CNC-314 Database Systems

Blood Donation Management System

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1 Table of Contents

2 Business Requirements

2.1 Business Purpose

The primary purpose of the Blood Donation System is to streamline and enhance the process of blood donation and distribution within our organization. In the face of an ever-changing healthcare environment, it is crucial for us to adapt and innovate to continue fulfilling our mission of saving lives through blood donation.

The proposed system will contribute to meeting our business objectives in several ways:

1. **Efficiency**: Through computerized registration, administration burden can get substantially minimalized to allow staff focus on the core issues.
2. **Accessibility**: We will use a friendly website to access more possible donors who will easily register.
3. **Safety and Compliance**: With an updated database of medical status records for all the donors, the system will help enforce compliance with all health and safety requirements and implement relevant checklists.
4. **Improved Service**: With using patients' blood type while selecting a correct donor it is possible to maximize quality of provided services by assuring that there will be "the right blood in the right person and at the right time".
5. **Data Analysis**: This system will provide relevant information that is vital in understanding the trend of donations and making future planning based on those figures.

2.2 Business Scope

a) **Business Domain:** Blood donation & distribution is an essential part of the healthcare industry, being a crucial element for survival for millions of people around the world.

b) **Range of Business Activities:** All blood donation activities start with donor registration and proceed through health screening, blood collection, storage, and distribution. These involve contacts with donor management, medical screenings, laboratory as well as inpatient services. These direct external entities relating to the business activities include donors, recipients, nonprofit organizations, and regulators.

c) **Scope of the System:** The proposed blood donation system will support the aforesaid business areas:
   - *Donor registration and management:* This system will register new donors into the system and maintain the records of donors in the databases.
   - *Health screening:* It will be used for recording and following up on donor health information supplied.
   - *Blood type matching:* It can also help in matching the donors with recipients depending on their blood groups.
   - *Blood collection, storage, and distribution:* It is supposed to monitor the management process of collected, stored, and distributed donated blood.

- *Fast response alert in times of crisis and dependable access to aid.*

2.3 Business Overview

The blood donation system exists in the health care setting working closely with various internal departments like laboratory, as well as other external stakeholders like non-profit organizations, hospitals, and private sectors among others. Here is a brief overview:

Internal Divisions:

1. **Donor management**: manages registering of new donors and keeps a donor list updated.
2. **Medical screening**: screens and assesses the health of prospective donors to ascertain their suitability for donation.
3. **Laboratory services**: also involved in testing the donated blood, as well as finding the blood types.
4. **Hospital services**: this ensures that hospitals and clinics are supplied with blood.
5. **Nonprofit organizations services**: offer support during critical situations such as crises.

External entities:

1. **Donors**: people who sign up for blood donation.
2. **Recipients:** recipients, which include individuals or entities such as hospitals.
3. **Regulatory bodies**: organizations which control process to satisfy health and safety laws.
4. **Nonprofit organization**: some organizations helping in need like the red crescent.

The interrelation between these divisions and entities is as follows:

- Through the donor management, donors register while the medical screening conducts health checkup on them.
- Blood of selected donors is then collected and sent to laboratory services where it is tested and stored once approved.
- It is then sent across to recipients through blood.

The regulatory bodies govern all activities that are done in accordance with their guidelines.

2.4 Business Environment

The Blood Donation System operates within a complex environment that includes both internal and external factors. These factors should be taken into consideration when understanding the business and eliciting stakeholder requirements for the system.

External Factors

Market Trends: The demand for blood and blood products is constantly changing due to factors such as population growth, medical advancements, and public health crises. The system should be flexible enough to adapt to these changes.

Laws and Regulations: The system must comply with all relevant laws and regulations related to healthcare and data privacy. This includes regulations regarding the collection, storage, and distribution of blood, as well as the protection of donor information.

Social Responsibilities: As a healthcare organization, we have a responsibility to promote public health and safety. This includes educating the public about the importance of blood donation and ensuring that our practices are ethical and transparent.

Technology Base: The system should leverage the latest technologies to improve efficiency and user experience. This includes using secure and scalable technologies for data management, and user-friendly interfaces for donor registration.

Internal Factors

Organizational Structure: The system should align with the structure and operations of the organization. This includes integrating with existing systems (such as Hospital management systems) and processes and supporting the roles and responsibilities of different divisions within the organization.

Resources: The development and maintenance of the system will require resources such as funding, personnel, and time. These resources should be considered when planning and prioritizing system requirements.

2.5 Business Processes

1. **Donor Registration:** This is the first step where potential donors register their details in the system. The system interface will capture necessary information such as name, contact details, and medical history.
2. **Health Screening:** Post registration, donors undergo a health screening process. The system will record the results of these screenings to ensure donor eligibility.
3. **Blood Donation:** During the appointment, the blood is collected from the donor. The system tracks this process, recording details like the volume of blood collected and the time of donation.
4. **Blood Testing & Storage:** The collected blood is then tested and stored. The system will update the blood inventory accordingly.
5. **Blood Distribution:** When a need arises, the system helps in matching the blood type with the recipients and aids in the distribution process.

