Application of the Supply Chain Concept to Blood Banks for effective Sickle Cell Treatment

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Abstract: This research gives an overview of the Supply Chain of the blood bank with specific reference to the Sickle Cell Treatment. The study proceeds towards surveying the public who are either the donors or the non-donors. The awareness of Sickle Cell Disease, public contribution towards the disease and finally the implementation of Information technology in terms of a mobile App are discussed in a flow in this research. The research concludes that people are aware about Sickle Cell and are willing to contribute to the treatment through blood donation. Because of constraint of time, personal obligations some online blood donating services are demanded so as to collect blood from the Donor's bedside.
A Supply Chain Model has been proposed at the end of this research that incorporated the use of technology in the benefit of the Sickle Cell patient.
Key Words: Sickle Cell, Supply Chain Management.

Introduction

Sickle cell is genetic or undying disorder. As it is transmitted from the person's parent, it is a most common form of an inherited blood disorder. A common treatment to this disease is periodic blood transfusions.In certain cases, the sickle cell patient is given blood transfusions.When the red blood cells count falls the normal level, blood transfusion is done to the sickle cell patient to avoid further problems. (Sickle-cell disease). The diagnosis of this disease is done by solubility test, or if solubility found to be positive, then electrophoresis is necessary.There are various treatments available to this disease. These ttreatments includes some vaccines with some precautions as healthy diet drink high water, high rest etc. and folic acid tablets. A lifetime treatment is preferred in this disease as this disease is of perThe disease is permanent; hence life time treatment is necessary. The bone marrow transplant, kidney transplant and gallbladder transplant allow some patients in severe condition to cure disease. Some patient result in death in serious condition (Bolwar, 2015).

Supply Chain Determinants for the Blood Banks:

Alike any Product Manufacturing or Service firm, Supply Chain Management can also be identified for Blood Banks. Various supply chain determinants for the blood banks are Procurement, Facility management, Inventory and Logistics management. In blood banks the basic material that is procured from the suppliers are the medical supplies like syringes, containers etc. Blood as a major material forms the vital product to be procured from its donors. Facility management deals with the proper layout within the bank. It deals with the proper workplace organisation with respect to storage and usage of the medical supplies.

