Assessment of Turnaround Time of Blood Component Delivery System from Transfusion Medicine to Ward/ICU/OT for Transfusion: A Study on Health Care Assistants in a Private Hospital, Mumbai

Dissertation Submitted to

The IIHMR University, Jaipur

for the partial fulfilment for the award of the degree of

Master of Business Administration (MBA)

in

Hospital and Health Management

by

Dr. Apoorva Sancheti

Under the Supervision and Guidance of

Dr. Seema Mehta

2023

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Declaration

I hereby declare that this dissertation titled **Assessment of Turnaround Time of Blood Component Delivery System from Transfusion Medicine to Ward/ICU/OT for Transfusion in a Private Hospital, Mumbai: A Study on Health Care Assistants** is the bonafide record of my original researchwork. I declare that it has not been submitted to any other university or institution for the award of any degree or diploma. Information derived from the published or unpublished workof others has been duly acknowledged in the text.

Dr Apoorva Sancheti

Date:

COMPLETION CERTIFICATE

Kokilaben Dhirubhai Ambani
hospital & medical research institute
Every Life Matters

KDAH/HR/OL/2023/05/277

Date: 22.05.2023

TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Dr. Apoorva Sancheti** has successfully completed her **2 month and 18 days** period of **Internship** from 08.03.2023 to 26.05.2023 in the **Department of Clinical Quality** at **Kokilaben Dhirubhai Ambani Hospital & Medical Research Institute, Mumbai** under the guidance of Chief Manager - Clinical Quality, Ms. Krishnaveni Nimmakayala.

Dr. Apoorva has completed her tenure entirely to the satisfaction of the hospital management.

We wish her all the best in her future endeavor.

Best Regards,

For Kokilaben Dhirubhai Ambani Hospital & Medical Research Institute,

Rashma Nathani
Chief Manager - Human Resources

CERTIFICATE

This is to certify that dissertation titled **Assessment of Turnaround Time of Blood Component Delivery System from Transfusion Medicine to Ward/ICU/OT for Transfusion in a Private Hospital, Mumbai: A Study on Health Care Assistants** is a record of the research work undertaken by **Dr Apoorva Sancheti** in partial fulfillment of the requirements for the awardof the degree of MBA (Hospital and Health Management) from the IIHMR University, Jaipur under my guidance and supervision and her approach to the research study has been sincere, scientific, and analytical.

Faculty Guide
IIHMR University, Jaipur

Date

School Dean
IIHMR University, Jaipur

Date

ABSTRACT

The study describes the DMAIC (Define, Measure, Analyze, Improve, and Control) approach within a Lean Six Sigma framework for blood component delivery system to identify the areas of delay and improve the average turn-around time.

The study data was collected from 4th May 2023 to 16th May 2023, focusing on the role of HCAs and blood issue counter actions.

Primary data was collected by real time tracking for relevant sub-processes, while secondary data was obtained from blood request forms and blood issue forms.

Within the different DMAIC phases, tools such as process mapping and why-why analysis were applied.

Microsoft Excel was used for result analysis and determining the total count, average, maximum, minimum TAT taken by blood issue counter to acknowledge request or sample, issue blood component and those exceeding the benchmark. Through pareto analysis, the study identifies non-value-added activities within the current process.

Based on the analysis reason of delays, and interventions were designed to address them. The study provided recommendations for improving the existing process.

ACKNOWLEDGEMENT

I consider myself highly fortunate for receiving a fantastic opportunity to pursue my summer internship at Kokilaben Dhirubhai Ambani Hospital, Mumbai. For this, I am indebted to Ms. Krishnaveni Nimmakayala.

I want to express my warm veneration towards Mrs. Krishnaveni Nimmakayala, Chief Manager-Clinical Quality Department of the organization for her mentorship, guidance, constant supervision, and a keen interest in helping me learn and pushing my limits. I want to thank Dr Rajesh Sawant, Head Blood Centre Department for sharing his valuable insights and support. I sincerely thank Mrs. Hansa Shah, Personal Assistant-Clinical Quality Department for her support and genuine concern.

I am in awe of all the professionals at Kokilaben Dhirubhai Ambani Hospital, Mumbai, for being an example of grit, perseverance, dedication and offering their best services to the public.

I want to thank Dr P. R. Sodhani (President, Dean of Indian Institute of Health Management Research, IIHMR University-Jaipur) for providing me with this wonderful opportunity.

I want to thank my university mentor, Dr Seema Mehta, Professor at IIHMR University, for her active participation and her constructive feedback which guided me in making this report a successful project.