2.6 Business Rules

In compliance with the non-functional requirements stated in the Strs documents, business rules of blood donation system are as follows:

Donor Eligibility Rule: Only individuals who meet the eligibility criteria (age, weight, health status, etc.) can register as donors.

Health Screening Rule: Every potential donor must undergo a health screening before they can donate blood.

Donation Frequency Rule: There must be a minimum period of time between two donations by the same donor (typically 56 days).

Blood Type Matching Rule: Donated blood must be matched with recipients based on blood type compatibility.

Data Privacy Rule: All donor information must be kept confidential and used only for the purposes of the Blood Donation System, security compliance with healthcare regulation (e.g., HIPAA).

Inventory Management Rule: The system must track the quantity and blood type of all donated blood in storage.

Distribution Rule: Blood units must be distributed on a first-in-first-out basis to ensure that no unit expires while in storage.

Priority of distribution Rule: If in case of crisis or emergency, priority goes to those in crisis upon request.

2.7 Goal and Objective

By implementing the Blood Donation System, we aim to not only improve our internal operations but also enhance the experience for our donors and recipients, ultimately leading to more lives saved.

The major goal of Blood Donation System in our organization is to ease and improve the blood donation and distribution system. The constantly changing environment in healthcare requires us to adjust and create new ways through which he can deliver on its mission of serving through blood donation.

3 System Operational Concept

3.1 Scope

This document covers the operational concept of the Blood Donation system, as well as any subsystems it may encompass.

3.2 Identification

The Blood Donation system will be referred to as BDS for the rest of this document.

3.3 Overview

The purposes of this document are to give a clear and obvious description of the planned BDS to both consumer and stakeholder. The main consumer audience should be organizational or government institutes who are legally allowed to operate a blood bank or a similar constitution. The stakeholders may be public or private health organizations, government facilities or individual contractors.

3.3.1 System Overview

The BDS should provide an easy, simple and convenient way for blood banks to safely store and save detailed blood donor accounts, in addition to any prior donations he or she has previously made with the consumer.

BDS should also provide various subsystems that improve quality of life and add multiple useful functions. BDS should contain a disease recognition subsystem to determine if a donor’s sample is safe or not, a method of contacting and communicating with hospitals or other medical

facilities to book the donated blood samples, and a separate database of both blood donors and receivers including related histories to both

3.4 Concepts for the proposed system

3.4.1 Objectives

The primary objective is to create an interface that allows employees to easily submit blood donor samples and saves their details in a large database. Samples from the database can then be sorted or filtered according to blood type so that the organization's employees can have a much simpler, convenient and faster way to assign samples to recipients.

3.4.2 Operational Policies and Constraints

1st. Only health organization, government facilities and licensed persona should be able to operate and use the system.

2nd. The system must not be accessed by non-employees.

3rd. A separate facility must be provided to store the blood samples and receive donations.

4th. Infected samples shall be placed in a separate database, never to interact with healthy samples.

5th. At least one employee must be present around the device on which the system is installed.

6th. The system must be active 24/7 and must be available during crisis.

7th. The database must have a backup that is continuously updated.

3.4.3 Description of the System

After being prompted by the donor, the employee should input the donor details into the system. The system submits the details into the database then requests the blood sample. Once provided, the number of available blood samples by the donor is increased. If a medical facility requests samples, the system will reserve the requested amount for the facility.