Inventory management deals with proper storage of material. The material in the inventory at blood banks is basically of two types. One type of inventory is the inventory of the donor and the receiver information. This database contains the details of the donors in the form of name, age, blood types etc. The other form of inventory is for the blood that is donated. This contains blood or its components like plasma, RBCs or platelets.Logistics management deals with the physical moment of the blood and its components within and outside. It comprises of the cold storage monitoring system, Transfer bags and storage units, Transportation vehicles to and from the blood banks and hospitals or to the patient's bedside.
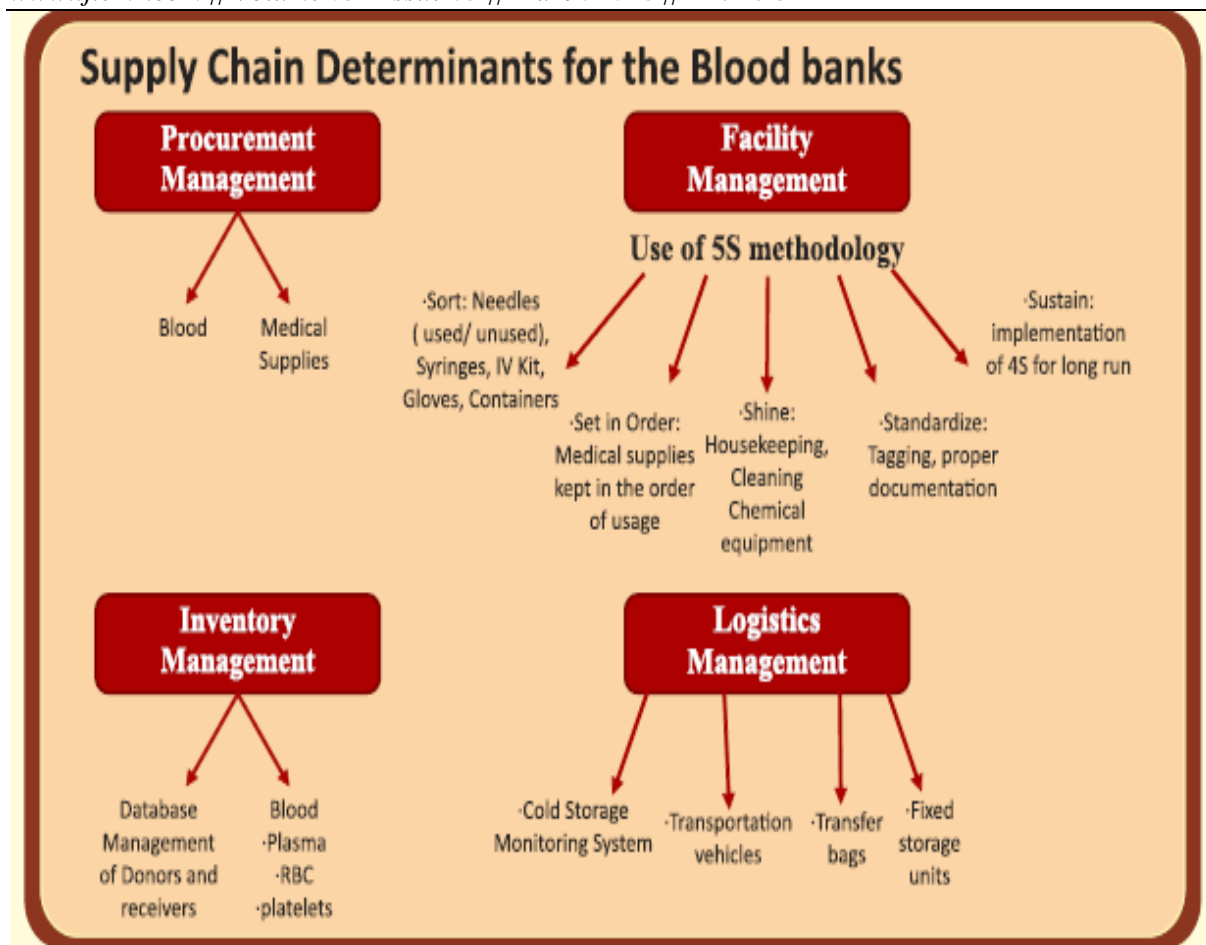
Figure 1: Supply Chain Determinants for Blood banks

Research Problem

The total blood transfusion cost due to procurement process, storage,cost of machinery for testing the blood, infrastructure, salary of staff, quality maintenance, expiry on shelf leads to increasing cost of blood. Since blood transfusion is the most common way of treating the treating the patient, ppatients family may not bear this frequent transfusion cost. Patients spend large sums on purchasing blood or its components from the blood banks.

Objectives of the Study

More people contributing to blood donations may lead to excess or frequent demand fulfilling. This could further lead to lessening the losses due to expiry on shelf of blood at blood banks. But are people aware of blood donation? Are they willing to donate blood at frequent levels at the blood banks? To get answers to these questions the first objective that is framed is

1. **To understand the Demand Side Problems of the Blood banks.**

Supply Chain Management deals with managing the flow of material and information from source to the end user. Use of Information Technology is one important aspect of Supply Chain Management. One objective of this study was to check whether a mobile App can be put into this chain of blood donation to blood acceptation and how this management system could aid a sickle cell patient. In this study, an effort has been made to develop an efficient Supply Chain Model that can facilitate effective management of treatment to the sickle cell patients.

2. **To propose a model for Effective Management of Treatment to the Sickle Cell Patients**
HYPOTHESIS:
Ho1. Donors are not willing to attain the sickle cell patient when required.
Ho2. Donors are not willing to use Mobile app to keep updated with the blood requirement.

