

Deployment of blood bank information system in Delhi NCT using web mapping application

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Abstract: Blood bank is a storehouse for collection of blood, which is gathered by the procedure of donation, primarily for future or in emergency use. But the information regarding the blood storage and availability is of utmost important, otherwise the information unavailable at the right time is of no use. In order to have all the information starting from the blood bank location to its stock inventory, a platform has been built. Focus of this paper is to build a browser-based user-friendly application as a solution to problem, which is faced daily due to shortage of blood thus minimizing the efforts and maximizing the utility. The study aims at the availability of cumulative information of blood availability in the banks and hospitals especially for the administrative personnel at the time of any crisis.

Keywords: Geographic Information System (GIS), ESRI WebApp builder, operational surveillance, real time tracking, Survey123

1. Introduction

A Geographic Information System (GIS) is a browser-based system for storing, capturing, displaying and checking data related to positions on the Earth's surface. GIS relates seemingly unrelated data, which can help individuals and organizations better understand the spatial patterns and relationships. GIS technology is a crucial part of spatial data infrastructure, which has been described by the White House as the technology, policies, standards, human resources, and related activities, which is necessary to acquire, process, distribute, use, maintain, and preserve spatial data. GIS technology desegregates database operations like unparalleled visual imaging and geographical analysis extended by maps with interrogation and statistical analysis (Kim et al., 2018; Mostafa et al., 2014; Kanani et al., 2017).

The GIS in India works on bulk data creation of digital ground survey maps to site mapping, transitions and digital computation, analysis and providing custom made presentations based on survey data of an area. The dimensions of maps differ for each resource, sector, function and element. After collection of data, it is transformed and translated into knowledge. This in turn helps the information seekers to properly plan for the future, manage their resources efficiently, and make critical business decisions to expand the territories of business including health care, logistics, agriculture, oil & gas, telecommunication, public safety etc. (Premasudha et al., 2009; Priya et al., 2014; Kanani et al., 2017).

Considering health care, the methods for improving health by implementation of geospatial technologies has become widespread in many nations (Haynes et al., 2016), but India's adoption of these approaches has been fairly slow. There is no coordination between blood banks and hospitals (Debroy, 2017). Blood Bank Information System plays an integral part, considering the utility of GIS in today's health sector. The idea of creating such an information system was boomed by analyzing the amount of wastage of blood (figure 1) every year in India. The idea

is to create a web application with the help of ESRI (Environmental System Research Institute) Webapp Builder, which shall provide a platform to the hospitals and the blood bank management authorities wherein all the blood stock related data (table 1) can be analyzed and updated at the same time.

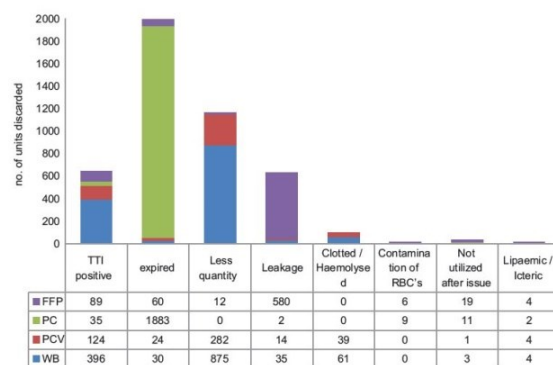


Figure 1: Graph showing blood discard reasons along with units (Source: Global Journal of Transfusion Medicine)

Table 1: Examples of blood use

Automobile Accident	50 units of blood
Heart Surgery	6 units of blood/6 units of platelets
Organ Transplant	40 units of blood/ 30 units of platelets
20 bags of Cryoprecipitate	25 units of fresh frozen plasma
Bone Marrow Plant	120 units of platelets/ 20 units of blood
Burn Victims	20 units of platelets

The platform shall contain information about the blood stock (updated by the blood banks from time to time), hospital data (who will be accessing the data), location of the blood banks (for nearest location identification). Real-

time updating of data is incorporated for continuous tracking and monitoring of blood stock, to have a clear idea about the demand and supply of blood for each group. The application will provide all necessary information to both blood banks and the hospitals at their fingertip.

