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Contribution to the Computerization of the Information System of the National Blood Transfusion Center of Chad

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Abstract **Original Research Article**

Introduction: The work presented in this document concerns the computerization of the information system of the CNTS in Chad. It follows on from an initial work which consisted in setting up a system allowing the systematic collection of data on donors, donations and LBPs. Given its organization and with the evolution of time, the system presented difficulties in terms of the fluidity of the circuit and the automation of data collection. The main objective of this project is therefore to improve this system by defining an improved circuit by strongly involving the users and the computerization of the data collection system. ***Material and methods:*** The material consisted of human and IT resources. The work methodology focused primarily on user training, defining a new data circuit, adding other functionalities to the data collection software and setting up an intranet. ***Results:*** As a result of this work, we achieved full user support for the system. Many other software features have been developed and a new data circuit has been defined. ***Conclusion:*** Thanks to the strategies put in place, we have succeeded in computerizing the entire blood donation circuit in this center, thus making the information circuit more fluid. The results of this work can serve as an example for the development of health information systems in a country like ours. Prospects for extending the system to the collection of other data can be explored by those in charge of the center and why not the possibility of extension at the national level?

Keywords: Health information system, computerization, blood donation, Labile Blood Products, National Blood Transfusion Center, Ndjamena.

1. INTRODUCTION

An information system is an organized set of resources (personnel, software, processes, data, materials, IT and telecommunications equipment, etc.) allowing the collection, storage, structuring, modeling, management, manipulation, analysis, transport, exchange and dissemination of information (texts, images, sounds, video, etc.) within an organization [1-4]; it is the memory, the ears and the speech of the organization [5]. The use of IT resources makes it possible to dematerialize and automate most of the operations in an information system.

The benefits of computerization are numerous: sharing of information, saving time, improving data protection and confidentiality, ... [6-9].

The work we present here follows on from what we did in the previous year, which consisted of improving the data collection system. During this previous work, we had set up a system centered on the systematic collection of data on the donor, the donation and the products generated and information on their release. This allowed us to build a database of all donors and the products generated from their donations. A data collection application that we designed was implemented but could not record all of the data due to lack of other features.

The main object of this work is therefore to improve the previous work by developing the application implemented in order to allow the collection of all the data produced in the information circuit and their exploitation on the one hand and on the other hand

in putting in place a system to capture data as it is produced.

1.1 Presentation of the reception structure.

The host structure is the Chad National Blood Transfusion Center. It was created by Law 027 of October 11, 1996 [14]. In 2000, a decree defining its statute and its missions (the organization of blood transfusion at the national level by ensuring the samples, preparation, storage and distribution of blood and its derivatives) was published [14-16], but it was in 2009 that the CNTS became truly operational.

1.2 Presentation of the existing information system.

The system we present below is based on the work we did last year.

1.2.1 General presentation

It is a system based on the use of paper forms for data collection and a computer database for data storage.

Here is how the system is organized

- The data are produced and collected on paper forms at the level of five units (pre-donation examination, sampling, biological qualification laboratory, separation laboratory and management of labile blood products).
- Pre-donation data: identification of the donor and other administrative information (donor number, name, first name, date of birth, place of birth, blood group, sex, profession, national identity card number, marital status , type of donor, level of study, telephone number 1, telephone number 2, address or place of residence, surname and first name of a trusted person, telephone number 1 trusted person, telephone number 2 trusted person) and the pre-donation test questionnaire.
- Data from the collection room: date of donation, donation number, quantity to be collected, quantity collected, state of donation (rejection or storage), reasons for rejection (rejection, insufficient quantity, incompatible pre-donation test, low hemoglobin, underweight, abnormal blood pressure)
- Data from the biological qualification laboratory: examination type (HIV test, hepatitis B test, hepatitis C test, syphilis test, blood typing), examination result (positive, negative, A +, A-, B +, B-, AB + , AB-, O +, O-), state of donation (rejection or retention) cause of rejection (positive result, undetermined result)
- Separation laboratory data: PSL number, nature of the product (whole blood, concentrated red blood cells, plasma, platelets), date of separation, expiration date

LBP management data: surname and first name of the recipient patient, sex, blood group, age, name and first name of the patient's relative who came to collect the product, his telephone number, number and name of the reception structure of the patient. sick, reception service, release date from the PSL.