Population and Sample Size:

In this study the population considered was the general public of the Nagpur city. The population was divided into the blood donors and the non-donors.

The sample size was 200 respondents. 100 respondents were the blood donors. This comprised of people who donated blood on frequent level and those who had at least donated blood once in the lifetime. The other 100 respondents in the sample were those who had never donated blood. The sampling method used in this research was cluster sampling followed by simple random and convenience sampling. Respondents who were the blood donors were identified from various blood banks. This was a part of convenience sampling as the data was collected from the available donors at the blood banks. The two clusters were formed from the total population. First cluster was of those people who were the active and regular blood donors and those who had donated blood at least once. The second cluster comprised of the people who did not donate blood.

Data Analysis:

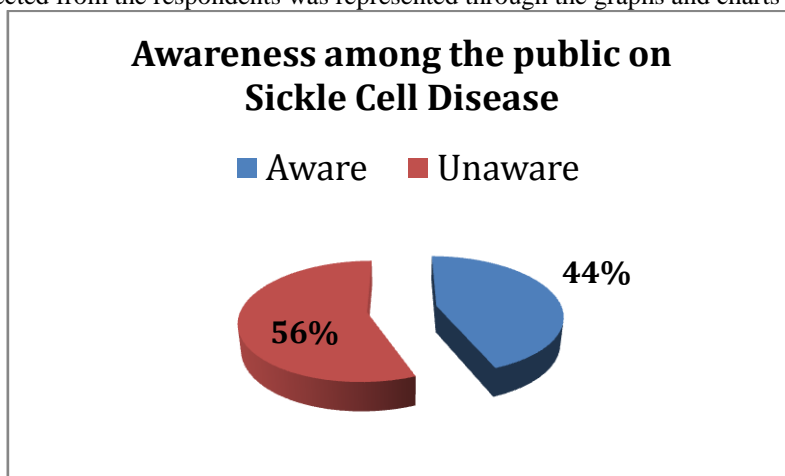Data collected from the respondents was represented through the graphs and charts as given below.

Figure 2:Awareness among the public on Sickle Cell Disease

Figure 2 shows the awareness among the public on the Sickle Cell disease. The data revealed that only 44% of the people are aware of the disease. People are known of the disease in general. But the symptoms, diagnosis and treatment of the sickle cell disease is not known to most of the public. As this disease is permanent in nature, the sufferer or the patient is not willing to reveal himself. This can further contribute towards people not being aware of the disease.
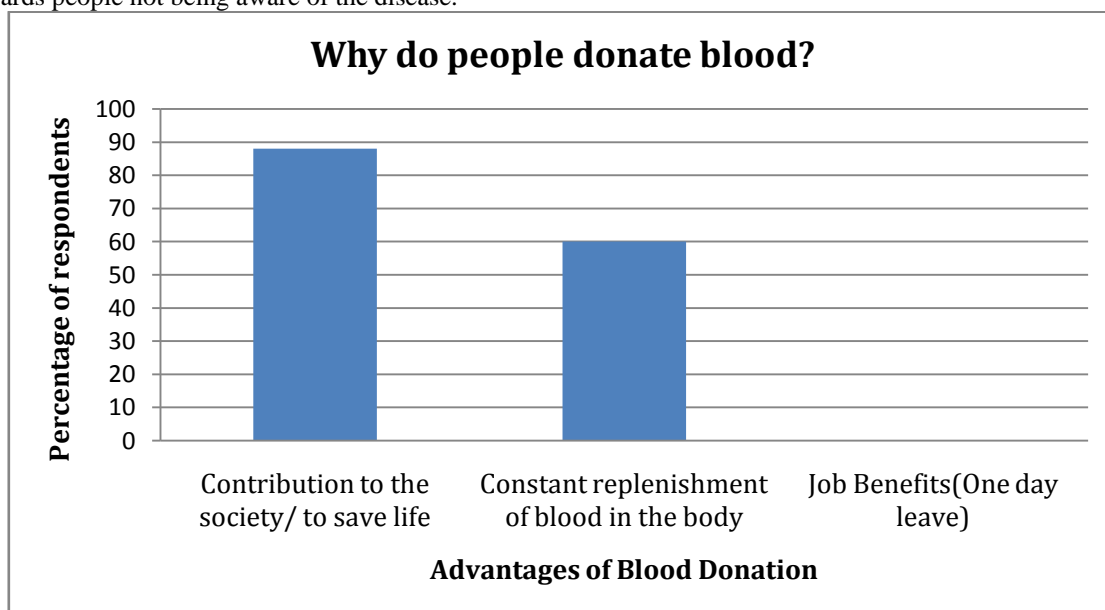