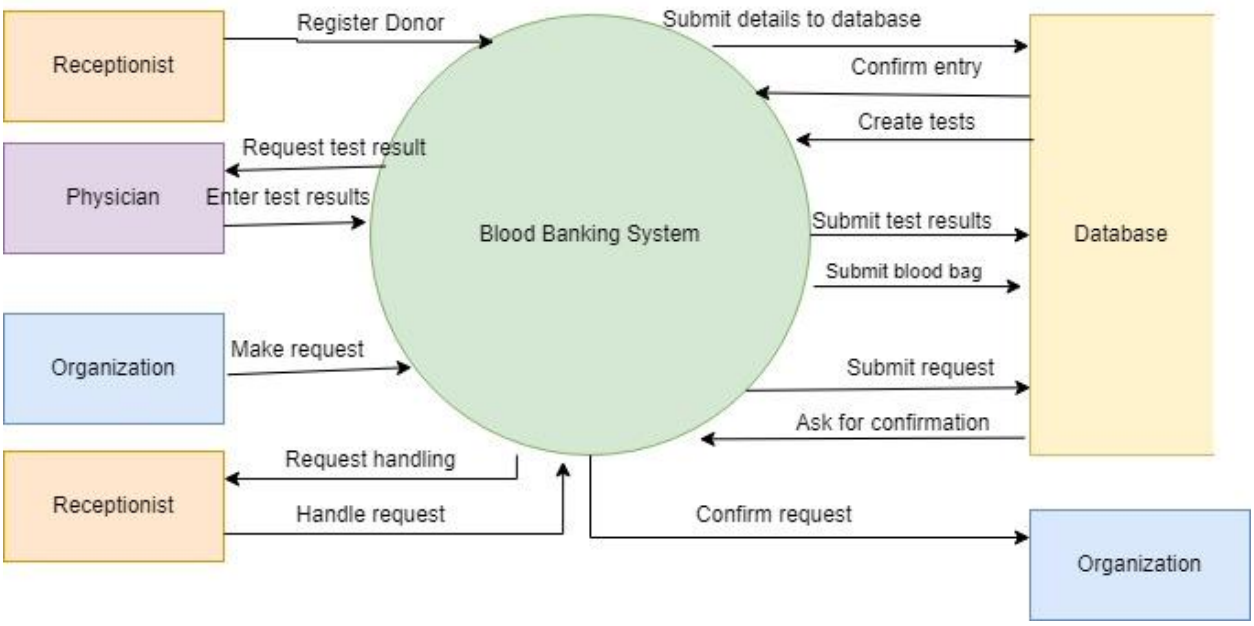


Figure 1 Level 0 DFD

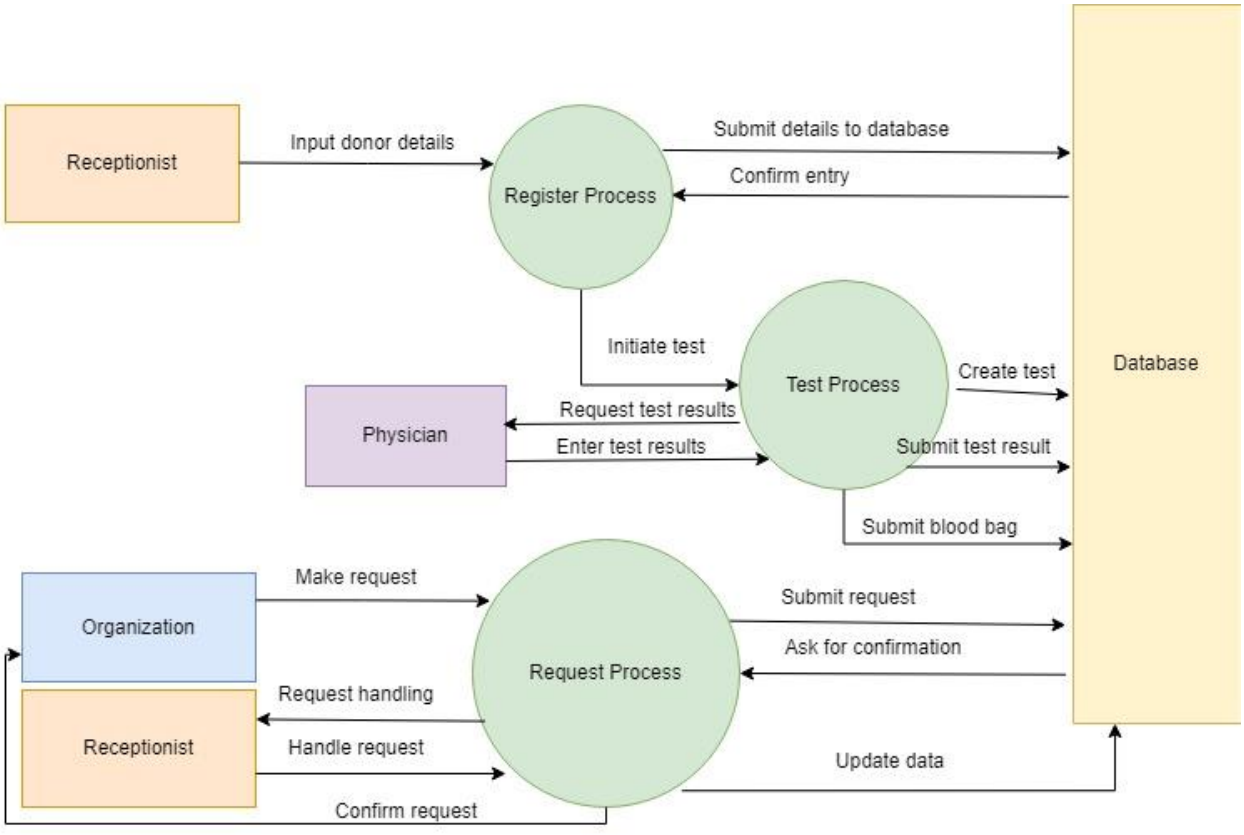


Figure 2 Level 1 DFD

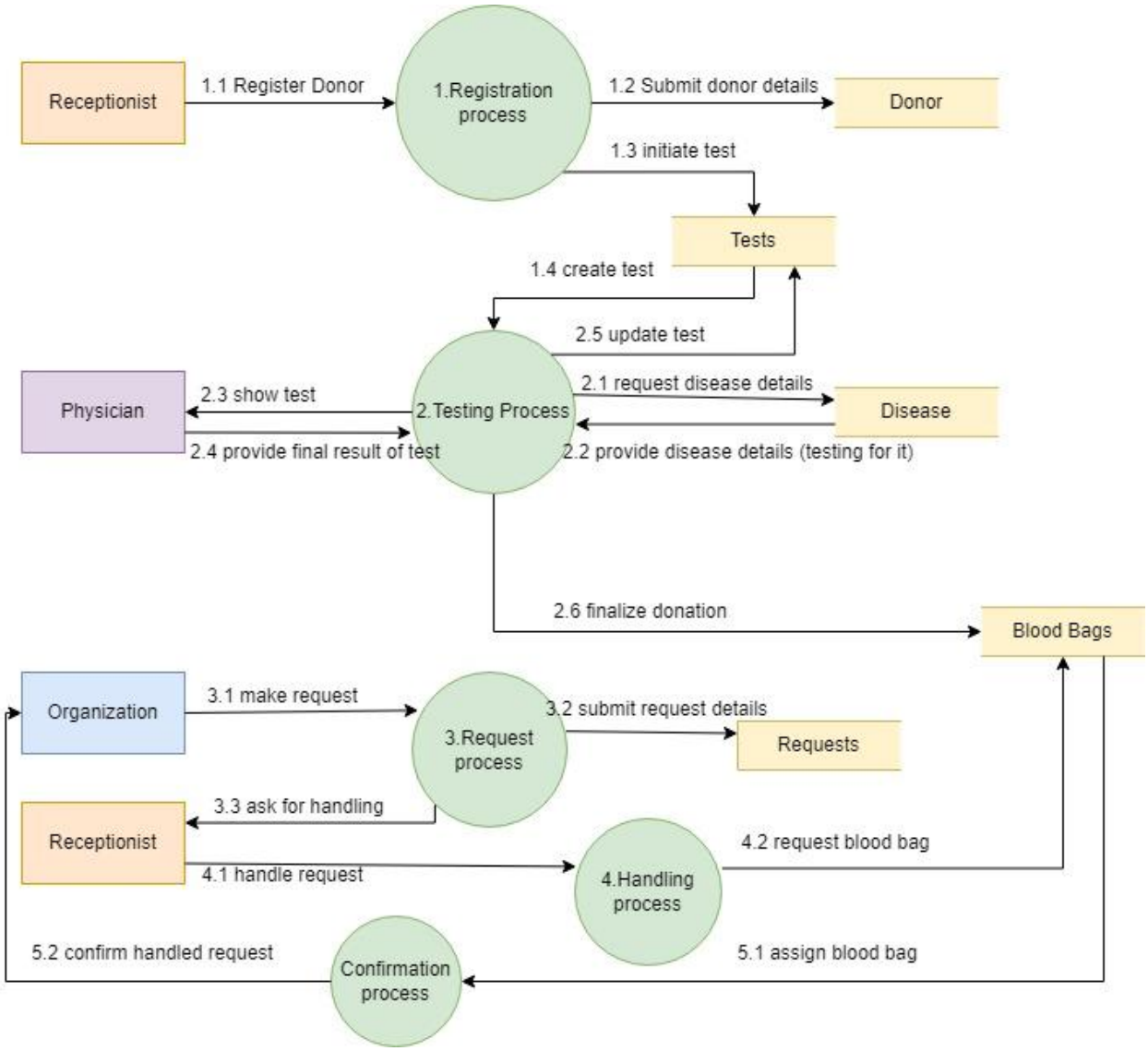


Figure 3 DFD Level 2

3.4.4 Modes of Operation

The system should always be operational. It operates during crisis and a separate power generator must be provided in the case of an outage.

3.4.5 Involved Personnel

3.4.5.1 Organizational Structure

A proper medical institution or clinic is where the system is installed. Methods of receiving blood samples are not handled by the system.

3.4.5.2 Profiles of user classes

Employee: Employees take hold of the system and mainly interact with the donors. They input the donor's details and receive their blood samples.

Medical Facilities: Medical facilities are allowed to directly contact the institution's system and request blood samples.

3.4.5.3 Other personnel

Professional medical staff is always present and are allowed to use the database. Technicians are also granted access for maintenance and repair of the system.

3.4.6 Support Environment

The institution or organization is separately contracted with medical professionals to act as staff, as well as hospitals, medical facilities or delivery companies for the task of delivering reserved blood samples.

3.5 Operational Scenarios

Scenario 1	Donor requests to donate blood. Employee asks, receives and inputs donor's details. System submits the donor as a new entry in the database, then requests the donor's sample. Sample is provided and is validated, then added to the database. The employee safely stores the blood donation until needed.
Scenario 2	Donor requests to donate blood. Employee asks, receives and inputs donor's details. System detects the user as an existing entry in the database. Sample is incremented and the blood donation is safely stored until needed.
Scenario 3	Donor requests to donate blood. Employee asks, receives and inputs donor's details. System submits the donor as a new entry in the database, then requests the donor's sample. Sample is provided and is deemed invalid. Sample is not added to the database, and the employee is notified.
Scenario 4	Medical facility requests a number of donations. The system checks for available samples and finds the number required. The system reserves the samples for the facility.
Scenario 5	Medical facility requests a number of donations. The system checks for available samples and does not find any. The facility is notified.
Scenario 6	Medical facility requests a number of donations. The system checks for available samples and does not find enough. The facility is notified.