The entry of all the data produced should be done using the Don @ BDIS application that we had developed and implemented.

A data management unit is responsible for collecting the various forms and arranging them for input.

Fig-1: Shows the data circuit

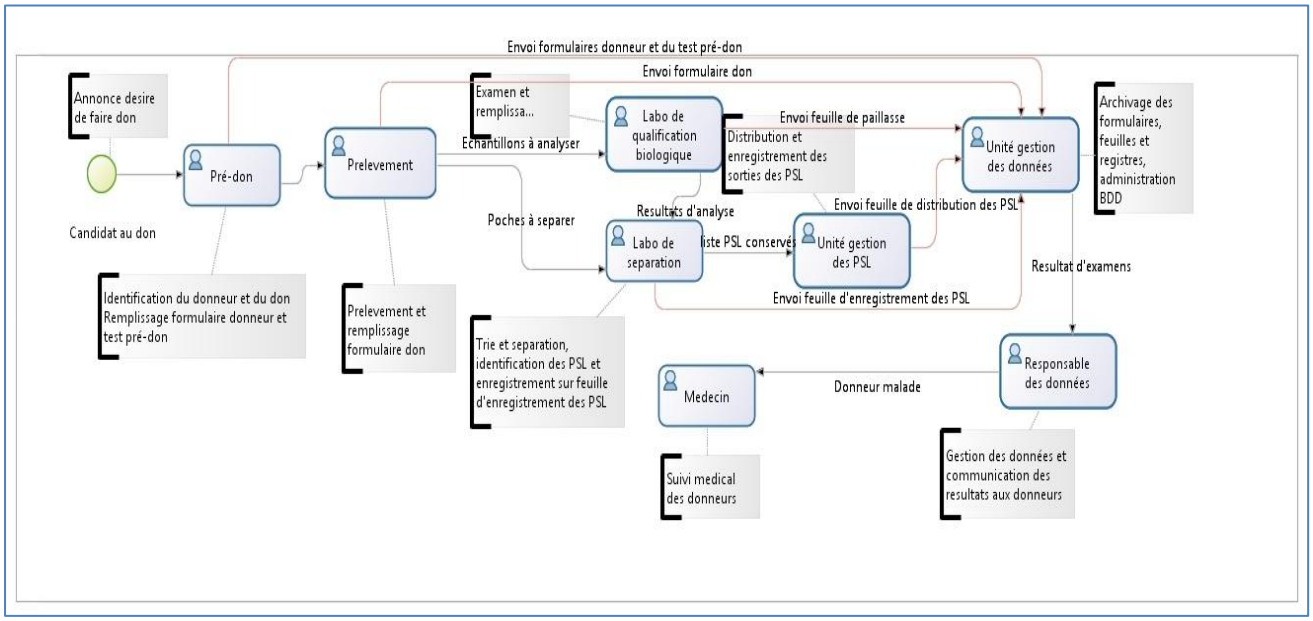

Fig-1: General diagram of the information circuit

1.2.2 The data entry system

The data collected through the forms is then entered into the database. Due to the lack of a network, we installed the software on the three computers that allow us to enter data (one computer serves as a server and for recording donations, lab results, PSLs, PSL exits; the other two are used to register donors only and are available at the secretariat). The software runs on a local WampServer with a MySQL database. Here's how it's organized:

The various forms completed in the units concerned are all submitted to the data management unit. The data management unit sends donor forms to secretaries for recording donor data. Then, the data recorded on the secretaries 'machines will be transferred to the server database using the "export" and "import" functions of PhpMyAdmin (thus the data recorded on the secretaries' machines, as soon as they are transferred to server database, are erased over time). After importing the donor information, we then save the other data in the following order: pre-donation test questionnaire, donation, results of examination, the PSL and the exit of the PSL. It is a very tedious system on the computer plan especially when the number of requests of the PSL is very important. The tasks should be distributed on all the users which will reduce the work and allow the automation of data collection.

1.3 Rationale for the choice of topic

The system we had put in place has certainly enabled the CNTS to improve the quality of its data, but it has shortcomings that deserve to be corrected. The shortcomings are mainly of a material and organizational nature.

