Improving and Supporting Blood Donation Practices in Khartoum, Sudan Blood Banks through Android Mobile App and Web Application System

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ABSTRACT

As the most developing countries Sudan is considered one of the famous countries in Africa that is inflected with diseases that cause problems of the blood loss such as, malaria, cancer, hemophilia and renal failure. As the result of these problems, every day blood is required in hospitals and emergency treatment facilities. To meet this demands, blood donation is considered the only way to obtain blood to keep banks with sufficient supply of blood but in spite of the increasing number of donations, blood banks and blood donation process still unable to provide enough blood to meet the high demand, and problems in current system been used by blood banks identified as one elements of losing donors or does not retune to repeat the donation. In this study, we are aimed to develop and implements system that can used by blood transfusion service to motivate donors as well as facilitate or improve donation process. The implemented system consist tow components, android mobile app for donors task while a web application components to do all function or task of blood banks or their employees such as doctors and different departments of laboratory.

Keywords :- Blood donation, Donors practices, Web application, Android Mobile App.

I. INTRODUCTION

Blood transfusion is consider a life saving intervention, regarding this importance every country established blood banks to keeps sufficient blood bags that can be used in case of blood loss related to road traffic accidents, pregnancy complication, malaria, anemia, hemorrhage, surgery and chemotherapy. Although safe and sustainable blood supply is an essential component in the health care system worldwide, however blood is scarce and demand far outweighs the supply [1].

According to the World Health Organization (WHO), to meet the requirements for blood, 1% of the population needs to donate blood [2]. WHO has continuously support significant progress to improve the availability and safety of blood transfusion such as every year on 14 June, countries around the world celebrate World Blood Donor Day.

However, millions of patients in developing countries do not have timely access to this vital resource. In addition, humanitarian emergencies and armed conflicts in the Region have increased the demand for blood and made delivery of these lifesaving products challenging and complex [3].

In Sudan, blood transfusion services are authorized by the National Center for Blood Transfusion under the management of the Deputy Minister of National Health. Every state in Sudan has one or more blood banks, which are responsible for providing blood transfusion services. In Khartoum state, the Sudanese central blood bank (STAC) is responsible for such services. Since 2006, the needs of private hospitals have been covered by STAC's laboratory.

II. MOTIVATION AND PROBLEM STATEMENT

Voluntary blood donations are fundamental to maintaining a safe and adequate supply of blood to meet high demands. A report by the WHO indicates that the proportion of voluntary non-remunerated blood donations in Sudan is about 17.1% including both whole blood and apheresis donations [3].

Many people wish to donate blood to help others but this willing may face many obstacles due to lack of information such as people do not know how to find out information, schedules and activities of existing blood donor [4].

Moreover, satisfaction with the blood donation process represents an important factor in donors recruitment and retention programs because positive satisfaction are strongly linked with the donors intent to return [5], [6].

In Khartoum- Sudan, in spite of the increasing number of donations the blood donation process still struggles to provide enough blood to meet the high demand. In addition, blood donors are unlikely to donate repeatedly due to a lack of motivation. Therefore, blood donation service in Khartoum-Sudan, still remains challenging and there is a need to be innovative in this service or process.



Fig. 1 The proportion of voluntary non-remunerated blood donations in countries of the Eastern Mediterranean Region donations [3].

III. RELATED RESEARCH

The tremendous growth of communication technologies presents many opportunities that can be invests in many different purposes within healthcare scoters. For instance social networks and mobile technologies have been widely used to direct efforts towards patient-centric healthcare by involving the patients in the healthcare process [2].

In the past, various forms of media were used to disseminate appeals for blood donors, including cinema slides before films, book covers, postal flyers, magazine advertisements, and posters [7].

Today, social media has completely changed the concept of communication and sharing. In regard to blood donation, social media can reach a broad audience in a very short time and can play a vital role in eliminating misconceptions about the process by disseminating accurate knowledge about donation as well as disseminate appeals for blood donors [8].

Furthermore, in the age of information technology, smartphones, and other communication technologies represent the advent of tremendous growth. During the last decade, the number of smartphones per person has increased dramatically. In regard to blood donation, this growth can play an important role in information dissemination and supporting the donation process.