3.6 Summary of impacts

3.6.1.1 Operational impacts

The installation of the system in any facility drastically improves efficiency and sustainability. The interface is designed with simplicity in mind such that employees are able to easily utilize the system efficiently. Procedures will take much less time to submit samples and donor details into a database, as well as much easier to assign them to patients and recipients.

Input of donor details is done on the system instead of on paper. The system is active at all times and thus allows its usage even during general crisis situations. Operational budget is reduced drastically and is reserved only for outside contracts – such as delivery companies to deliver reserved blood samples to medical facilities. The system's ability to identify suitable recipients based on donors significantly reduces the risk of human error when assigning blood samples.

3.6.1.2 Impacts during development

Studies must be conducted with medical professionals and scientists to determine valid and invalid blood samples. Personnel required will gradually decrease over time.

3.7 Analysis of the proposed system

3.7.1 Benefits

- Reduced costs.
- Greater efficiency.
- Reduced risk of human error.
- Availability in times of need, 24/7.
- Direct communication with medical facilities to quicken the delivery of blood samples.

3.7.2 Disadvantages and limitations

- Vulnerability to malfunctions.
- Chance for catastrophic database wipeout.

4 Stakeholder Requirements Specification

4.1 Introduction

4.1.1 Purpose

This document serves as an overview of the specifications for the Inventory Control Database Management System and Blood Bank Management. It offers a firm grasp of the requirements and expectations of the parties engaged in the system's development and operation.

4.1.2 Scope

This document's scope includes the following stakeholders' requirements:

- Blood bank staff
- Hospital administrators
- Regulatory authorities
- Donors
- Technicians
- System administrators
- Non-Profit Organizations

4.2 Stakeholder Requirements

4.2.1 Stakeholder Identification

Blood Bank Staff: The staff members that oversee the blood bank's daily operations, blood delivery, storage, and collection.

Hospital Administrators: The administrators who require access to blood inventory and usage reports and statistics.

Regulatory Authorities: government organizations or institutions in charge of making sure safety and blood banking laws are followed.

Donors: Blood donors who would want to keep track of their contributions and associated data.

Technicians: technicians in charge of blood product quality control and laboratory testing.

System Administrators: IT professionals oversee setting up and maintaining the system.

Non-Profit Organizations: nonprofit groups that support the project's associated social, environmental, or humanitarian goals. They can be interested in the project's results and look for assistance, financing, or partnership to carry out their goals. Involvement from them may be crucial for initiatives that affect the environment or society.

4.2.2 Stakeholder Needs

1. Blood Bank Staff
   - Interface that is easy to use for managing inventories and collecting blood.
   - monitoring of blood stock levels in real time.
   - alerts on out-of-stock or expired merchandise.
   - the capacity to create and print blood product labels.
2. Hospital Administrators
   - availability of thorough reports on blood usage, inventory, and waste.
   - Better decision-making through data visualization.
   - Control user access to protect data.
3. Regulatory Authorities
   - adherence to legal requirements, such as those regarding reporting and data preservation.
   - System access for audits and inspections.
4. Donors
   - the ability to browse their donation history through a portal.
   - Notifications of upcoming donation appointments.
   - details regarding their eligibility to donate and state of health.
5. Technicians
   - Tools for testing and quality assurance of blood products.
   - historical data availability for quality control.
6. System Administrators
   - robustness and scalability to aid in system maintenance.
   - Techniques for data recovery and backup.
   - safeguards to keep sensitive data safe.
7. Non-Profit Organizations
   - Opportunities for cooperation to further their goal.
   - access to data and project information that supports their case.
   - Requests for possible financing or assistance to advance their activities.
   - advocacy in behalf of philanthropic, environmental, or social causes.
   - participation in the decision-making processes of projects, particularly when those projects have a direct bearing on their goal.

5 System Requirements Specification

5.1 Introduction

The Blood Donation System Database is designed to facilitate the management of blood donor information, and inventory for a blood donation center or organization.

It will be used by healthcare professionals, staff, and administrators to ensure the efficient collection, storage, and distribution of blood and related information.

5.1.1 Purpose

The purpose of the Blood Donation System Database is to streamline the blood donation process, ensuring that an adequate supply of safe and compatible blood is available for patients in need.

High-level objectives include improving donor management, enhancing inventory tracking, and increasing the overall efficiency of blood donation operations.

5.1.2 Project Scope

The system will manage donor registration, donor information updates, and blood donation history.

It will not handle financial transactions, such as payment for blood or services.

The system will be used within the blood donation center and accessible to authorized personnel.