To enter the data, three machines have been allocated; two machines are used by the secretaries who take care of entering the donor forms and another machine is used to enter the rest of the forms. Since the machines are not interconnected, each of the machines has a database; the data transfer system described above is very tedious and poses a problem of data quality. The functionality of the software was insufficient to cover the needs of computerization.

Given the shortcomings observed and the desire of the management to modernize its information system, we initiated in agreement with the management this project which has for main goal the improvement of the system put in place during our work last year.

The objective of this study is to contribute to the improvement of the information system of the National Blood Transfusion Center of N'Djamena.

2. MATERIAL AND METHODS

2.1 Material

The material that contributed to the completion of the work consists of:

- Human resources: all the staff of the said center were involved.
- IT resources: the IT stock is made up of six computers (including five stationary and a laptop), a copier-printer, and a printer.
- A wireless intranet network using a Wi-Fi router

2.2 Methods

2.2.1 User training

We started with an introduction to computers and more particularly word processing with Word for those with no computer knowledge this was intended to allow each user to be able to enter data produced in his unit. This training was only dedicated to nurses and technicians who will have to enter data. The secretaries, for their part, benefited from our supervision for the execution of certain functions over which they had no control.

Before starting with the new system, machines were made available to users for training. Simulations were made with the paper forms.

2.2.2 Development of missing features in the Don @ BDIS software

As the functionalities previously present were insufficient to cover the needs in terms of management of donations, we devoted part of our time to the development of the software to allow the recording of all the data and their exploitation.

2.2.3 Deployment of an intranet and networking of the Don @ BDIS application

We have deployed a Wi-Fi network to cover the perimeter of the center. Subsequently, we installed the database of our application on a dedicated machine as a server and we configured the interconnection of the other machines to the server.

2.2.4 Installation of an intranet messaging application

The tool used is Free Minter, which allows users to send messages to each other over the intranet.

2.2.5 Identification system

We have defined rules for the identification of donors, donations and labile blood products, which allows us to have a unique identifier for each donor, each donation and each product. To identify, for example, a donor, the latter must have an identity document. After having taken all the possible information, a unique donor number is assigned to him.This number is written on his donation form, at the next donation he is invited to present this form but in case of loss it is possible to find this number thanks to the donor phone number.

2.2.6 Data security

- Authenticated machine access: machines are protected by a password

- Authenticated Wi-Fi network access: the network is protected by the WPS system
- Authenticated data access: each user has a username and password

2.2.7 Data backup

To avoid possible data loss, the database is backed up twice a week on external hard drives.

2.2.9 Project management

Project management is placed under the responsibility of a team made up of the General Supervisor of the establishment, the Insurance Manager

3. RESULTS

3.1 The new data circuit

An information system is logically organized around the processes of the body [17]. The new circuit has been defined taking into account the main stages of the donation and the future of the bags. The stages of donation vary from one organization to another [18-20], we modeled on the business process of the establishment to define the data circuit while making some tweaking to improve the circuit.

The circuit follows the following steps: Reception of the donor in the waiting room, registration of donors by the secretaries, pre-donation medical maintenance, collection, sample analysis, separation of bags, distribution.

At the waiting room (this is the preliminary stage): All donors are received in the waiting room. At the secretariat: All sorted donors are referred to the secretariat to be registered. Pre-donation: the pre-donation agent receives the donor, retrieves the information recorded at the secretariat on his machine by entering the donor's identification number. He performs the pre-donation examination and completes the pre-donation test questionnaire. If the test is compatible, it directs the donor for collection. If the test is not compatible, it directly records the donation to count it as an unsatisfied donation then it sends a message via the FreeMinter application to the collection unit to indicate the incompatibility of the donor, this allows the unit to find rejected donations.

On collection: the collection agent finds the donor's identifier on the donation form presented by the donor. He takes the sample, if the quantity to be collected is reached, he takes a sample which he sends to the qualification lab and the bag will be sent to the separation lab.

In the biological qualification laboratory: the technician in charge of the examination, receives the samples bearing the identifier of the donation concerned, performs the examination, mentions the results on his bench sheet and then records them on his machine using the donation identifier mentioned on the collection tube. It then completes the information on the donation part "donation status" = "retained or rejected". For contaminated samples, he completes the donation information by selecting "Status" = "rejection + positive result".