In the past mobile phones have limited used such as making calls and sending messages but today with the advent of smartphones that combine the power of computing and communication into a single device makes smartphones an valuable asset that exceeded traditional use in the past and becoming central to our communication and information needs [9].

The use of Mobile phones in supporting health care interventions are significant increased in developing countries such as used in dissemination of health information and raising awareness [10]. Moreover, the WHO announced that the mobile health sector has the ability to transform the face of health service delivery around the world [11].

In reared to blood donation, mobile phone SMS text messages It is used frequently by blood transfusion services to increase awareness of blood donation [12], [13].

However, although SMS can play vital roles in raising awareness but may face challenges within communities that has audiences with limited ability to read or write [14].

According to Reference [16], the used of voice messages based on languages of target audience can be feasible within these communities. In addition, as means to encourage an individual's to donate blood, Reference [16], argued that caller tunes feature of mobile phones has so far not been used for aiding blood donation, and designing free caller tunes particularly relevant for non-blood donors with no caller tunes can be used to promote them to donate blood.

Mobile Apps are software that can be installed onto a mobile device, such as a smartphone or tablet to conduct business, commutations and entertainment. Today mobile based application have widely used and become a part of our daily life [17], [18].

In regard to blood donation, globally various smartphone applications have been released to support blood donation practices and motivate donors to become regulars [19]–[25]. These apps can help blood donation organizations manage and track donor records, find new donors, check donor eligibility, schedule donations, visualize the available bloodstock, and inform users of donation needs in nearby locations using geolocation services.

In addition to the features mentioned above, apps are considered valuable resources for blood donation organizations, as they can assist in planning for future demands and easily remind existing donors to donate more frequently thanks to the fact that most young people have smartphones. This is especially useful since studies indicate that most blood donors are young (more likely to have smartphones) and would like to track their donations [26].

Apps can even help users find blood centers, allow donation centers to advertise their needs, monitor blood bank levels, and map the exact path to reach a donation center using GPS (Global Positioning System).

In Sudan, using mobile apps to support business and practices upon different fields are attract the attention of many organization, and in regard to blood donation there is an app called Revived it as one blood application that aims to connect blood donors with those asked for blood as a means to speed up access to donors and receive required blood, and these app are sponsored by a telecommunication company called Zain.

In sum, Table1 present some contributions of the researchers regarding blood donation in terms of investing mobile phones and developing apps that can be used to support blood donation practices as well as motives and rising donors awareness to participates in saving the human life.

In the present study, we are aim to build a web based system and mobile app that can be used by Sudanese blood banks as an aid to support and improve both blood donation practices as well as motivate donors to donate blood frequently.

TABLE I CONTRIBUTIONS OF THE RESEARCHERS REGARDING BLOOD DONATION.

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IV. CURRENT SYSTEM OR PRACTICES

Blood donation process and blood banks in Sudan use paper and manual methods to recorded the information of both blood donation process and donors. The current system is considered one of the most important elements that has direct effect on donor decision to repeat donation or become regular. Moreover , the current system has many problems that challenge blood transfusion agency in meeting high demands of blood needs, this problems or limitations can be summarized as follow:

- All information is registered in document base paper format manually.
- Donors are asked to fill blood donation form for each donation, and no any past information is saved.
- Searching for specific donors in document paper take a long time, especially to list and inform regular donors that donation date has coming soon.
- Number of donors expected to attend and willing to donate are unknown, and that lead some donors fail to donate due to insufficient time to serve all donors or time restriction for some donors.
- Many donors may leave donation place without donating because they waited a long time.
- Future needs or demands for blood are unknown due to all previous needs are undocumented, and only recorded in papers.
- In public hospitals blood banks only donors with rare blood group type are recorded manually to contact them in emergency. Unfortunately most of them change their addresses and phone numbers.
- There is a difficulty in listing the regular donors that have donation soon because all donors are recorded in same paper document manually, and it requires surfing all documents every day to identify this category of donors.
- Refused donors for temporary health problems are not recorded to contact them to donate in the future after barriers removed .

In sum, IT supporting blood donation are not exist as way to stimulate donors to donate blood .