Figure 3:Reasons for people donating blood

Figure 3 shows the major reasons for which they donate blood. The major reasons identified form the respondents were as follows.

Contribution to the society: some people are aware of the importance of blood donation. They donate blood to help a patient in need. This would ultimately save the patient's life.

Constant replenishment of blood in the body: When a unit of blood is donated, about a quarter of a gram of iron is lost. This gets replenished from the food that is taken from the weeks of donation. Since having too much of iron in blood may not be good for the blood vessels, regulation of iron level is beneficial (4 Unexpected Benefits of Donating Blood)Around 60% of the donors give blood for constant replenishment of the blood in the body.

One reason identified for donating blood was the benefit of a day leave that the person receives from his job. But none of the respondents agreed to this being a motivation to donate blood.
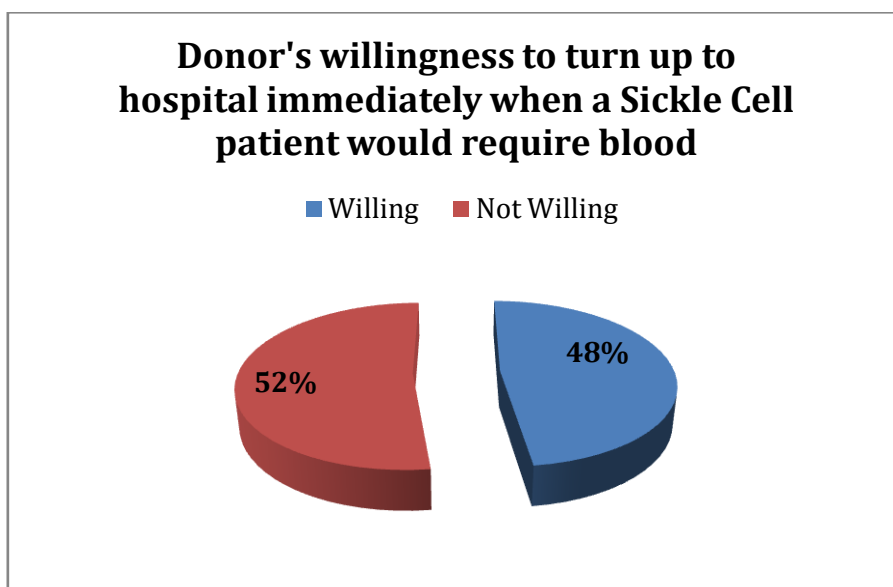

Figure 4:Donor's willingness to turn up to hospital immediately when a Sickle Cell patient would require blood