At the separation laboratory: the separation laboratory agent finds healthy donations using the "stored donations" tab or by searching for donation and then entering the current date; thus the system displays all the donations of the day with their status. Contaminated bags will be destined for destruction.

The product manager: He manages the entire system.

The Data Manager: he manages all the data.

The data management unit: this unit is responsible for managing the computer database.

Figures 2 and 3 shows the process described.

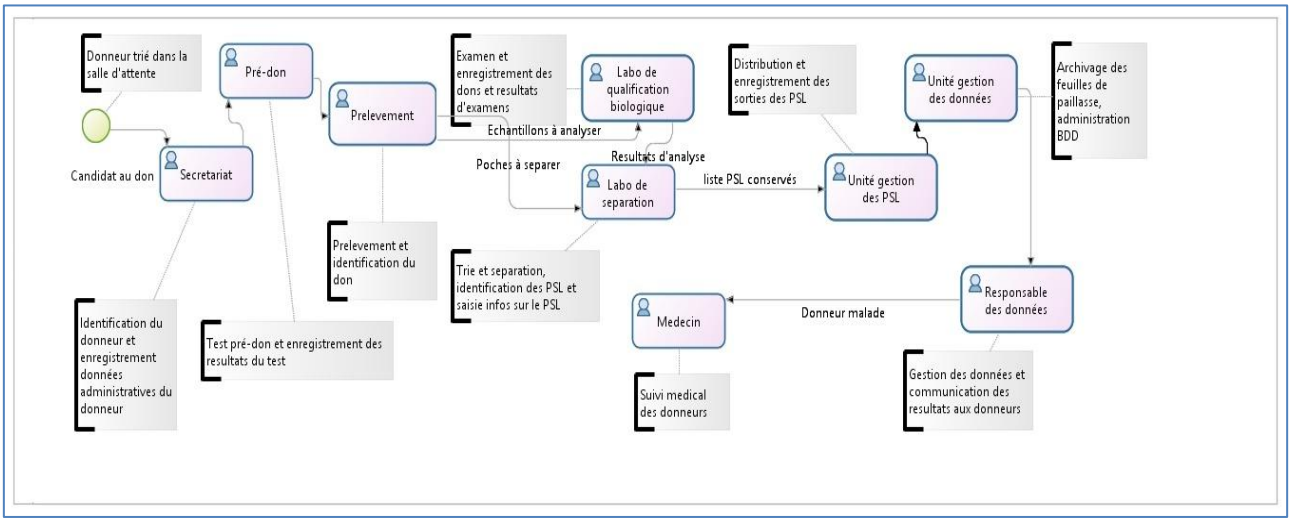

Fig-2: New data circuit

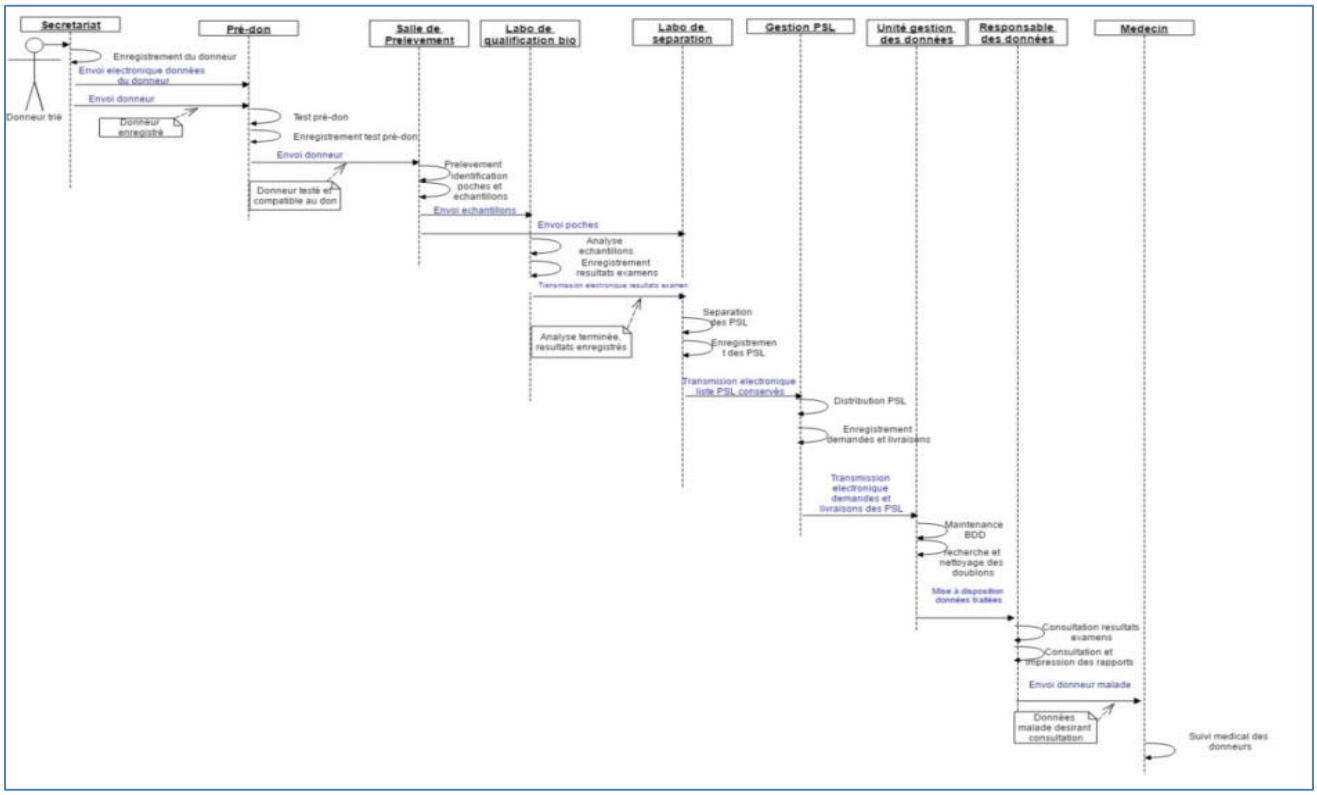

Fig-3: Data transmission sequence diagram

3.2 The Don @ BDIS application and new features

3.2.1 Building the application

The Don @ BDIS application is obtained from the modification of the source code of the Sanggre Blood Donor Information System software.

3.2.2 The functionalities obtained

- Register donors
- Record pre-donation tests
- Save donations
- Record exam results
- Register products
- Record the release of products
- Add user
- Add a health structure
- Find a donor
- Find a donation
- Search for exam results
- Search for a product and its destination
- Find an employee
- View pre-donation test information and display pre-donation test result
- Make global statistics of donors by category
- Make global statistics of laboratory examinations

Display list of stored PSLs: display of PSLs awaiting distribution

- Display list of rejected donations: display list of donations for which one of the qualifying tests is positive (from the search for donation window, you can search for donations according to their status)
- Display list of donations to be separated: display list of healthy donations ready to be separated (by clicking on advanced search and on list of kept donations you can obtain this result)
- Display monthly donation statistics: number of donations collected during the month according to blood types
- Display monthly statistics of donors by type and by sex: monthly number of donors by type (voluntary, family, ambulant, autologous) and by sex (female, male)
- Display monthly exam statistics: monthly number of exams according to the type of exam and test results
- Display monthly statistics of the pockets requested: monthly number of pockets requested by structure
- Display monthly statistics of bags delivered with blood groups: monthly number of bags delivered by blood group
- Display monthly delivery statistics by requesting structures: monthly number of bags delivered by structure
- Display the annual number of donations by donor: number of donations made by a donor during a year
- Printing of reports (it is possible to print reports)
- Display next donation date for voluntary donors: date of the next appointment

- Display list of expired products: list of PSLs whose expiration date has been reached (thanks to this function you can see all expired PSLs)
- Edit a recording (it is currently possible to edit some recordings)
- Input controls (input controls have been added to some fields)