V. PROPOSED SYSTEM

The present study has tow component, a web application and mobile app that aims to support and improve both blood donation and donors practices in Khartoum-Sudan. The web application component is aimed to carry out all services or functions of service provider (hospitals and blood banks) including data entry, doctors, and employees of laboratory while the mobile app component is aimed to conduct all functions of service consumer (Donors).

Each components can expanded in more details below under heading :Service consumer(the app for donors) and service provider (the web application for both hospitals and blood banks actors).



Fig. 1 Architecture of proposed system

A. Android App for Donors- Service consumer

The donors firstly must download the application, and installing it. After installation, once the app is lunched tow options are provided to donors: Login and Register. If the donor has already registered, then the right information are used to login (email and password), whilst donor has not account must go to register and fill the basic information such national id number, name, place, date of birth, blood group,.....etc. In addition using email service API, a welcome message send to donors when they register in the app for first time.

Once the donor has successfully login, as one incentive to motivate donors the app show the current blood needs of hospitals that are only matched with donor blood group and not yet meets by blood banks, moreover the app provide donor with a menu that have the following option:

- Appointments Booking, and then this appointments will forward to donor email as reminder.
- Current Appointments with ability to update them.
- Previous Appointments with ability to track their blood after donation such when blood is checked for viruses ,blood group confirmed, blood delivered or waiting to deliver and etc.
- Donors Profile contains the total number of donation, the number of successful donation, the

number of failed donation, date of last donation and date of next donation .

- Current blood needs of the hospitals that are matched with blood donor group (based on blood compatibility) and not yet meets by blood banks because once the needs are meets from blood banks is removed from these list.
- Statistics about donation and donors, and these as one incentives to motivate donors to donate as well as used by blood banks to plans for the future.
- Exit button to close the app and exit.

Furthermore, all the above services provided to donors through the app, Also can be carried out as web application from the web site by just login with the same information that are used to login in the app.

B. A web application for both hospitals and blood banks -Service provider.

To make the system more useful and usable, the proposed system considers that any hospitals or blood banks have an account to be used in both conducing hospitals activities and blood banks activities. In other words the proposed system will use the a permission that allow blood banks or hospitals to only see the information that belong to them as well as users also see only the information based on their hospitals or blood banks.

The web application section has many users within the blood banks or hospitals, the administrator user is responsible for adding hospitals, blood banks, campaigns and users based on both hospitals or blood banks that belong to them and their roles (data entry, doctors, Lab, serology, derivatives, viruses and cashier). These users can be classified based on their roles as follow:

- 1) **Data entry:** Every hospitals or blood banks have this kind of user to add shifts (working hours) and total number of donors planned to accept them in this duration, and can be adjusted based on their workforce. Moreover, In case of private hospitals or hospitals that has not blood banks, the data entry user is used to request new blood or tracks current request that submitted to STAC laboratory(Central blood bank)or blood banks.
- 2) **Doctors:** Every blood banks or hospitals have many users from the types or roles doctor to be used in approving donors before donation, where doctors see only the list of donors that have appointment today or now, and based on the conducted routine tests(such as weight, length, vital signs) donors are approved to donate or rejected or delayed. Furthermore, only the list of approved donors are forwarded to next steps and message about the decision passed to donors through the app to be display in previous appointments screen.

- 3) *Lab*: This user has tow functions, one is used to complete the process of donors approving where another routine tests are conducted such as hemoglobin level, and if the hemoglobin amount is enough then the donor approved to donate else the reasons of rejection or delay are identified. Second, the lab technician processed the final list of approved donors and start actual blood drawing process, and if it success then information of blood bags are registered as well as blood serums are prepared and sensed to both serology and viruses department to confirm blood group or detect viruses in blood respectively, After that valid blood bags are moved to derivatives section.
- 4) Derivatives: This user is responsible of processing the list of blood bags forwarded from lab user to extracts blood components from them and block the extracted components until the serum results are received from serology and viruses department, and if it positive then blood components are moved to delivery section whilst in case of negative result blood components are burned or damaged. This components are actual blood to deliver to hospitals in needs.
- 5) *Serology:* This section or user have two functions, the one is responsible from confirming blood group of each serums received ,and the second is to processed the blood request made by the hospitals where the requests can be approved or rejected or delayed. All the approved requests are directly moved to be processed by delivery section while the delayed requests remain in this section until is been approved or rejected.
- 6) *Viruses:* This user or section is responsible from processed the list of serums that are sent from lab section, and identify the viruses that are detected in serums or notify there is no viruses.
- 7) Cashier: This section or user are responsible from receiving the list of approved blood requests made by hospitals from the serology and use the available stocks to deliver it based on both type of requested components and blood compatibility where the system ordered blood components matched the request according to their expire date.



