of a single component. A sample may be discarded on expiry.

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 list of all donated blood samples.
    - 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 on address).

5. **Analysis queries:**
    - Generate list of all donors having a specific blood type.
    - Select all donations with all test results negative (hence can be stored in the blood inventory).
    - Find all donors registered by a particular receptionist.
    - Find all donors registered at a particular blood donation center.
    - Find all donors who have donated at a particular blood donation center.
    - 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 donation center, receptionist or hospital.
    - Insertion of a new donation and blood entity for each donor, only if the donor passes the pre-screening tests, based on the constraints described above.
    - Insertion of blood test results for each donation.
    - Insertion of samples in the blood inventory, only if the corresponding blood test result is negative.
    - Insertion of a new order from a hospital.

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 in the blood inventory which have been ordered.
    - Delete all samples in the blood inventory which have expired.
    - Delete all blood records with test result positive (cannot be used for donation).