2. Study area

Delhi, well known as the National Capital Territory of Delhi (NCT), is a city and a union territory of India. Delhi lies in North of India. It borders the Indian states of Haryana on the north, west and south and Uttar Pradesh to the east covering an area of 1,484 square kilometers (573 sq. mi). Being a capital region with its administrative prominence, huge population along with a well-connected transport network, this part has been considered as the area of study (figure 2).

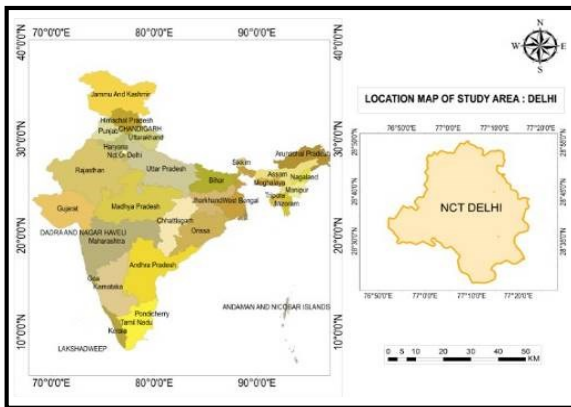


Figure 2: Location map of Delhi NCT

3. Objectives

The main objective of the study is to build an Automated Blood Bank Information system which could act as an operational surveillance system for hospitals and blood banks to optimize the work flow and bridge the gap between information exchanges when it comes to the requirement of blood. However, this system would also:

- Provide location-based blood bank information for easy accessibility.
- Provide stock information regarding individual blood groups.
- Provide a platform to understand the blood stocks, demand, peak time demand, real time updates of data etc. for instant action and one glance information purpose.
- Provide a common data collection method as Mobile Medical App which could be filled by all the blood banks for the information update of different blood groups and instant upload for real time update (Data collection both online and offline).

4. Materials and methodology

4.1 Database preparation

To undergo this study, we have used the following datasets:

- Administrative boundary of Delhi NCT.
- Blood Bank locations.
- Hospital locations along with patient details.

- Amount of blood available for each blood group at particular blood banks.

The blood bank location data was collected by taking the points from Google Earth in a KML (Keyhole Markup Language) format. This was then run through ESRI ArcMap to convert to shape file for further usage. The hospital locational data along with their domain of specialty was collected in the similar manner as that for the blood bank data (KML to shape file). Blood Banks and Hospitals detailed information (Figure 3) was collected from online governmental portal (<https://data.gov.in/catalog/blood-bank-directory-national-health-portal>; <https://data.gov.in/catalog/hospital-directory-national-health-portal>).

4.2 Data pre-processing

Pre-processing usually consists of a sequence of operations, the number and order of which is defined by the aim of the research and the type of data collected from various sources. The main steps followed are:

- Cleaning, sorting, filtering and appending of collected data in order to obtain an error free data for better analysis and representation.
- Conversion of generated KML file to shape file.
- Conversion of CSV files to point data and exporting it to shape file using ESRI ArcMap.
- Assigning of projections to each layer.
- Creation of ESRI ArcGIS online account for further accessibility and creating dashboards.

4.3 Data processing

The main focus was on building an application with the help of ESRI ArcGIS Web-App builder which would ease the process of monitoring and analyzing the demand, supply, and wastage of blood for different blood banks as per hospital requirements. After creating the Arc GIS account, the shape files created in Arc Map 10.5 were shared and published as a map package. The published shape files were built through ESRI Web Feature Services for further processing in order to build the web application.

Once the theme is decided, the next step is to configure the widgets of the application. The detailed workflow that has been ingested to provide a detailed insight of the process is shown in figure 4.

The selected theme of the application is displayed on the dashboard with different infographics based on the data for better visualization and analysis. The infographics are selected to show the relation between the different attributes of the data of the Blood Banks which includes pie, count, column, bar graph, line graph and filter.

The next agenda is to build the application in such a way that the user could access the data for information from the provided data. Operation dashboard was created on Arc GIS online which was later on integrated with the Survey123 form in such a way that the data which will be updated by the blood banks would immediately reflect on the dashboard by changing the graphs and counts (Figures 5 &)

The screenshot shows the data.gov.in website interface. The header includes the 'data.gov.in' logo and navigation links. The main content area displays a catalog entry for 'State/UT wise Number of Sub-Divisional Hospital, District Hospital & Mobile Medical Units functioning as on March 2010'. The entry includes a title, description, release under policy, contributor, and keywords. A 'Catalog Info' sidebar on the left provides additional details. A 'CSV' icon is visible, indicating the data format.