Fig. 3 Block diagram of proposed system

VI. METHODOLOGIES

To develops and implements the proposed system, the study used the following list of technologies and tools :

- Android Studio
- PHP
- My SQL
- Java and JavaScript
- Html5
- JQuery
- CSS
- CodeIgniter
- WampServer

VII. IMPLEMENTATION AND RESULT

After donors download and install the apps, then the first screen of the apps is shown in Fig. 4, and donors are required to register for first time or logging if already they have an account. In case of registration for first time, a welcome message send to donors email.

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	LOGIN	
	userName	
	Email	
	Register	Login

Fig. 4 Login Page

Once the registered donors successfully logged in , the app show the current needs of blood requested by the all hospitals as shown in Fig. 5, while Fig.6 in the web application components, show the status of the blood requests according to logged hospital.

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الخرطوم التعليمي سعد احمد 2019-03-2019	A +
مستشفي ود مدني التعليمي احمد يوسف 09-03-2019	AB+
مسٽشفي ڪسلا عاصم حسن 09-03-2019	0+

5	101
New Appointment	
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مستشفي ڪسلا عاصم حسن 09-03-2019	0+

Fig. 7 Menu of Functional Services

Also, as one incentives to motivates donors, the app provide many statistics information such as shown in Fig.8 and Fig.9.



Fig. 8 No. of Donors have Appointments Today and Total No. of Donors

Fig. 5 Current Blood Request From all Hospitals

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5	111111112222	عمر حسن	2019-02-17	2019-02-21	0+	2 / مليليتير	cancer	RBC	DELIVERED	لعديل
6	8882222	פכמב כונובן	2019-02-17	2019-02-23	AB+	17 مىيىيتىر	blood bleeding	Plateless	DELIVERED	تعديل
7	252430	اللمبي عبدالرحيم	2019-02-17	2019-02-24	AB+	17 مايليتير	blood bleeding	RBC	REJECTED	تعديل
8	33556565	بغرى مسن	2019-02-18	2019-02-20	0+	17 مايليتير	cancer	RBC	DELIVERED	تعديل
9	4545454	حمدان دلقو	2019-02-18	2019-02-20	A-	17 مايليتير	kidney transformation	RBC	DELIVERED	تعديل
10	4567876543	أسماء على	2019-03-09	2019-03-16	B+	27	Kidney diatysis	RBC	NEW	incit.

Fig. 6 List and Status of Blood Request for specific hospital

Furthermore, as shown in Fig.7, donors can do many functions such appointments booking, update current appointments, view donation profile, tracks previous appointments and brows the statistics information of blood banks such as blood stocks and rates of donation.



Fig. 9 Stored blood per group, delivered blood per group and requested blood from hospitals Donors

For the web based application components, data are processed based on the users role and blood banks, a partial set results or implementation can be shown in Figures below.

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Fig. 10 List of donors to meets doctors- Doctors Page

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Fig. 15 List of approved request that need delivering - Serology user page.



Fig. 16 Delivering one blood requests - Cashier user page.

VIII. CONCLUSIONS

In this study we are proposed and implemented a system based on two components : a web based application and an android mobile app that aimed to mitigate the limitations of current system used by blood banks in Khartoum- Sudan. Using a web based components, the hospitals or blood banks can do their various duties in a manner that will increase motivation or reduce frustrations between donors and employees of blood banks whilst the app components allow donors to avoid the problems of long waiting time, select they preferred slots time to donate and tracking the journey of donation as well as levels of blood stocks in the banks.

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Fig. 13 Register detected virus in blood - Viruses Page.

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Fig. 14 List of blood request from hospitals need approving - Serology Page.

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