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ANALYSIS ON NATION’S BLOOD MANAGEMENT SYSTEM AND WASTAGE USING INTERNET OF THINGS AND DIGITAL TWIN

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Abstract: *In India 62 million trauma induced surgeries are performed every year. It is a witness more than 1,300 road crashes every day. There are around 10 million pregnancy complications, 230 million major operations and 331 million cancer-related procedures like chemotherapy require blood transfusion. Before reaching the needy on time each year, about 6.6 lakh units of blood and its components are wasted in India. In 2016 alone, the units of blood and its components were discarded across the country is over 6.58 lakh units. Around 50% of the wasted units were blood components and products such as plasma that has a longer shelf life of one year as compared to whole blood unit and red blood cells that must be used within 35-45 days. In this paper, we present an architecture prototype of a county-wide Blood Management System using Internet of Things and Digital Twin whereby any hospital or blood bank at the nearest location can search for their desired blood group and can donate to the nearest blood bank or hospital within City/State/Country in case of excess blood supply. Data about the hospitals and blood bank will be collected using web application hosted on cloud and it will be accessible to hospitals, blood banks within the country. These data will contain the Inventory information along with GPS location. Donors can enter details along with address and GPS coordinates. Primary reason of wastage is because of deterioration during storage and expiry of blood units due to outdated. The study shall help to reduce blood wastage, improve transportation of blood units to all needy areas.*

Keywords: *Internet of Things, GPS, blood wastage, Transportation, Expiration*

I INTRODUCTION

Before reaching the needy on time each year, about 6.6 lakh units of blood and its components are wasted in India. In year 2017, the National Aids Control Organization revealed that between 2012 and 2016 over 2.8 million units of blood and its components and blood products were discarded by blood banks across India. In 2016 alone, over 6.58 lakh units of blood and its components were discarded across the country. Around 50% of the wasted units were blood components and products such as plasma that has a longer shelf life of one year as compared to whole blood unit and red blood cells that must be used within 35-45 days. The states like Maharashtra, Uttar Pradesh, Karnataka and Tamilnadu are worst offenders in terms of discarding not just whole blood but even the blood products like red blood cells, platelets, and plasma.

Blood is wasted when it cannot be transfused to a patient for technical reasons which include faults in storage or expiration. Many factors lead to wastage of blood and its components in India like broken bag, burst packs, contaminated packs, under donations, clotted donations, broken seal, delays conducting tests due to staff shortage or resource crunch, fridge failure, lack of proper storage, problems with the manufacturing and testing of blood components, expired units, over-ordering, improper transport, returned after 30 minutes, or reasons like lack of proper knowledge and awareness. While 16 states and UTs faced a shortage of blood supply, 18 states had an excess of it in the Year 2016-17. Generally, Maharashtra, Kerala and Punjab are the best performers in blood donation, with more than 35% excess of blood supply for each state. States like Sikkim

initially faced shortfall later had increased availability by 22%, leading to a surplus of 4%.

However, incidents of wastage of blood units collected are frequent to happen in above mentioned states. Shelf life of blood is about 30-45 days, so excess of blood needs to be soon sent to all needy areas. On the other end there are states like Arunachal Pradesh, Chhattisgarh, Uttar Pradesh, and Meghalaya who struggle to meet more than 40% of their blood requirements. transportation, manufacturing and testing of blood components and storage must be taken care to reduce blood wastage.

II PHASES OF BLOOD MANAGEMENT

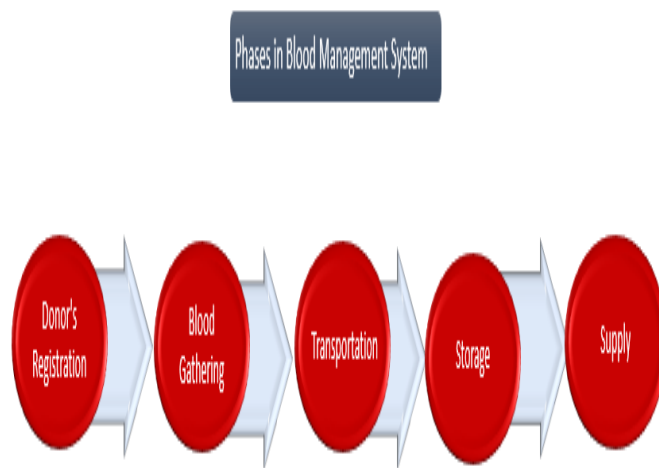


Figure 1 Phases in Blood Management System.

Blood Management system can be divided into four main terms, in Figure 1.: Collection, Transportation, Storage and supply.

III REGISTRATION AND COLLECTION

Blood donation starts with donor at the blood center, Donors can be returning donors, who donate on regular basis, and new donors, who are entering the system occasionally or for the first time. Most health institutions, Hospitals and blood centers use Excel paper as a database of blood donors, in emergencies it is difficult to communicate with donors. When a donor Register for the first time, he/she is requested to provide personal details (e.g., name, address, age, job, gender, blood group, GPS location) and medical/health (e.g., diagnosis, lab results, treatments) data, which are collected through applications.