As purchasing blood from the blood banks could be costly to the patient,and if the donor can be made available at the bedside of the patient, the intermediate process of blood storage, processing etc at the blood bank level can be discarded. Thus the cost to the patient can be lessened. With this view when the donors were asked if they can immediately reach the patient bedside for blood donation, 48% donors were willing to respond to the requirement.
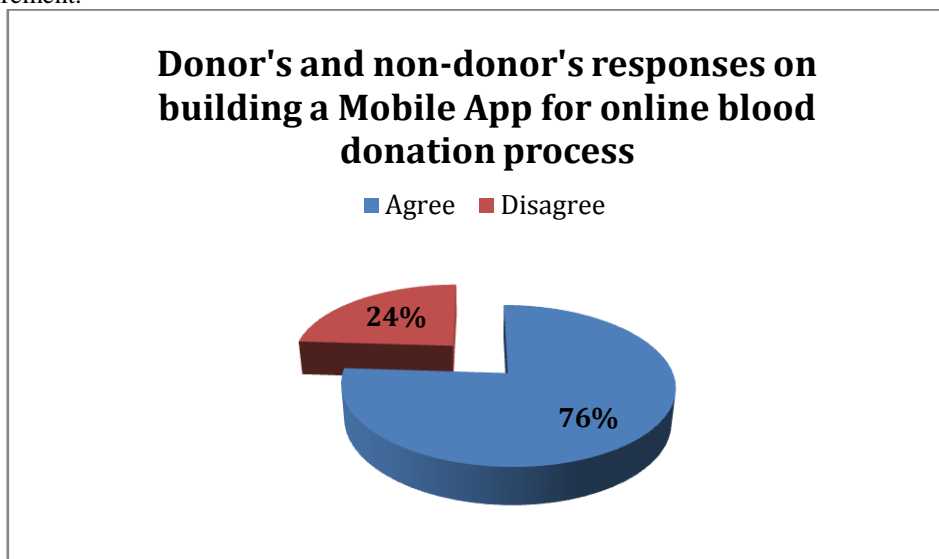

Figure 5:Donor's and non-donor's responses on building a Mobile App for online blood donation process

Above chart shows the percent response of the donors of the study who were asked whether a mobile App be developed to support and help a sickle cell patient. A donor can donate blood at regular intervals after the blood is completely replenished in the body. Since the donor may not keep record of the previous donation, may not turn up on time for further donation. Such donors were asked if a mobile app be developed that would

- giveregular reminders for blood donation.
- give a signal to the donor when a sickle cell patient would require blood.
- confirmdonor's availability at patient's bedside for blood donation.

76% of the respondents showed positive response on building an App that would help a sickle cell patient.
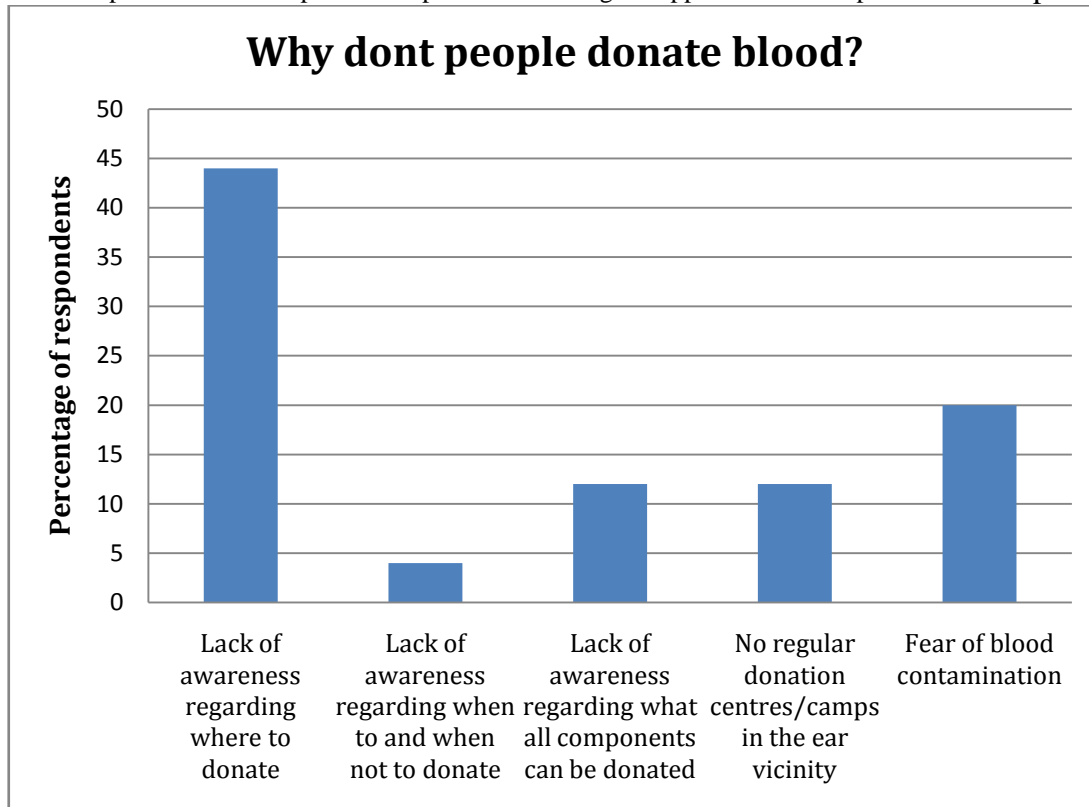

