

Designing an Information System Model for National Blood Bank of Sri Lanka

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Abstract— *Life is a precious element from all the belongings we have. Blood is an essential asset for survival from different circumstances. Therefore, donation of blood is an essential criterion for the human beings to save the lives of their beings. The National Blood Bank of Sri Lanka is the only authorized institute that maintains the donation of blood. The existing system faces the challenge of dealing with management of donating blood as it is manual. Similar systems in the global context have been developed as web based systems as well as android applications. In the local context, there is only one system that can be found which will help to organize blood donation campaigns. This study is based on designing an Information System Model for the National Blood Bank of Sri Lanka to utilize the donation of blood to minimize the existing barriers such as limiting early reservations for donations, lack of centralized database to keep the donors' records, low security etc. The system will also facilitate organizing blood donation campaigns all over the country with the help of the National Blood Bank of Sri Lanka. An extended version of scientific method has been used as the research methodology and it has been accomplished by using software requirements namely ASP.net and Microsoft SQL Server database. Using the queries that have been written, blood transfusion can be done effectively, as for the need and on time. The limitations of the manual system can be indicated through the observations of the existing domain and providing a questionnaire to the staff of blood bank. The system has been tested in the real blood bank environment. Evaluation of the solution has been done with 30 participants from the Blood Bank and the results show that 80% increase in the productivity in six months.*

Keywords— Donor, Blood, National Blood Bank

I. INTRODUCTION

The requirement for the blood is an important factor in contemporary medicine and healthcare. For every second there will have an individual who needs blood to save the life. National blood bank of Sri Lanka is the only

authorized firm for coordinating and administrating donation of blood, blood stocks & stock movements. Yet, blood management has been identified as a challenging task the existing manual system engages in certain limitations. This paper is introduced an Management Information System for the National Blood Bank of Sri Lanka to utilize the donation of blood. In doing so the introduction outline objectives, background and motivation for the research, problem in brief, proposed solution, resource requirements, overview of the structure of the rest of the paper.

With the aim to design a MIS to the Blood Bank this paper has identified the following key milestones.

- To critically study the current practices and issues in blood donation management in Sri Lanka.
- To critically study the existing computer based solutions for blood donation management in local and world context.
- To provide online information flow for the management of blood donors, patients and staff of blood bank.
- To provide a means for the hospital's blood bank to publicize nationwide information about the blood donation events to the public.
- To provide authentic and authorized features to current system where private and confidential data can only be viewed by authorized user.
- To facilitate users to organize blood donation campaigns with the aid of Blood Bank.
- To provide synchronized and centralized donor and blood stock database to the blood bank.

Blood donation and transfusion service involves management of donating blood, maintaining blood stocks & stock movements for a successful blood transfusion on time as per the requirement. Given the dangerous nature of blood and blood components, it contains the difficult controlling, monitoring and the complete documentation of the whole procedure from blood collection to blood transfusion and it will directly affect to donors, patients as well as the staff of Blood Bank Sri Lanka.

Nevertheless, in face of the significant amount of data and information in a daily interval, blood bank of Sri Lanka currently encounters various errors certainly that will lead to major risks in the mentioned process of blood donation and transfusion service. Errors at the time of administration of blood or blood components are the most frequent documented site of error in the transfusion of the wrong blood. Furthermore, with the existing manual system there is no chance to facilitate donors for early reservations for their easiness. Lack of centralized database to keep donors records and low security are also critical failures in the current procedure.

A. Proposed Solution-MIS for National Blood Bank of Sri Lanka

Management Information System that will be the solution for the above problem has been designed by using ASP.net and Microsoft SQL database that will be run on windows based operating system. The donor details that are captured by the bar code system, donor details blood stock details, donation campaign details are stored in Microsoft SQL database. There will be a separate system that will be developed by using php and MySQL database as the client. With the aid of a web service that will be forced on Service Oriented Architecture patient details in the client side have been matched with particular donors who are compatible with the patient's blood group. This can be presented as a simple algorithm and using the quires that have been written, blood transfusion can be done effectively, as for the need and on time.

II. METHODOLOGY & EXPERIMENTAL DESIGN

Research methodology of this paper is an extended method of scientific technology. Therefore, the background theory is built up with observations, study, problem definition, hypothesis, experimental design, data gathering and analysis and finally conclusion.