Dr Apoorva Sancheti

MBA in Hospital and Healthcare Management

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ABBREVIATIONS

- **KDAH:** Kokilaben Dhirubhai Ambani Hospital
- **BC:** Blood Center
- **BRF:** Blood Request Form
- **BIF:** Blood Issue Form
- **BIC:** Blood Issue Counter
- **PRBC:** Packed Red Blood Cells
- **FFP:** Fresh Frozen Plasma
- **Cryo:** Cryoprecipitate
- **SDP:** Single Donor Platelet
- **RDP:** Random Donor Platelet
- **PLTs:** Platelets
- **HCA:** Health Care Assistant
- **CAP:** College of American Pathology Accreditation
- **NABL:** National Accreditation Board for Testing and Calibration Laboratories
- **RMO:** Resident Medical Officer
- **DNB:** Diplomate of National Board
- **PRN:** Permanent Registration Number

RESEARCH TOPIC

Assessment of Turnaround Time of Blood Component Delivery System from Transfusion Medicine to Ward/ICU/OT for Transfusion in a Private Hospital, Mumbai: A Study on Health Care Assistants.

CHAPTER1: INTRODUCTION

Blood transfusion (BT) is one of the most frequently carried out medical procedures in modern hospitals. The layman perceives it as one of the most helpful lifesaving procedures and maybe a sign of the severity of the patient's sickness. As a result, the turnaround time (TAT) before commencing a blood transfusion (BT) is an essential quality parameter.

Turnaround Time: It is a term commonly used in various industries, including healthcare, manufacturing, customer service, and logistics, to refer to the time it takes for a process or task to be completed from start to finish.

The Turnaround Time (TAT) for blood bag transport refers to the duration it takes to transport blood bags from the blood issue counter or blood center to ward/ICU/OT.The TAT for blood bag transport is crucial in ensuring the timely availability of blood products for transfusion and medical treatments.

Blood bag transportation plays a critical role in the healthcare system, ensuring the safe and efficient delivery of blood products from blood center to different patient care areas within hospitals. The transportation of blood bags requires careful handling, adherence to strict protocols, and specialized logistics to maintain the integrity and viability of the donated blood. The transportation plays more complex part when immediate transfusions can be a decisive factor in any medical process.

The transportation process begins at blood collection center, where donated blood is carefully screened, tested, and processed. Once the blood is deemed safe for transfusion, it is stored in sterile, sealed bags that are specifically designed for this purpose. These blood bags contain lifesaving components such as red blood cells, plasma, and platelets, which are vital for various medical procedures, surgeries, and treating patients with critical conditions.

The timely delivery system of component from Transfusion medicine (Blood Centre) department to the respective ward/ICU/OT for Blood Transfusion is done by healthcare assistants (HCAs). HCAs transport blood bags in specific temperature while maintaining the integrity of the blood products. The blood bags handed over to HCAs

by following standard operating procedures as per NABL and CAP guidelines. This includes strict chain of protocols, system of blood request forms and blood issue forms for tracking patient and blood bags, provide tamper-evident packaging to prevent unauthorized access or tampering, multiple levels of cross-check and check-by. All this is critical for the management of patients and a milestone to achieve in delivering patient centric care.

Efficient blood bag transportation is essential for a well-functioning healthcare system, as it ensures that hospitals and medical facilities have an adequate supply of blood products for transfusions and emergency situations. The coordination between blood collection center, HCAs, and healthcare provider (doctors and nurses) is crucial to maintain a seamless supply chain and meet the demand for blood and blood products within hospital.

The blood or blood component reserved and issued once the HCAs sent to blood issue counter with blood request form or blood issue form.

The dedicated professionals involved in blood bag transportation play a vital role, by writing blood request form and blood issue form.

BLOOD REQUEST FORM: It is a laboratory requisition form used by doctors to request serology laboratory to test sent blood samples for cross matching and antibody screening to reserve blood components. The form combines patient registration information, barcodes sticker for billing, specimen information, barcoded specimen labels and a provider order for confirmation of testing.

BLOOD ISSUE FORM: It is a form used by doctors to request the issue of reserve blood component from Blood Centre. The form combines patient registration information, diagnosis, unit and component specifications, barcodes sticker for billing, specimen information, barcoded specimen labels and a provider order for confirmation of testing.

The delay in delivering of blood component to floor manifolds multiple reasons resulting in long waiting time for HCAs at blood issue counter and repetition of previous steps due to manual discrepancies from Ward/ICU/OT interrupts in smooth functioning of Blood Centre.