Figure 6: Reasons for people not donating blood

Government and various organisations are working on generating awareness about blood donation. Over the years, their efforts have contributed to the demand fulfilment of blood to an extent. But the demand supply gap is wide despite of the huge population of the country. Many health care facilities in the country do not receive the adequate supplies of blood. Disparities in access of donors in different areas have led to wastage of blood stock in some parts of the country. And some parts are facing a huge deficiency of blood supply. The below average medical facilities and practices in many parts of the country have given rise to the instances of transmission of infective diseases like AIDS. Voluntary blood donation comprises about 70% of the blood demand, with the rest coming from replacement donors, whereas 62 nations in the world fulfil their blood demands through voluntary donations. The major reasons for the people not donating blood are the physiological problems, low haemoglobin count, fear of pain and weakness after the procedure, and illiteracy(Blood donation in India).This study identified various reasons that contributed to not donating blood as under.

- Lack of awareness regarding where to donate
- Lack of awareness regarding when to and when not to donate
- Lack of awareness regarding what all components can be donated
- No regular donation centres/camps in the ear vicinity
- Fear of blood contamination

It was identified that people are not aware of regarding where to donate. This means that most people do not have knowledge about the camps or the blood banks. Further people also fear to donate blood because of the fear of blood contamination.

Testing of Hypothesis:

Here the first hypothesis that was formulated was that the donors are not willing to attain the sickle cell patient when required. Chi Square test was performed to test the given hypothesis. It could be seen that the null hypothesis is rejected. This means that the donors wish to attain a sickle cell patient at bedside as and when required. The other assumption was that the donors are not willing to use Mobile app to keep updated with the blood requirement. In this case the null assumption is rejected. Donors support the development of such mobile app that could help a Sickle Cell patient.

Null Hypothesis	p value	□	
Donors are not willing to attain the sickle cell patient when required.	0.966	0.05	Reject Null hypothesis
Donors are not willing to use Mobile app to keep updated with the blood requirement.	1.000	0.05	Reject Null hypothesis