According to the targeted domain, observations have been done by vising the blood bank of Sri Lanka with expectation of identifying real scenario. Here, an interview had been conducted with the staff members of blood bank which is situated in Narahenpita. The procedure of the blood donation has been described as step by step.

Donor registration, patient registration, blood stock management and stock movements and issuing and conducting donation campaigns are the main activities of the blood bank and currently there is a manual system to

maintain the records of particular parties. Donor registration is accompanied by either in-house registration which is done by in blood bank or branches of blood bank in hospitals or mobile registration which is conducted as blood campaigns all over the country. In-house registration is handled by using bar-code system. Blood donating is a continuous activity and it is not only performed when the blood is required for a particular patient. The person who is willing to donate blood must be fulfilled several specifications to be qualified as a donor. If he or she is qualified he will be registered as a donor by filling the details of unit no, date, name & address, NIC, Telephone No, Sex, Blood group, no of donations and etc. Unit No is the blood packet no and it is the no that can be identified the donor after the donation onwards.

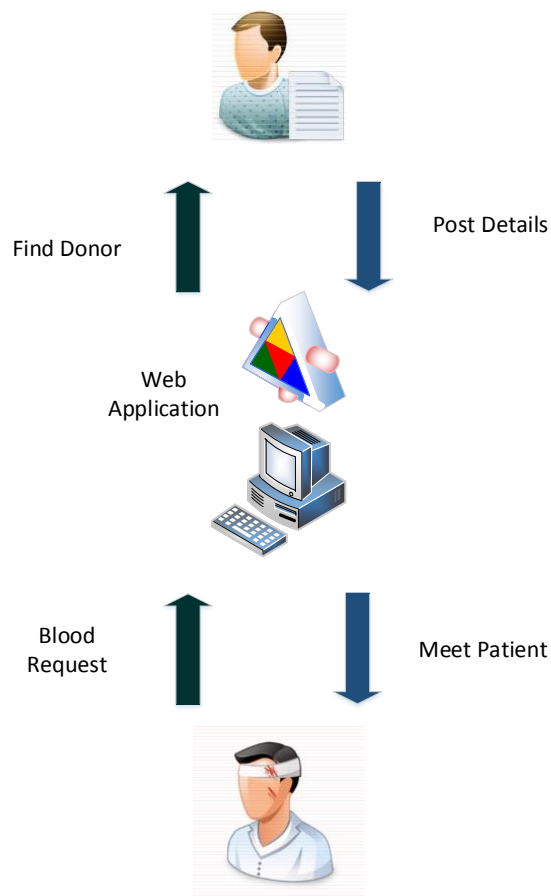


Figure 1. Scenario of the Proposed Solution
Source: Author

Blood stocks are maintained as group wise, Rh, reserved or unreserved blood (daily or monthly) and discard date of blood. If the particular blood group is currently not

available in the hospital blood bank it should be informed to the nearest cluster to that particular hospital. Stock movements are handled in a situation of unavailability of rare blood groups.

National blood bank keeps no of registers for the purpose of maintaining records of requests, donors, cross match and etc. Mobile campaigns are conducted by several organizations with the permission of the blood bank.

A. Literature behind the Analysis

Research accompanied on similar study areas are inspected in the hope of eliciting and analysing underlying research concepts behind those researches. Moreover, the study can be used to view the problem and proposed solution in terms of a general and different perception so that a quality solution can be stated.

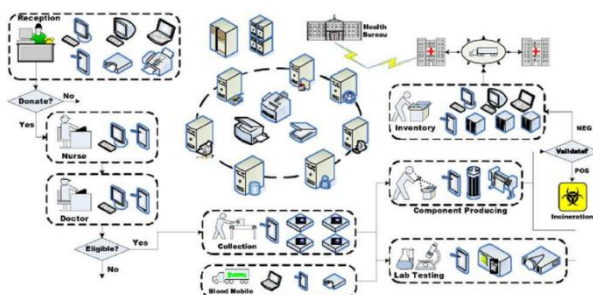


Figure 2. Workflow and infrastructure of a blood bank information system

Source: Chao, Dong and Li, 2008

1) Bar Code Reader & Electronic Donor Card Read/Write Machine:

As mentioned by Chao, Dong and Li (2008), SIBAS- A Blood Bank Information System and Its 5-year Implementation at Macau has been used peripheral devices and instruments such as barcode reader and printer to the purpose of printing donation number. Every division of the blood bank is prepared with barcode readers so that a series of complex processing could keep rigorous consistency. Electronic donor card read/write machine is another technology that SIBAS used to provide the best service to blood donors. Electronic donor card may be the most welcomed one. It can not only store the donor's basic data in magnetic bar but also print the fine picture about the donor's donation information. The whole solution is based on the thermo rewritable card technology of Rewrite Card Technology Inc.