5.2 Overall Description

5.2.1 Description

Internal Interfaces:

Donor Registration and Management Module: model that interfaces with the donor registration and management module. This module handles the initial registration of the donors, updates donor profiles, and finally maintains an in-depth record of donors' medical and donation history. The database is tightly integrated with this module to ensure the accuracy of donor information.

Inventory Management Module: The inventory management module can communicate with the database itself that it updates and retrieves information on the available blood types, quantities, and expiration dates. This real-time connection is certainly crucial to maintaining and ensuring that the center maintains an adequate and safe blood supply.

Reporting and Analytics Module: The database supports the reporting and analytics module method : providing data for generating reports on donor statistics, and inventory levels. It allows for data-driven decision-making and performance analysis.

External Interfaces:

External Data Sources: The Blood Donation System Database may interact with external data sources for verification of donor information, such as government health databases, to ensure the accuracy and integrity of medical records.

Blood Testing Laboratories: The database might share donor-specific data with external blood testing laboratories to facilitate the screening and testing of donated blood.

Messaging Services: The system may communicate with external messaging services to send appointment reminders to donors.

5.2.2 User Class

User classes include Donors, Healthcare Professionals, Administrative Staff, and System Administrators. Donors provide their information and donate blood. Healthcare Professionals manage donor health data. Administrative Staff schedule appointments and oversee inventory. System Administrators maintain system security and configuration.

5.2.3 Operating Environment

The system will operate on standard server hardware and support a range of web browsers for user access. It will require a database server (e.g., Oracle SQL) and a web server.

5.2.4 Design and Implementation Constraints

Budget constraints may limit hardware and software choices. The system must operate within the organization's existing network infrastructure.

5.2.5 Assumptions

Assumptions include that donors provide accurate medical information, and the organization complies with data privacy regulations.

The website will remain accessible 24/7, except during planned maintenance periods, and will be capable of handling crisis-level traffic and usage.

5.2.6 Dependencies

The system relies on external messaging services for appointment reminders and may interact with government health databases to verify donor information.

5.3 Functional Requirements

5.3.1.1 Functional Conditions

1. Addressing Blood Shortages
    - Therefore, such a system should try to bridge the gap between blood supply and needs.
    - The should take into considerations such as, mismanagements and inefficiencies in becoming databases.
2. Donor Management
    - Use a patron system for tracking eligibility of a patron, reminding eligible givers.
    - Provide a way of identifying areas near blood donation camps and encourage more people to donate blood.
3. Request Management
    - Devise an appropriate place for blood donors to freely ask for blood when needed.

4. IoT Integration
    - Connect the application to the server using IoT and allow inter-application communication.
    - Improve efficiency in IoT on data collection as well as sharing.
5. Promoting Community Health
    - Help create a healthy community through a campaign for blood donation, solving urgent cases of acute blood shortages.
6. Data Collection and Analytics
    - Data collection and analysis to improve upon the blood bank performance and make evidence-based decisions.
7. Unborn Scope and Conclusion
    - The system should have the capability for unborn expansion, particularly t he development of a graphical user interface(GUI) grounded application.
    - The
      GUI application should enable users to connect with colorful blood banks in the megacity and access information about
      the availability of different blood types.
    - GUI application should give real- time information about available benefa ctors in case of emergency situations.
    - The system should support the integration of the application with ambulances to save time during emergency medical situations.
    - The application should allow ambulances to piece up information about patients' blood types and direct them to hospitals.
    - Hospitals should admit announcements before
      the expiry date of blood units
      and be informed about forthcoming test dates and results for blood units.
    - A devoted application for blood benefactors should be developed, which sends SMS warnings to eligible benefactors and provides information about forthcoming blood donation camps.
    - The system should grease the creation of an informed and apprehensive community regarding blood donation and its significance.

5.3.1.2 Non-Functional Requirements

1. Database Management
    - The system should efficiently manage and cache blood bank data.
    - It should support data creation, retrieval, update, and deletion from colorful perspectives.
2. Efficiency and Time Savings
    - The system should be designed to enhance efficiency and save time in managing blood bank operations.
3. Database Structure
    - The system should have a well- structured database to support effective blood bank operations.

4. Server and Application Integration
    - Ensure that the server and application components are well-integrated to give a flawless experience for users.
5. Security and Compliance
    - Implement security measures to cover sensitive medical data, icing compliance with healthcare regulations (e.g., HIPAA).
6. Scalability
    - Design the system to handle a potentially large volume of data and druggies as it gains fashion ability.
7. User Announcements
    - Give announcement features for benefactors, blood donors, and other applicable stakeholders.
8. User Interface
    - Design an intuitive and user-friendly interface for the application to grease easy navigation.
9. IoT Device Compatibility
    - Ensure compatibility with IoT devices for effective data exchange and communication.
10. Training and User Support
    - Develop a training program for users to understand the system and offer specialized support when demanded.
11. Documentation
    - Prepare user manuals and specialized documentation for system administrators.
12. Testing
    - Plan and execute thorough testing, including unit testing, integration testing, and user acceptance testing.
13. Compliance with original regulations
    - Ensure that the system complies with applicable original healthcare and data protection regulations.
14. Budget and timeline
    - Establish a clear budget and timeline for the development and implementation of the system.