Catalog Info

- Title:** Rural Health Statistics in India - 2010
- Description:** Health Ministry is regularly compiling and disseminating information on rural health care services through publication Rural Health Statistics in India. Data provides data of Rural Health Statistics 2010. Rural Health S... [+]
- Released Under:** National Data Sharing and Accessibility Policy (NDSAP)
- Contributor:** Ministry of Health and Family Welfare
Department of Health and Family Welfare
- Keywords:** RHS PHC CHC Nurse Specialist ANM primary community Divisional Hospital mobile Medical

State/UT wise Number of Sub-Divisional Hospital, District Hospital & Mobile Medical Units functioning as on March 2010

CSV

- Granularity:** Annual
- File Size:** 815 bytes
- Download:** 108
- Reference URL:** <https://nrhm-mis.nic.in/>
- Visual Access:** NA

Figure 3: Data collection website

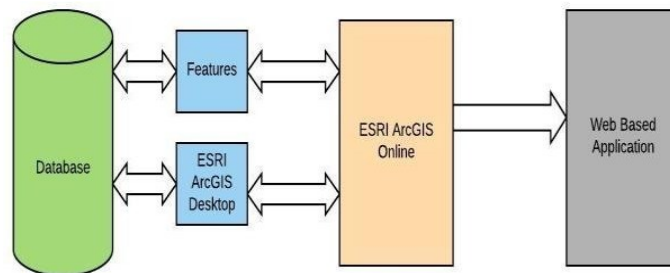


Figure 4: Web GIS architecture

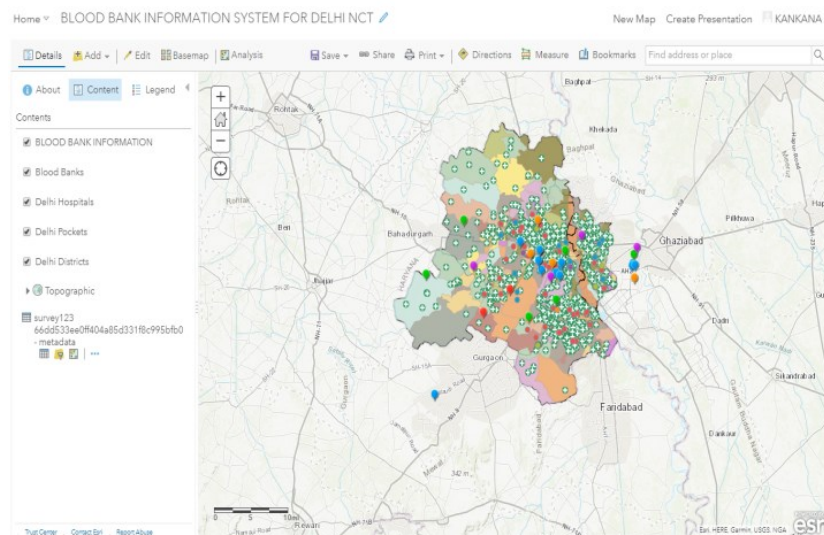


Figure 5: Web Map for Blood Bank Information System

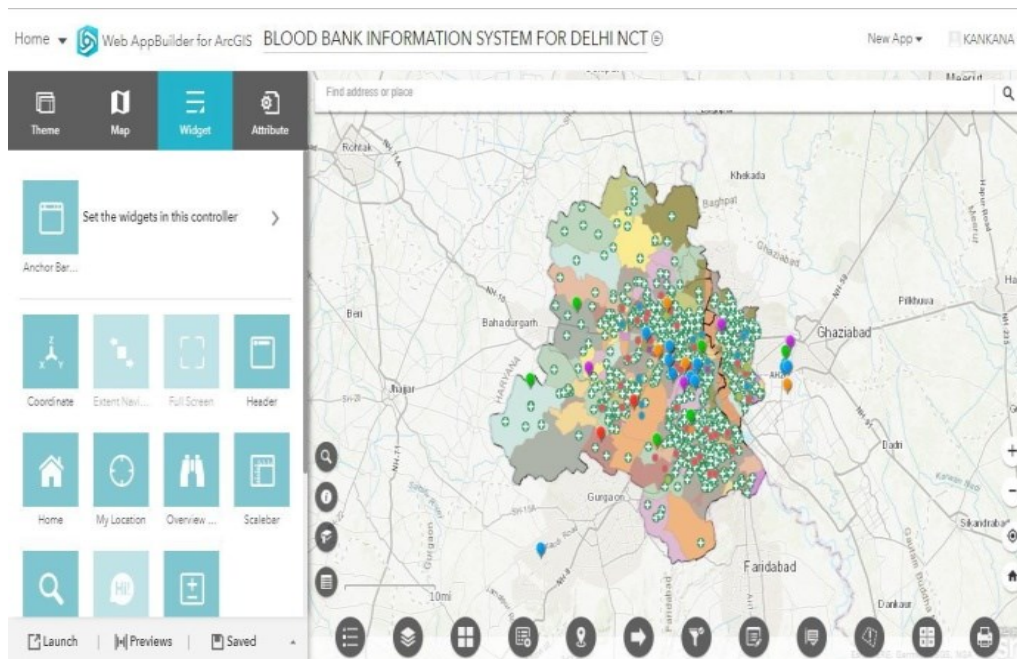


Figure 6: Configuring the widgets in web application

The Survey123 for Arc GIS was built with a motive that the blood bank organizations could fill up the built form with the details of their stock and other organizational details which was further integrated with the operations of the dashboard and web application, which would help in real time updating for a more well-built application.

5. Results and discussions

The application was intended to show the nearest facilities, the summary and analyze a particular situation. The resultant web mapping application and operation dashboard is showing satisfactory results which are intended to be achieved. Developed application can be helpful to mitigate the blood wastage every year. The

Survey123 form is also integrated for real time update.

The web application can be accessed by both hospital and blood bank authority where data updating and viewing can be done from both the end as shown in figure 7.

The data was showing a trend in the infographic on the Operations Dashboard. Thus, accomplishing the main aim of this paper which was to build a platform wherein the hospitals and the blood could update their data and henceforth maintain the stocks, immediate requirement, past stocks, nearby facilities. The web application displays the final output along with the configuration which has been applied into it.