It is efficient for using a barcode system than entering donor details manually. It will be helpful for the donor as well to be identified as a donor. Electronic donor card is also benefited for the identification of a donor. But the technology that is used is advanced for the proposed system

2) Oracle-Based Database:

In terms of data and information management, SIBAS provides the all-round Oracle-based database solution in server end. The independent Oracle databases are configured, respectively, for the data and information of blood donors, donation, blood laboratory testing, and blood producing and inventory management (Chao, Dong and Li, 2008). In general, there is an optimized database for every division of CTS-Macau so that the efficiency of data management and information accessing could be substantially improved.

User role controlling has been handled by SIBAS using a specific database for use role management and controlling (Chao, Dong and Li, 2008). Before any operation on real database of blood bank information, the user has to pass through a series of independent procedures of identification and verification. On the other hand, the user's any operation on blood bank information will be recorded for backward inspection in this database. Middleware is used to improve the efficiency of data operation and information accessing; SIBAS makes good use of the concept and method of middleware, namely, packaging procedures, functions and triggers in Oracle database for data operation. Then the client end just submits its request and receives the desired results.

One advantage of using Oracle databases is due to Oracles belief in customer satisfaction. For example, all Oracle databases are backward compatible. Another important advantage offered by Oracle databases are their reliability. Oracle is a database that delivers excellent performance when challenged with demanding tasks. Oracle databases incorporate Flashback technology, which is a significant advantage. In the event of an application outage, due to any number of reasons, it is important not to lose data stored on a database system. Oracle's Flashback technology allows for efficient recovery of data incorrectly deleted or lost. Thus, Flashback technology essentially removes human error and increases database recovery time. In the end, this feature allows for a simplified management and administrative process.

3) *Android Technology:*

The Optimization of Blood Donor Information and Management System by Technopedia proposed a web based application and android application so that the blood donors are available easily within the required time (Priyal, Saranya and Shabana, 2014). The donors who are nearby location are tracked by the android application using GIS. The purpose of website is to update the relevant information regarding the donors who have already donated blood in various hospitals, therefore when it is needed for any others they can view other donors where it can be accessed through this website.

The web application has a system database where it consists of the information regarding existing and new donors and acceptors. The main problem is related with the information about knowing the details of donors in the city. The android application uses the GIS where the function is called as Geocoding which creates a point on a map to find the nearest locality of donor. A function of GIS is Onscreen digitization where the acceptor or patient who need the blood from donor for entering the data on the screen of the mobile phone.

Gift4Life is a similar system in Sri Lankan context that was developed as a web based blood campaign management system and also an android application. The application automates the operations online and has high user involvement in user registration, hosting a blood drive and search for a blood drive (Rajapaksha, 2013). A blood donor information management system that supports interconnection with e-mail, notification alerts or feed backs and social media. It also includes the location based services and monitoring of statistics (report generating facility). Android application that has searching, filtering and navigating facilities, updating donor profiles, get and spread information, use of social media and location based services.

The biggest advantage of Android is that it is an open source, integrated software platform and it also has a modern design so it is easy to use and install as well. Android allows developers to design applications for users based on their preferences. This is possible as Android OS is customizable for the particular project based on blood donation management. As android is an open platform it always tends to be far less expensive than other than conventional products.

B. Failures in the Current Practices

With the aid of observations and study problem definition of the research domain can be identified. Existing system does not facilitate donors to make early

reservations or bookings on the session of blood donation. It is a very important facility for those who are very busy and yet enthusiastic people to know and be sure when they can make blood donation instead of trying to work out where and when they can make blood donation when they are free. Lack of centralized database that will be used to keep the donors' records is also a major problem in this existing scenario. Each blood bank is having their own records of donors. If a donor makes donation in different hospital, no previous records can be traced except if the donor brings along the donation certificate. Hence, the donor is considered to be a first-timer if they make blood donation in a new place.