These system requirements should serve as a foundation for the design, development, and implementation of the Blood Bank Database Management System, addressing the requirements outlined in the abstract and icing that the system is effective, user-friendly, and biddable with regulations.

5.4 Use Cases

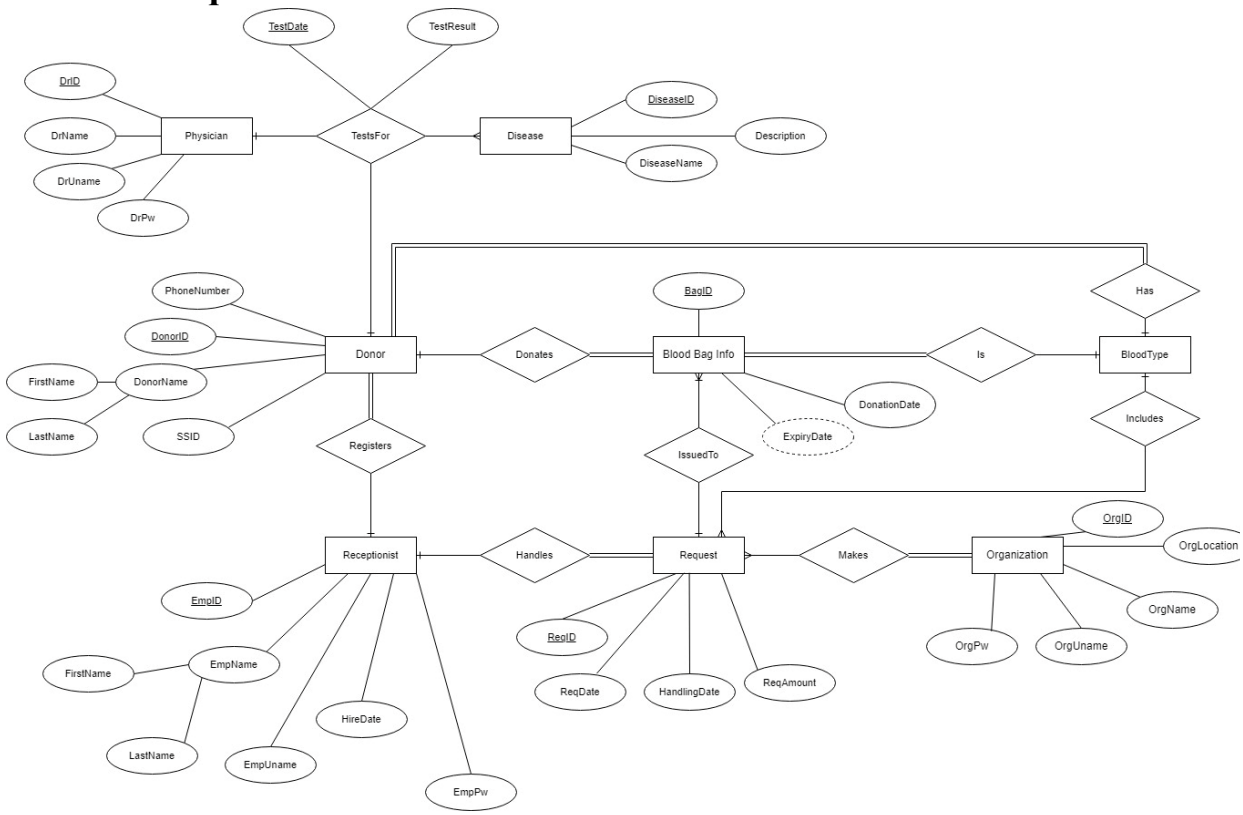
1. **Submit Donor Details:** This is a use case where a user submits their donor information. It involves interactions with the "Submit Donor Details" process and the "Confirm Submission" process.

2. **Primary Blood Sample Database Interaction:** This represents the interaction with the primary blood sample database, which may include use cases like "Retrieve Sample" and "Increment Samples for Donor." These interactions involve the "Primary Blood Sample Database" process.
3. **Medical Facility Interaction:** This use case involves interactions with medical facilities. It may include "Request Sample" and "Provide Sample" actions. These interactions involve the "Medical Facility" process.
4. **Employee Actions:** It's not entirely clear from the DFD what specific actions employees are performing. However, there might be use cases related to employees that could include "Input Donor Details," "Request Sample," and "Provide Sample."