Health Care Assistants:

HCAs are a vital part of the healthcare system providing essential support to patients, nurses, and other paramedical services. HCAs work under the direction of a registered Nurse (Nurse In charge or Team Leader). They work in 9-hour shifts (M/E/N).

The role of a HCAs can vary depending on the department they work, but some of their duties include:

- Assisting with personal care of patients, such as bathing, dressing, bed pans, diaper calls.
- Assisting with the movement and mobility of patients.
- Responsible for Patient counts.
- Responsible for dusting of patient related equipment such as IV stand, syringe pumps, dressing trolleys, bedside panel, monitors etc.
- Responsible for transportation of blood and blood related products, pharmacy returns.
- Responsible for patients shifting in O.T (in and out).
- Helps in body shifting to mortuary, going to bio medical waste if any instrument breaks.
- Assist in collecting forms from TPA counter, xerox work.
- Responsible for making patient relatives bed making.
- Provide emotional support and comfort to patients.

QUALITY IN HEALTHCARE:

Health care has followed the example of the manufacturing industry in terms of quality management, initially focusing on retrospective evaluations of goods and results and ultimately doing contemporaneous assessments focused on processes. A healthcare review is critical to such evaluations.

An information system that integrates departmental data into a hospital wide framework, contains objective criteria for assessing procedures and results, and monitors changes to an organization's care delivery processes are used by organisations. The purpose of an integrated, patient-centered information system is to create a continuous loop inside an organisation for enhancing clinical and administrative quality.

Different organisations use distinct quality management and continuous quality improvement techniques, tactics, and technology. TQM (Total Quality Management), Six Sigma, or something similar will most likely be used to describe the programme. The phrases BPR (Business Process Reengineering), Operational Excellence, and Business Excellence all refer to the same terms used to describe the same thing.

Regardless of the methodology, strategy, tool, or name of the continuous improvement programmes, each organisation will undoubtedly require a careful selection and combination of many methods, tools, and techniques in its implementation process.

Six Sigma is one of the strategies used for quality improvement of hospital operations processes. It is a collection of concepts and techniques for quality improvement. DMAIC (Define, Measure, Analyse, Improve, and Control) is one such Six Sigma approach used here for quality improvement process. It is a data-driven life-cycle approach to Six Sigma process improvement projects. DMAIC is an abbreviation that stands for five interrelated phases: define, measure, analyse, improve, and control.

AIM

The aim of the study is to analyze the blood component delivery system to identify the areas of delay and improve the average turn-around time using DMAIC approach.

OBJECTIVE

1. To identify factors that may contribute to delays in the delivery of blood components from blood issue counter to patients.
2. To determine the average total time consumed in blood or blood product issue, delivery, and transfusion to the patients.

RATIONALE

A patient visiting a hospital expects complete care from the time of admission to the time of discharge, along with, complete medical care and advice. Blood transfusion is an important medical procedure that can save lives. The timely delivery of blood components from the Transfusion Medicine department to the wards, ICUs, or operating theaters is crucial for the management of patients. Delays in the process can lead to prolonged waiting times for HCAs at the blood issue counter and interruptions in the smooth functioning of the Blood Centre.

This study will provide valuable insights into identifying the factors causing delays in the delivery process, quantify the average total time consumed, existing challenges and areas for improvement in the blood component delivery system.

The study was taken up as a quality improvement initiative to increase the availability of HCAs on floor, determine TAT and eliminate the reasons causing delay. Improving the efficiency of the blood component delivery system to have a direct impact on providing patient-centric care.