With the manual system, there are difficulties in managing the donors' records hence the system requires more space to store information and it also has a risk to damage or misplace the documents. It has affected the low security of the current system. Unauthorized users may access the documents and make some changes. The accessibility is limitless and it affects more corruptions to the system. The current system is handled by the human beings without the aid of a machine. Human beings create more faults than a computer when inserting, deleting and updating data to the document manually. This is where designing a model to utilize donation of blood becomes more essential.

C. Hypothesis for Proposed Model

Proposed Information System Model can improve efficiency of Blood Donation of Sri Lanka as it is a critical issue as indicated above. Users of the proposed system can easily access through the web application with minimum errors and mainly overcome the existing problem of the system. Donors who are willing to donate blood can be accomplished the donation effectively with their busy schedules and finally transfusion can be achieved for the justification of particular patients. As a whole the proposed solution will be benefited to the patients who are required blood.

D. Experimental Design

Proposed Information Model will use a central database to store blood bank details of Sri Lanka including donor details, blood stock details and details about blood donation campaigns. Since the system is web based, authorized persons can login anywhere and anytime. User interfaces developed using ASP.NET that allows access to SQL database which located on the computer to retrieve store and update the information. The solution

also embraces a php based system that will store the details of patients who are required blood. This portion of the solution will be connected to the central data base with the aid of a web service that will be written as a web method of ASP.Net.

Information System Model that is introduced through this research has been consisted with three layers namely Presentation Layer, Application Layer and Data Link Layer. Presentation Layer handles interactions with users by controlling interfaces to present information that are identified in observations and study in the scientific method. Information which is gathered by the presentation layer will be delivered to the application layer in order to manipulate according to the given instructions.

The foremost roles of the proposed model are Administrator, Donor, and Medical Officer In charge, Medical laboratory Technician (MLT), Nurses, Public Health Inspector (PHI) and Campaign Organizer. Here, donors have the facility of creating their profiles by entering their main details. They are also able view the details of upcoming events that will be held by the Blood bank of Sri Lanka. MLTs, Nurses and PHIs will have the ability to enter donor details, blood stock details and blood campaign details. Any user who accesses this solution will have a great chance to consolidate a blood donation campaign with the approval and the help of the national Blood Bank of Sri Lanka. Medical Officer In charge will enter the patient details through the system in the particular hospital that will be designed using php.

Application layer builds collaboration between the presentation layer where the inputs of the interfaces and the data link layer where the required data are contained. To accomplish the objectives of the proposed model, the application layer designates the logics and processes of the solution. The solution will be designed by using the ASP.Net.

Data Link Layer comprises the database management applications which will be facilitated to store the data of each module. Data base that is designed by Microsoft SQL Server 2008 R2 contains separate tables to store details of Donor, Donation, Blood Stock, Blood Issuing and etc. The users access the data that stored in the application on the data link layer over well designed interfaces that run on the presentation layer and the

user only receives the result of his/her request which capture the storage details from the user.

E. Data Gathering & Analysis

This research was highly based on gathering data using the techniques explicitly interviews, questionnaires, observations and documentary reviews. Here, interviews were conducted as face to face and though telephone with the blood bank staff members as representation of server side as well as with the medical officer in charge in certain hospital to represent client side. Interviews had been accompanied with an administrative member of Blood Bank in Narahenpita and a medical officer in Kegalle teaching hospital to identify the existing procedure, failures and the suggestions. The existing domain was also studied through the observation of current practices. Documents that had been provided by the interviewees were greatly useful to get a clear idea of the process. Blood Request forms, Blood stock details forms, donor registration forms and blood issuing forms are directly provided and donor information book that keeps all the details of donors was revealed.

Primary data have been gathered from the National Blood Bank of Sri Lanka and Kegalle Teaching Hospital. Primary data are the basic information to develop the application such as Donor Details, Patient Details, Blood Stock Details, Stock Movements and Campaign Details.

A mixture of qualitative and quantitative methodologies has been used as data analysis. Interviews and observations had been considered as qualitative methods where questionnaires and documentary review had been deliberated as quantitative methods.

III. RESULTS

With an in-depth analysis of data which have been gathered the proposed solution have been developed in ASP.net as server end with Microsoft SQL Server 2008 R2 and php as client end with MySQL database .This Proposed work predominantly consists with modules specifically donor registration, patient registration, blood stock management, stock movements, donor motivations and campaign management.