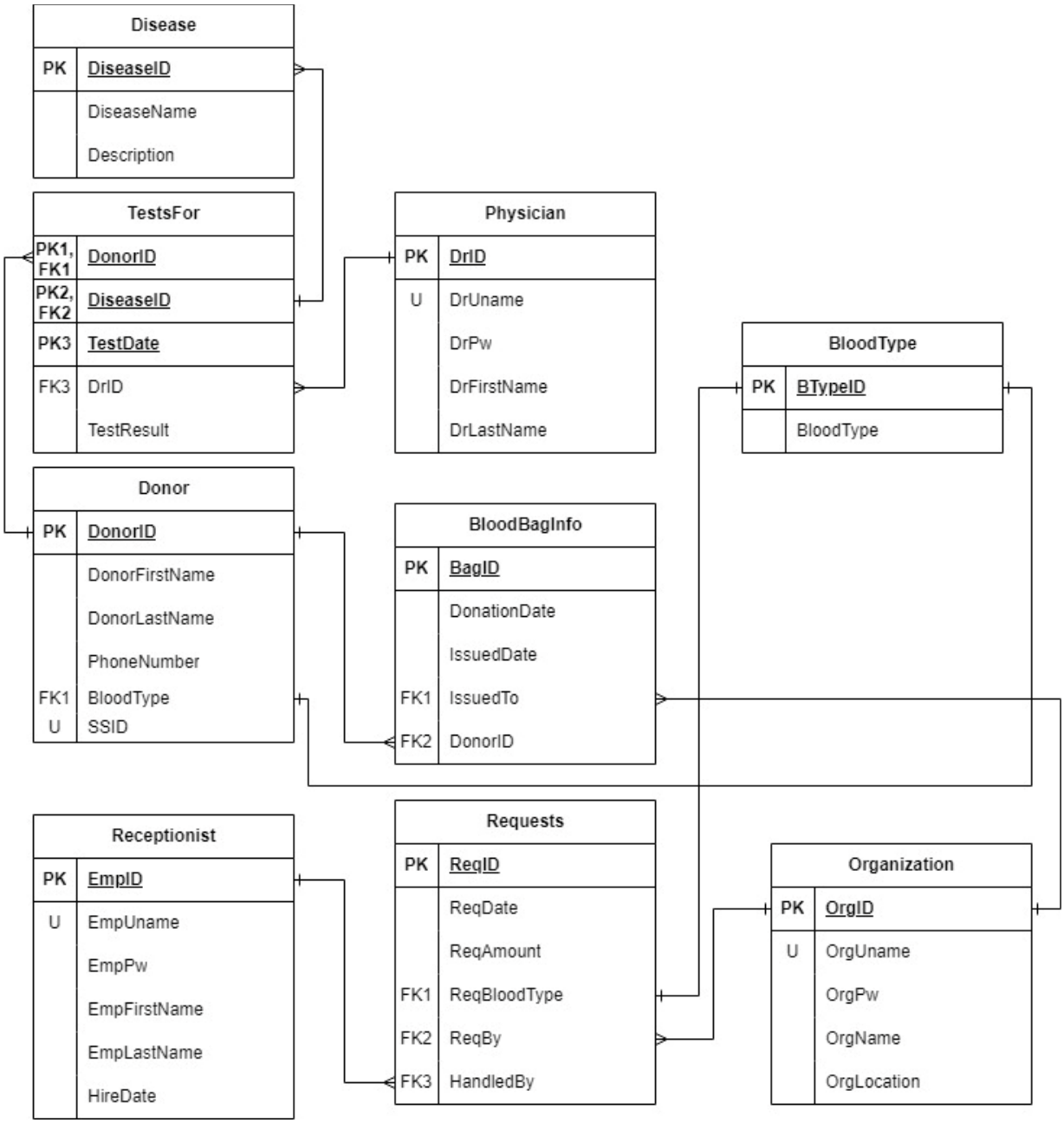
While in the second level.
Based on the additional information provided, you can identify more specific use cases in the Level 2 DFD diagram for the blood donation system. Here are the updated use cases:

1. **Submit Donor Details**
   - User submits donor information.
   - Process: "Submit Donor Details."
2. **Submission Process**
   - Check sample for diseases.
   - Validation process.
   - Display results to the user.
   - Interactions with the "Submission Process," "Validation Process," and "Result" processes.
3. **Primary Blood Sample Database Interaction**
   - Increment samples for a donor.
   - Decrement samples for a donor (reservation process).
   - Interactions with the "Primary Blood Sample Database" process.
4. **Reservation Process**
   - Request samples for reservation.
   - Confirm reservation.
   - Interactions with the "Reservation Process" and "Confirm Reservation" processes.
5. **Medical Facility Interaction**
   - Request sample from the blood donation system.
   - Provide a sample to the system.
   - Interactions with the "Medical Facility" process.
6. **Employee Actions**
   - Input donor details.
   - Request sample from the blood donation system.
   - Provide a sample to the system.
   - Interactions with the "Employee" process for these actions.

5.5 Data Requirements



ERD of Blood Banking System



Schema for blood banking system

5.6 Glossary

Donor: An individual who provides blood donations and registers with the system.

HIPAA: Health Insurance Portability and Accountability Act, a regulation for safeguarding healthcare information.