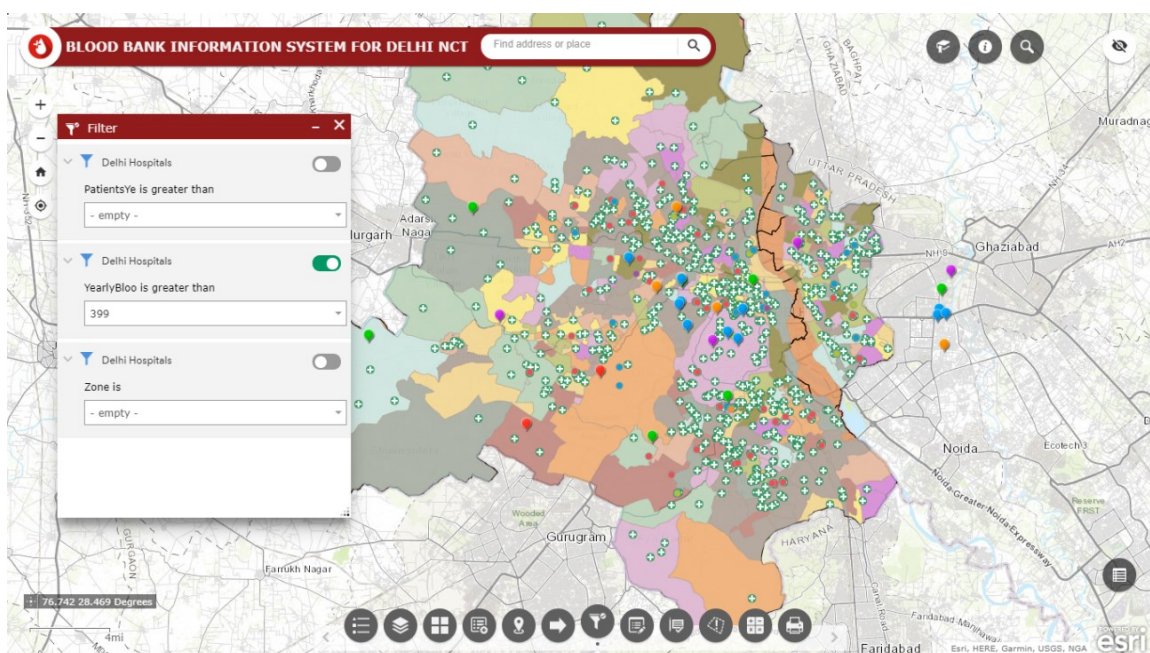


Figure 7: Web application user interface

The web mapping application can be accessed by the hospitals and the blood banks to get a clear idea regarding the information that have been stored by them. The different configured widgets will provide all the possible outcomes that the hospital or blood bank requires for any sort of analysis. The Surveillance Dashboard will show the initial graphical representation of the stored and updated data.

5.1 Blood bank information system

The blood bank information system is built mainly for the hospitals to have a clear picture about the existing information of all the hospitals in Delhi NCT (figure 8).

The web application shows all the information quarterly, its patients or the blood requirements.

The application can be accessed with the following URL:

<http://esriind-kankana.maps.arcgis.com/apps/webappviewer/index.html?id=a5c5726b4fdd49ad98edac79b0eb1826>

5.2 Surveillance dashboard

The Surveillance dashboard is built for the blood banks to keep track or record of their blood stock information (for each blood group) along with license, apheresis etc. The information is collected quarterly. The dashboard shows the real time update of the stock, requirements, location etc. about blood banks (Figure 9).

The application can be accessed with the following URL:

<https://esriind-kankana.maps.arcgis.com/apps/webappviewer/index.html?id=ae401bcc744f41cc8deec3cb6066b8bd8>