The solution has the ability to create donor profiles entering proper username and password. Here, he can register by filling main details and system has the ability to search if the donor is qualified for donation with his main details. If the donor is qualified with his main details system will send an e-mail to inform the particular donor. The system should be able to focus the location of the

particular donor. This solution will also inform the location that the donor can face to the test and if he/she is qualified, the transfusion can be completed and also have the ability to cancel the donor registration of any donor before or after getting blood. This kind of situations can be arrived due to disqualifications of those donors.

In the client side, authorized medical officers can add patient details to the system when the blood is required and alert will display in the system about the request in order to response to the particular request. According to the blood group of the particular patient the system will search if the blood of particular blood group is available. If the particular blood group is not available system has the ability to view it and send e-mails for nearest cluster. And also system will send an e-mail or a message to the donors who are matched with the blood group of the particular patient who required blood if the cluster does not available the particular blood group.

Proposed solution can access at any time details of both reserved and unreserved stock (by type of units, group and special characteristics. System has the ability to add/edit/delete details of shelf life of all units (time to expiry and will provide details of stock received, stock used and stock discard at monthly/as required. System should have the ability to record and stock details of unit movements including transfer between unreserved and reserved stock. System will also have functionalities such as linking all blood donation centres to generate the National Donor Registry to maintain the National Donor Registry for the system to alert suitability for donation status of the donor and ability for the system to view details of blood donation campaigns all over the country.

Following figures illustrates some of the interfaces of the proposed solution.

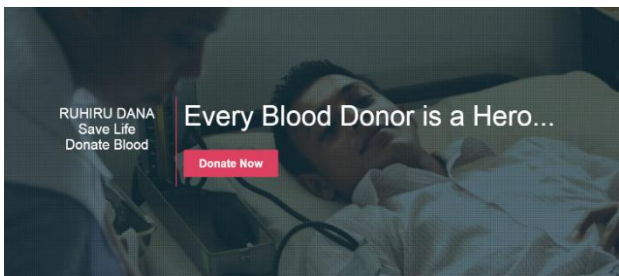


Figure 3. Home Page of MIS
Source: Author

Figure 4. Donation Details
Source: Author

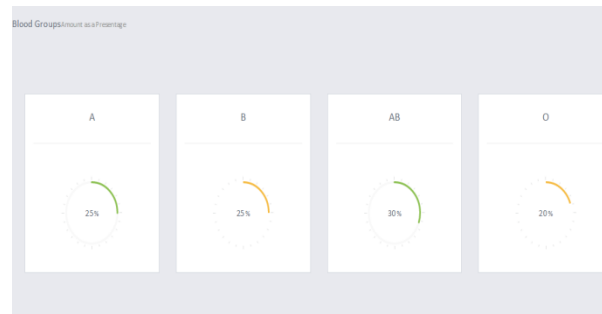


Figure 5. Visualizing Blood Groups
Source: Author

With an in-depth analysis of data that were gathered and the results that were gained by introducing this system, the mentioned hypothesis can be easily proved. Proposed system have been used in real blood bank environment and documents were proved that Users of the system can easily access through the web application with minimum errors and mainly overcome the existing problem of the system. The quality of the system was in a high with compared to manual system and Donors who are willing to donate blood can be accomplished the donation. As a whole, Transfusion can be achieved by providing a great chance to the helpless patients who were suffering with requirement of blood.

Patient Name	Donor Title	Donor Name	Donor Blood Group	Donor Email	Donor Tel	Donor Address	Donor NIC
Patient Blood Group: B-							
Sandun	Ms	ACI Amarasighe	B-	tsuchintha@gmail.com	0714964367	Gampaha	901234567V
Patient Blood Group: O+							
Bimal	Ms	SRCN Senanayake	O+	netimisonenayake@gmail.com	0711234567	Kegalle	915293255V

Figure 6. Matching Blood Groups using Web Service

Source: Author

IV. CONCLUSION

In this paper, an Information System Model to utilize the Donation of Blood has been explored. The research observed the underlying characteristics of blood donation and related data, and pointed out the relevant decisions for identified donation operations. Then, with the literal concerns on blood donation and transfusion service, various technologies that support were reviewed and commented in detail. The service provided by the proposed system is needed and valuable to health sector where a quality of the blood is considered for the safety of the patient through a systematic process by the blood management system. Finally, the research implemented an information system model to utilize the donation of Blood in National Blood Bank of Sri Lanka. It is based on an ASP.net web application using the Service Oriented Architecture.

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