CHAPTER 2: REVIEW OF LITERTATURE

Sr No	Paper Title	Learnings	References	Published On
1.	"Turnaround Time for Red Blood Cell Transfusion in the Hospitalized Patient: A Single-Center "Blood Ordering, Requisitioning, Blood Bank, Issue (of Blood), and Transfusion Delay" Study"	The article investigates the procedures that contribute to delays in starting a red blood cell transfusion and the turnaround time for blood transfusions in hospitalised patients. The average TAT for a blood transfusion, according to the study, was 55.5 minutes, with the largest delays occurring between blood issue and blood bank processing. The study also discovered several additional factors that contributed to TAT delays, such as mistakes in the transcription and requisitioning of blood orders as well as delays in nurse sampling. The study's main finding is that healthcare organisations must put strategies in place to enhance TAT and lessen delays in blood transfusions.	Agnihotri, N., & Agnihotri, A. (2018). Turnaround time for red blood cell transfusion in the hospitalized patient: A single-center "blood ordering, requisitioning, blood bank, issue (of blood), and transfusion delay" study. *Indian Journal of Critical Care Medicine: Peer-Reviewed, Official Publication of Indian Society of Critical Care Medicine*, *22*(12), 825–830. https://doi.org/10.4103/ijccm.IJCCM_403_18	2018
2	"Implementing Lean Six Sigma to Improve the Turnaround Time of Blood Samples in a Private Hospital of India"	The article discusses the use of the Lean-Six-Sigma (LSS) methodology in a private hospital in India to reduce the turnaround time for blood samples. During the deployment of LSS, the DMAIC technique served as the model for problem-solving. According to the study, the updated registration form reduced the number of blank or incomplete fields by 67%, which significantly lowered the number of insurance claim denials. In addition, "Federico II" of Naples (Italy) undertook a study that concentrated on how LSS Methodology could be used to lower the risk of healthcare-associated infections (HAIs). The	Alok, M., Samanta, K., Varaprasad, G., & Gurumurthy, A. (n.d.). Implementing lean six sigma to improve the turnaround. Ieomsociety.org. Retrieved May 23, 2023, from https://ieomsociety.org/proceedings/2022india/483.pdf	2022

		article's conclusion is that LSS approach can be used by healthcare organisations to improve quality, cost and productivity outcomes.		
3	“Lean six sigma methodologies improve clinical laboratory efficiency and reduce turnaround times”	This article discusses the use of Lean-Six-Sigma approach to improve clinical laboratory efficiency and reduce turnaround times. Although most accredited laboratories have workflow processes that are well-designed, the authors point out that there are still inefficiencies that might have an impact on quality, such as needless service duplication, lengthy wait times, and delays. The turnaround times for test results have been found as a major factor in patient unhappiness, and patient satisfaction is heavily dependent on these turnaround times. It is possible to increase the effectiveness and efficiency of clinical laboratory procedures using LSS. By placing a strong emphasis on quality, the authors concluded that laboratory management is required to save money and increase productivity., and foster user pleasure. All chosen performance metrics were evaluated following the effective use of quality-improvement initiatives utilising LSS methodologies.	Inal, T. C., Goruroglu Ozturk, O., Kibar, F., Cetiner, S., Matyar, S., Daglioglu, G., & Yaman, A. (2018). Lean six sigma methodologies improve clinical laboratory efficiency and reduce turnaround times. Journal of Clinical Laboratory Analysis, 32(1). https://doi.org/10.1002/jcla.22180	2017
4	“Blood sampling - Two sides to the story”	The peer-reviewed study explores blood sample variance in Scottish hospitals. A multi-method approach is used in the study, which includes 50 observations, 15 interviews, and 12 months of event data from all Scottish hospitals. The Functional Resonance Analysis Method (FRAM) was used to understand how variability could alter blood sample functions. The study revealed that the data used to assess the factors influencing performance had shortcomings. One investigator conducted a content analysis of the event data using theme coding and generated descriptive statistics. The SEIPS model was used to create level two codes, which reflected the	Pickup, L., Atkinson, S., Hollnagel, E., Bowie, P., Gray, S., Rawlinson, S., & Forrester, K. (2017). Blood sampling - Two sides to the story. Applied Ergonomics, 59(Pt A), 234–242. https://doi.org/10.1016/j.apergo.2016.08.027	2017

		incident's result. According to the writers, there are two.		

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Study type: Descriptive Cross-Sectional Study.

3.2 Research questions:

What are the factors that may contribute to delays in the delivery of blood components from blood issue counter to patients.

3.3 Setting of the Study: Kokilaben Dhirubhai Ambani Hospital, Mumbai.

3.4 Study Period: The study was conducted in hospital from 7th April to 22nd May.

GANTT CHART: Graphical representation for study time duration.