The menu is subdivided into six parts

- First part grouping the tabs: welcome, useful information, send sms to the donor via internet
- Second part (Recordings) grouping the tabs: Record a donor, Record pre-donation test, Record donation, Record examinations, Record products, Record patient applicants, Record output of products.
- Third part (Advanced search) grouping the tabs: Exam results, Female donors, Male donors, Volunteer donors, Find a donation, Find a product, Clinical examinations, Find a patient, Find an employee, List of stored donations, Find delivery, PSL in stock, expired PSL, Find a hospital
- Fourth part (global statistics) grouping the tabs: Total donors by category, Total donors for the current year, Total number of donations per donor, Total number of donations per donor this year, Number of donations per voluntary donor, Total examinations carried out, Total donations by blood group, Total delivery per hospital, Total request
- Fifth part (monthly statistics) grouping the tabs: Total donor month in progress, examinations carried out month in progress, Total request month in progress
- Sixth part (administration) grouping the tabs: Add a user, Add a hospital, Exit

Figures 4 and 5 shows the authentication and home pages

Fig-4: Screen shot of Don @ BDIS authentication page

Fig-5: Screen shot of Don @ BDIS home page

3.3 The new data recording system

In the new system data is recorded as it is produced at each data producing unit. A single database installed on the server centralizes all records.

3.4 System architecture

Figures 6 and 7 shows the different architectural aspects of the system. Note: Figure 6 is inspired by the Information Systems Master Plan Assistance guide [21].