*Chi Square test was used to test the hypothesis

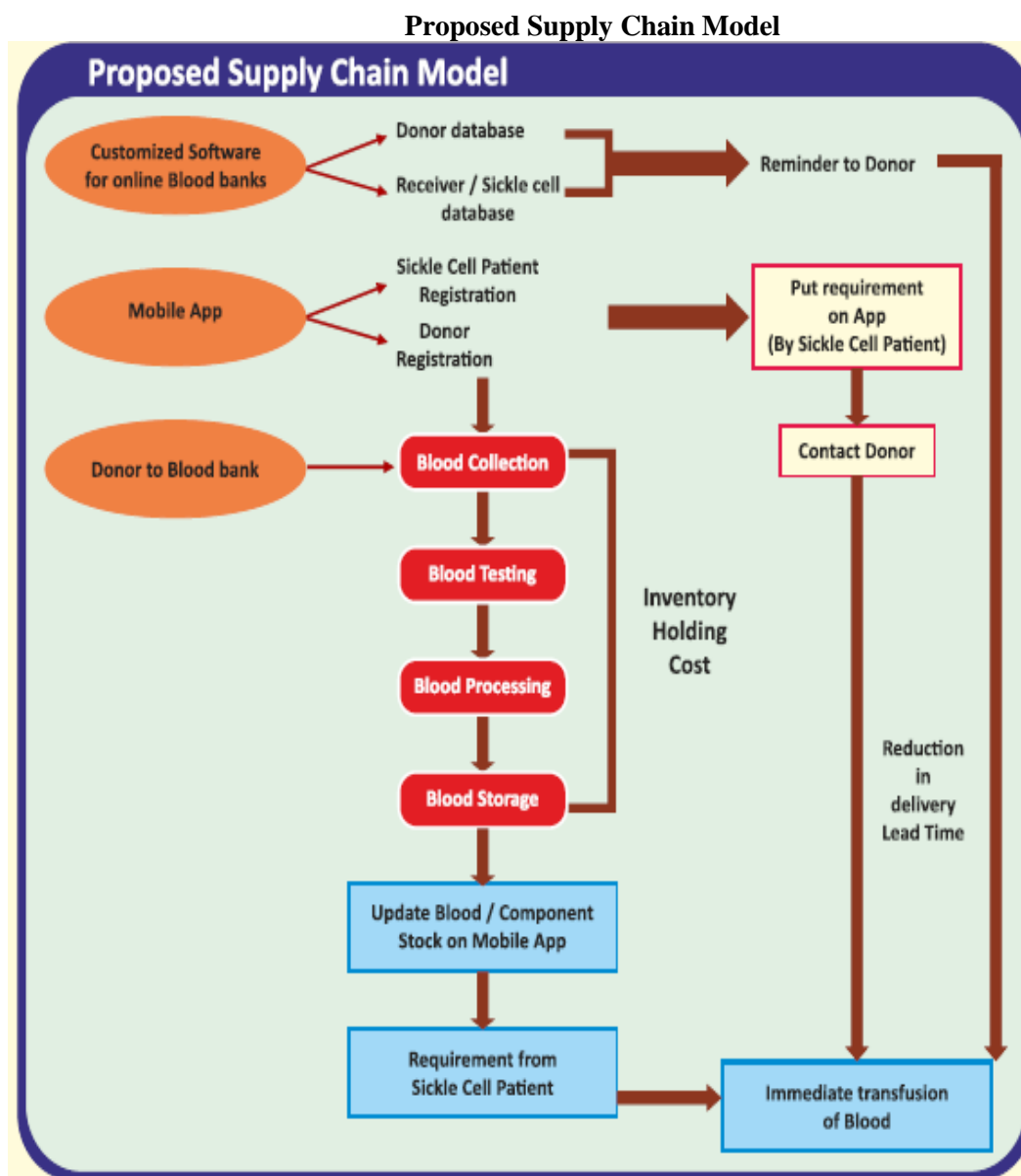**Proposed Supply Chain Model**

Figure 7: Proposed supply chain model for effective Sickle Cell treatment

Findings and Conclusion:

The study revealed that people are still unaware of the blood donation and it importance when it comes to the benefits of the sickle cell patients. Moreover people are also unaware of the sickle cell disease. Increasing awareness among the public can increase the inventory levels of blood at blood banks. Thus procurement of Blood and other components by the blood banks can be increased by increasing the awareness of the life threatening diseases like Sickle Cell among the public.

Mobile/ online blood banks can save the lead time for blood transfusion to the patient at times of need. Future research can be done in designing the Mobile App that is donor and user friendly. The App can stand as the mediatory to the donor and the recipient. The data suggests that the donors would appreciate the reminders being given to them for blood donation.Cost to the Sickle Cell patient can be brought down by implementing Just in Time through this Mobile app.

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