Ahmed AL-Kalbani (2017) [5] stated that in some hospital still using excel sheet in computer and they contact people by call or SMS in emergency case.

Ashlesha C. Adsul (2018) [1] has implemented automated blood management system which fetch information from database and will send SMS to the donor directly on his number which is stored at the time of registration. Hriday

Deb Das (2020) [3] used Geo-locations for blood donors in which requesters can search donors from their current or destination location within 5km, as a result, finding donors and arriving at the destination in the shortest time using GPS. Fauwzziyyah (2019) [2] In the Prospect and Significance of Lifeline defined working system of blood bank service that ensures patients get quick access to blood donors of any type, it can thrive in remotest of areas and easy to use for online and offline queries for both young and old because of Unstructured Supplementary Service Data Short Message Service (SMS) and free toll line. Ritika and Pau (2014) [7] examined different classification algorithms to find out a fair classification technique for the prediction of donations. Jenipha and Backiya lakshmi (2014) [10], made a blood donation application with an author named Android Blood Donor Life Saving Application in Cloud Computing. One client can contact quickly with donor of matching blood group. Their application provides list of donors in your city r area. The location-based application, operational on android platform, will help clients easily find donors of matching blood groups in their location and can be accessed via their mobile phone.

IV STORAGE AND TRANSPORTATION

Once Blood is collected from donors at city's regional blood centers, blood donation camps, blood must be stored in proper storage units or transferred before it perishes. These blood donation camps and other small blood centers sometimes deal with lack testing resources of the blood products, so must be transported to desired location.

transportation must be carefully performed as the blood must be stored before perishing and requires maintaining transportation conditions.

Ekici and Ozener (2014)[8] defined a variant of the Vehicle Routing Problem, i.e., the Maximum Blood Collection Problem (MBCP), in which blood collected in a set of blood donation sites is delivered with a fleet of collection vehicles to a single processing center. Mehmet Karakoc and Melih (2017)[4] designed Priority Based Vehicle Routing for Agile Blood Transportation between Donor/Client Sites using Artificial Intelligence based Vehicle Routing Problem (VRP) for Blood Transporters (BTs) and propose an efficient vehicle routing scheme for blood transportation between hospitals or Donor/Client Sites (DCSs) within a region. It is formulated to consider the urgency of the requests and responses to minimize the number of BTs while maintaining minimum traveling lengths considering priority. Karakoc et al. (2015)[9] used VRP approach with GA to blood transportation between medical facilities. However, in their approach they did not consider the urgency requirements of the blood transportation.

V SUPPLY

Patients may need a blood transfusion if they have anemia, sickle cell disease, a bleeding disorder such as hemophilia, or cancer. A cancer patient, on an average, needs at least 100 units of blood. Due to the inherent need to always have blood stocks and often unpredictable demands on the inventory, a very limited and inevitable outdated of blood and its components in blood bank is accepted. Collection of up to 500-1000 units of blood in a camp is acceptable and manageable, later it can be distributed to one's in need through blood banks or centralized blood repository.

Ahmed AL-Kalbani (2018) [5] Implementation a full network for Oman hospital through the mobile application that, can be used as a joint washer between the hospital and donor. This application will be downloaded by anyone as mobile app and there is website also for whom using computer. System works coordinator between the central blood bank in Muscat (Basher) and donors around country. Hridoy Deb Das (2020) [3] has designed system will help the blood requester to find the donors of requested blood groups in the nearby location. The problem with this system is it searches donor within 5km and is highly dependent on the donor. If no donors found within the 5km it may fail. Lau et al. (2013) [11] for long-term management of blood supply, predicted the future blood demand of thalassemia major patients for the next 10 years.

VI DISCUSSION AND OPEN ISSUES

Communication gap between blood banks, donors, regulators, hospitals, and receivers are leading to wastage of blood in India. Blood wastage could impose a serious impact on the healthcare system of the country. blood bank is accepting very limited and inevitable outdated of blood and its components because of internal need to always have blood stocks and often non predictable demands on the inventory.

Mega blood donation camps should be avoided to minimize blood wastage. A collection of up to 500 units of blood in a camp is acceptable and can be managed. But if more than 2000 units of blood are collected in a mega camp, 10 to 20 percent of the blood collected in such donation camps are wasted as per estimations because of deficiency in storage facilities and Infra problem.

Blood is wasted when it cannot be transfused to patient due to some technical reasons which include faults in storage or expiration. Many factors can lead to wastage of blood and its components in India like burst packs, contaminated packs, clotted donations, delays conducting tests due to staff shortage, broken bag, lack of proper storage, expired units, over-ordering, improper transport, returned after more than 30 minutes, problems with the manufacturing and testing of blood components, lack of proper knowledge and awareness.