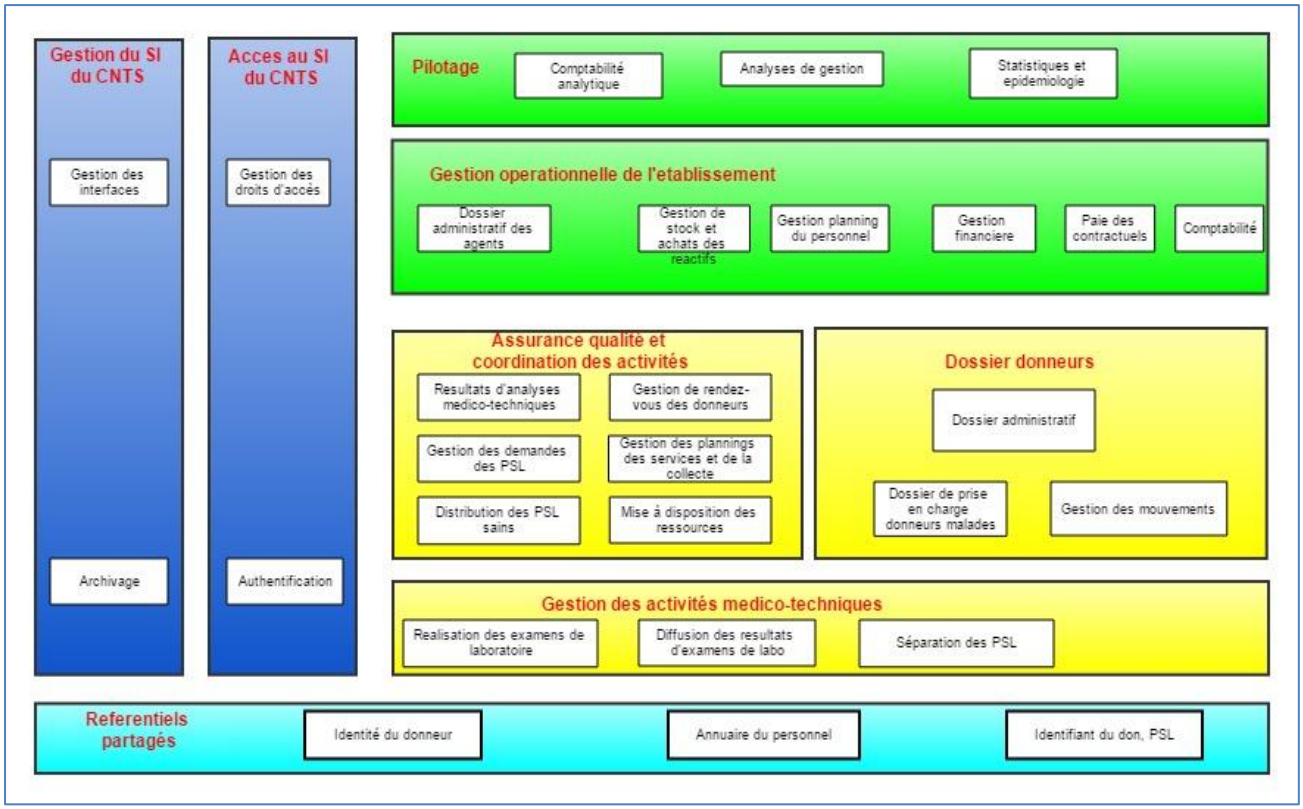

Fig-6: Functional mapping of the IS of the CNTS

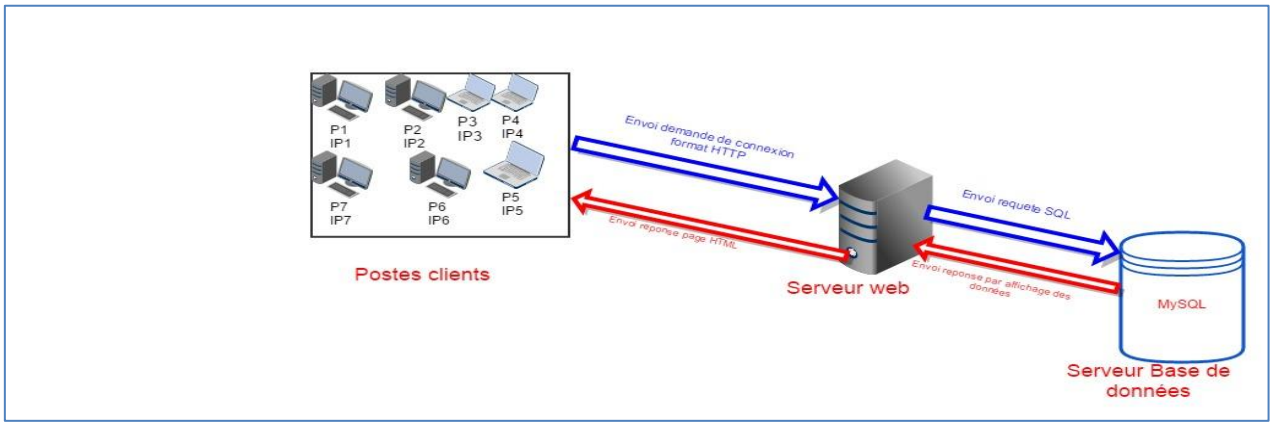

Fig-7: Technical view of the system

4. DISCUSSION

The work we had done previously presented some organizational and material difficulties. During this work, new strategies were developed in order to resolve these difficulties. These strategies were aimed first of all at full user buy-in to the project, reorganizing the data circuit and adding other hardware that could significantly improve the system.

We started with user training; when we would go out and tell users about setting up a computerized system, others had difficulty imagining the feasibility of the system. The user-centered process approach allowed us to gain the support of the various players since it was they who then encouraged us and suggested improvements. Some who did not touch the IT tool showed progress. The software has undergone significant modifications which allow it to record all the data produced in the system. It is also possible to make different statistics such as monthly and annual statistics of donors, donations, PSL, requests and deliveries of PSL, ...

It is therefore currently possible to enter data as it is produced and the obtaining of data is done in real time meaning the fluidity of the information circuit in addition it is a very secure system.

5. CONCLUSION

In a blood transfusion center, the traceability of products and other acts is essential [22]. To ensure

efficient traceability, an efficient information system is essential.

With the current availability of open source software packages and the reduced cost of computer hardware [23], the issue of computerization should no longer pose a major problem, and this given that computerization brings many advantages.

A year ago, we initiated a project which was to result in the computerization of the information system of a health structure which is equally important at the national level, the National Blood Transfusion Center. In a first phase, we used a system based on the use of paper forms and then we gradually moved towards IT (this was intended to avoid a sudden change in user practice); Today, at the end of a second phase which consisted in the accentuation of computerization, we have succeeded in computerizing the entire blood donation circuit in this center. Today the CNTS is one of the very first public health structures to computerize its information system. We believe that this project could serve as an example for other health structures in the country.

Other future prospects could be studied by those in charge of the center, in particular the extension to the collection of other data or even the extension to the national level.

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