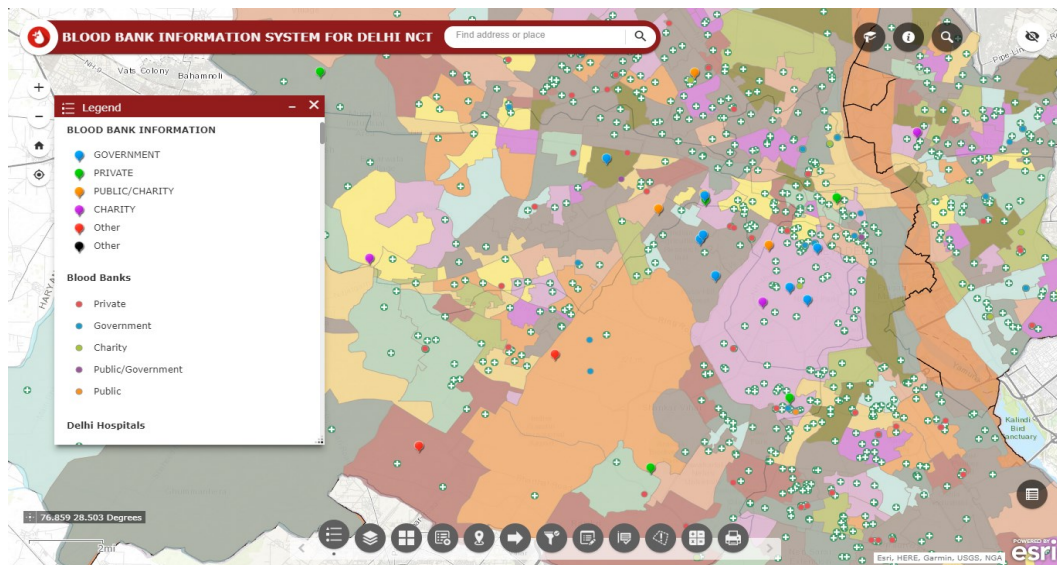


Figure 8: Zoomed view of nearest blood bank facility

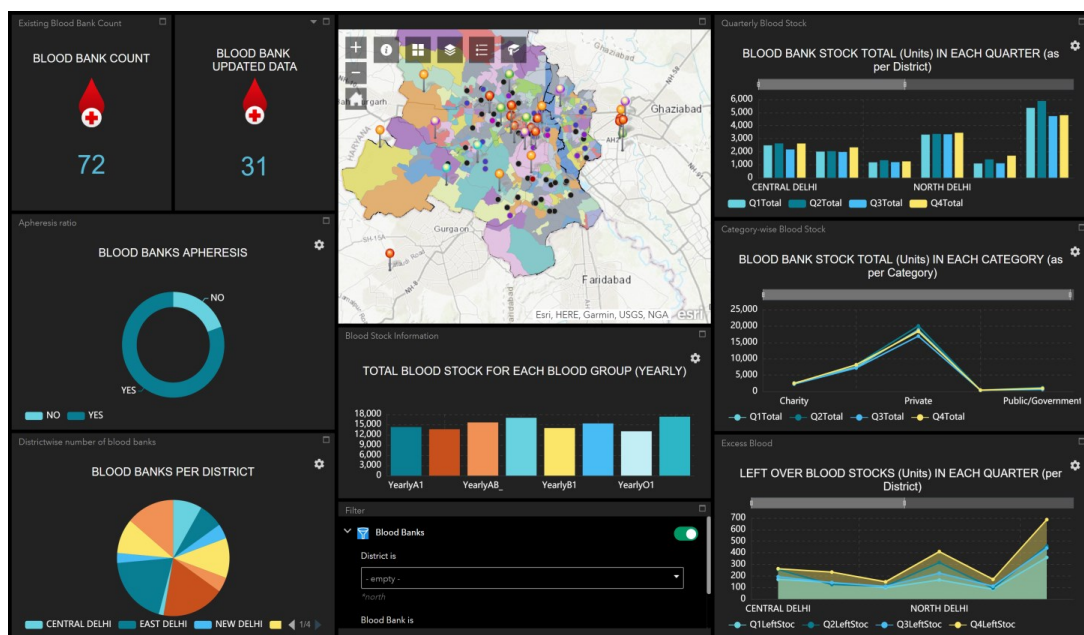


Figure 9: Dashboard view of web application

5.3 Blood bank information form

The blood bank information form was mainly made for collecting data on the fly and updating the same on the dashboard for real time visualization. The Survey123 form is for the blood banks over Delhi NCT to update their stocks, requirements etc. for easy monitoring (figure 10). The form can be accessed and filled using the following URL: <https://survey123.arcgis.com/share/66dd533ee0ff404a85d331f8c995bfb0>

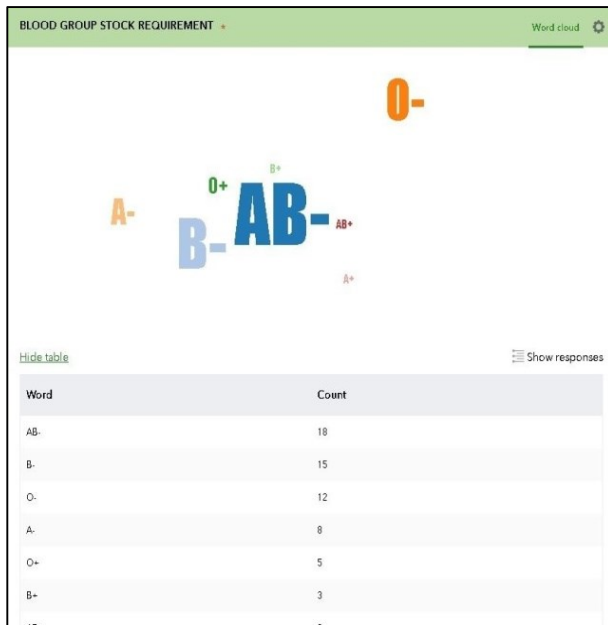


Figure 10: Word cloud in survey 123

6. Conclusions

Blood Bank Information System based on real time information has been developed along with an Operational Surveillance System and Mobile Medical Application. The proposed system facilitates a communication between the blood bank and different hospitals so that the appropriate answers can be received on a single platform. It also integrates the blood stock information for individual blood groups scattered among different blood banks and also the patient's blood group information from different hospitals to eradicate the blood exploitation. The Hospital Authority, Blood Banks and the Blood Bank Management Authority are able to use this Web Application to bridge the communication gap and provide necessary information for maintaining transparency. This reduces time which were usually taken to arrange a particular blood group in emergency situations and to keep a track of the blood availability. The application will help the user to locate the nearest blood banks, obtain information regarding the blood stocks etc. The Dashboard is built with an intension for real time data, updation for tracking, and report

generation on blood groups most in demand and difficult to collect, graphical representation for stock as blood group, etc. Survey123 will help in field data collection and integration. It is believed that this will not only facilitate the users with valuable information but will extend its functionality in saving lives of many.

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