VII SYSTEM ARCHITECTURE

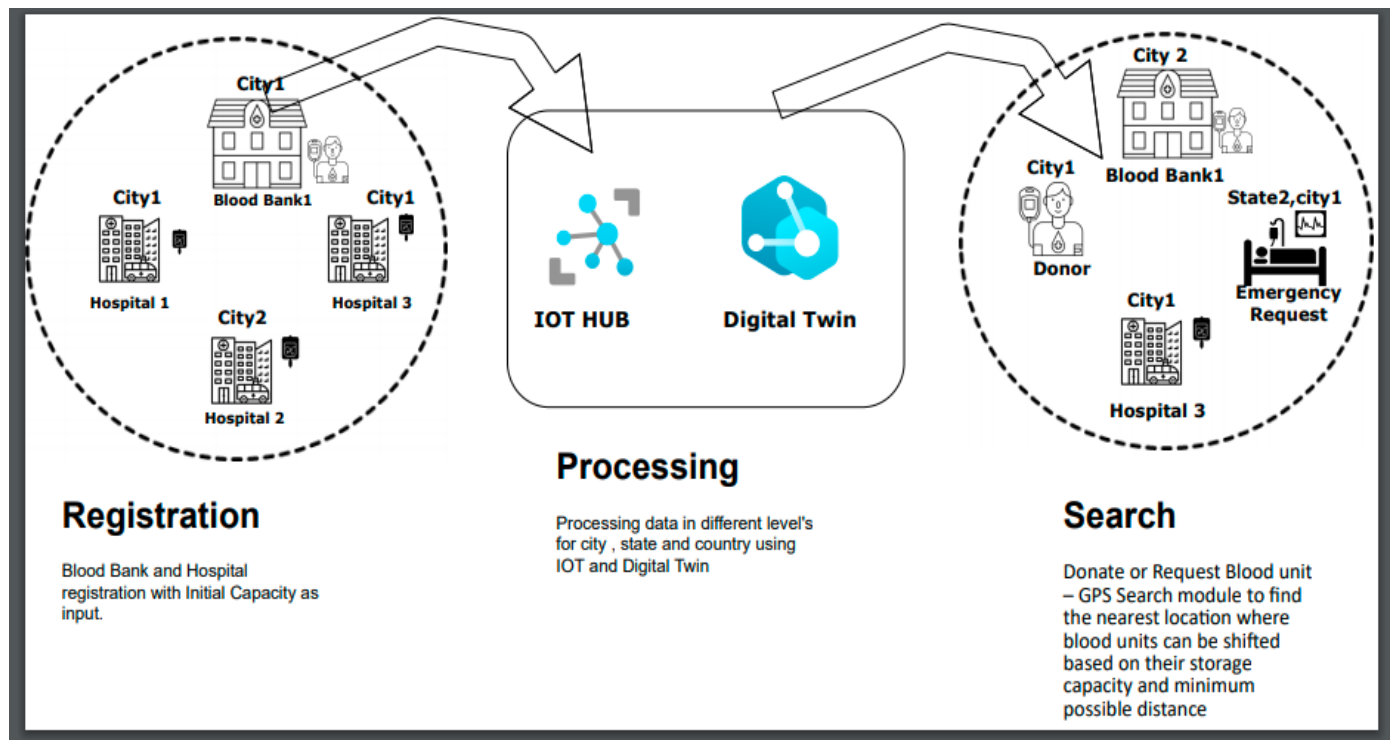


Figure 2 System Architecture / Proposed Framework.

VIII CONCLUSION

If patients have anemia, sickle cell disease, a bleeding disorder such as hemophilia, or cancer they may need a blood transfusion. A cancer patient generally needs at least 100 units of blood. India heavily relies on blood transfusions due to a higher prevalence of blood borne diseases and complications during pregnancy.

Traditional: A blood Bank can be defined as a bank or storage place where blood is collected, preserved, and used whenever needed or demanded. Everyone is aware that the traditional blood bank management system includes paperwork. Its way of working is not efficient enough at the time of emergency situations Mr. Shreyas Anil Chaudhari (2018) [6]. In some hospital still using excel sheet in computer and they contact people by call or SMS in emergency case.

Present: cloud-based blood bank system is to make the blood available on time to the people, even in emergency Mr. Shreyas Anil Chaudhari (2018) [6]. Whenever there is requirement for blood then patient will enter required blood group details and SMS will be send to the donor directly on his number which is stored at the time of registration Ashlesha C. Adsul (2018) [1]. Requesters can search donors from their current or destination location, can find more than one donor parallelly and request for more than one blood group, Using GPS finding donors and arriving at the destination will be easy and in the shortest time.

Future and Proposed: For Donate or Request Blood unit – There will be web-based GPS Search module will find the nearest location where blood units can be shifted based on their storage capacity and minimum possible distance.

Proper additive solutions are added to enhance shelf life and reduce wastage. The blood bank staff will issue the short expiry blood products first to reduce expiry and Wastage.

It is seen that blood products are often ordered but not used. To reduce blood wastage the treating doctors should decrease over ordering, system encourages rational blood unit transfer, instead of keeping the blood products in Hospital wards. It will be used return to blood bank within half hour if not used. As system is well connected to city, state, and country with access to donors, blood banks, regulators, hospitals, and receivers leading to less wastage of blood in India.

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