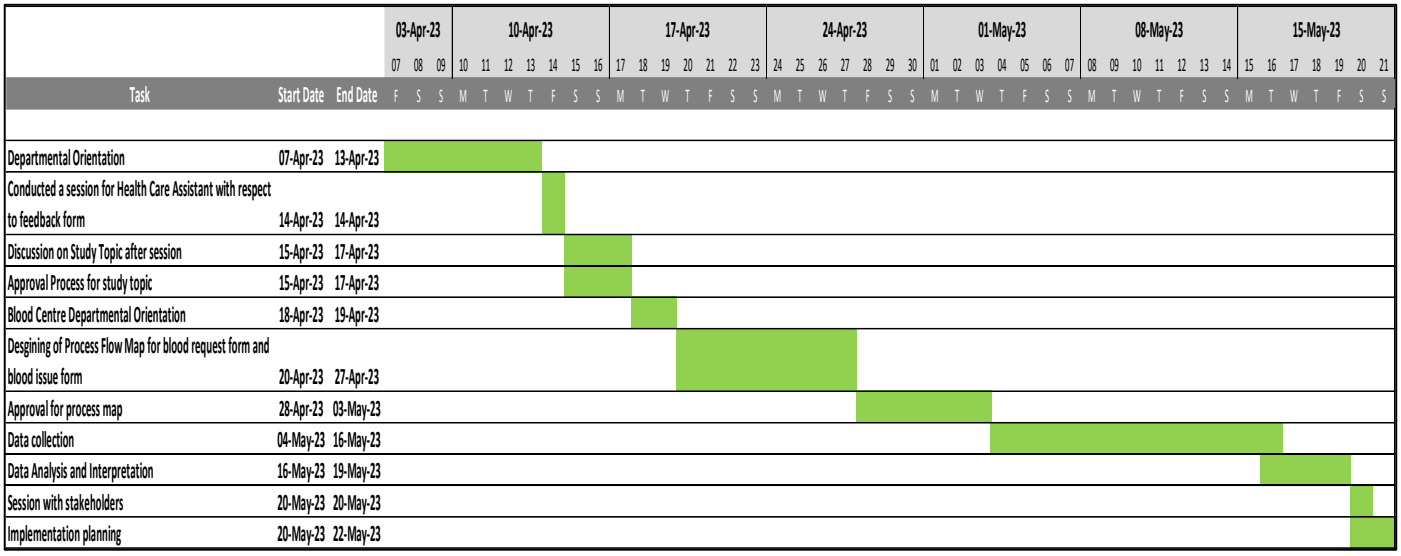


Figure. 3.1

3.5 Sampling Method: The sampling technique was Non- probability Purposive Sampling.

HCAs coming with blood request forms, blood issue form or blood sample from 9:00 AM to 7:00 PM were tracked. HCAs were observed from the time they come to the blood issue counter to the point they leave for their respective floor.

3.6 Sample Size:

- For Blood Request Form: (N=96) Health Care Assistants were observed.
- For Blood Issue Form: (N=108), 92 forms are collected with respect to Packed Red Blood Cells (PRBC), Single Donor Platelet (SDP), Random Donor Platelet (RDP), Granulocyte and 16 forms are collected for Fresh Frozen Plasma (FFP) and Cryoprecipitate (Cryo) Health Care Assistants were observed.

1. Inclusion Criteria:

- Data collected of all the HCAs coming to blood issue counter with Blood request Forms with or without samples for cross match, antibody screening in the time between working hours of (9:00 AM to 7:00PM)
- Data collected of all the HCAs coming to blood issue counter with Blood Issue Forms in the time between working hours of (9:00 AM to 7:00PM)

2. Exclusion Criteria:

- Blood Request Forms and Blood Issue Forms arriving at blood issue counter in the time after working hours of (7:00 PM to 8:00 AM).
- HCAs arriving at blood issue counter with sample requests for ABO grouping.
- HCAs arriving at blood issue counter with feedback forms and empty transfused bag.
- Orders are composed during Sunday, public holidays.

3.7 Study Procedure:

The research applied the six-sigma approach to identify and improve the quality of process by:

- Identify and remove the cause of defect (errors) and variation.
- Identify and eliminating the factors that are causing process steps to be repeated.
- Concentrating on the outcomes that are essential for the quality improvement process.

To achieve the above-mentioned objectives, the approach used in the study is DMAIC. The acronym stands for five phases: Define, Measure, Analyze, Improve, and Control. DMAIC is a data driven, problem-solving methodology used in the field of process improvement and quality management. DMAIC is commonly associated with the Six Sigma approach, which aims to reduce defects and variability in processes.

The simplified definition of each phase is:

D - Define: Clearly state and understand the problem or opportunity for improvement. Set goals and identify stakeholders involved.

M - Measure: Collect and analyze data to measure the current state of the process. Identify key performance indicators (KPIs) and establish the scope of parameters and their performances.

A - Analyze: Analyze the data collected to identify the key causes of the problem.

I - Improve: Develop and implement solutions to change the process and optimizing performance.

C - Control: Establish controls and monitoring systems to ensure that the improvements are sustained.

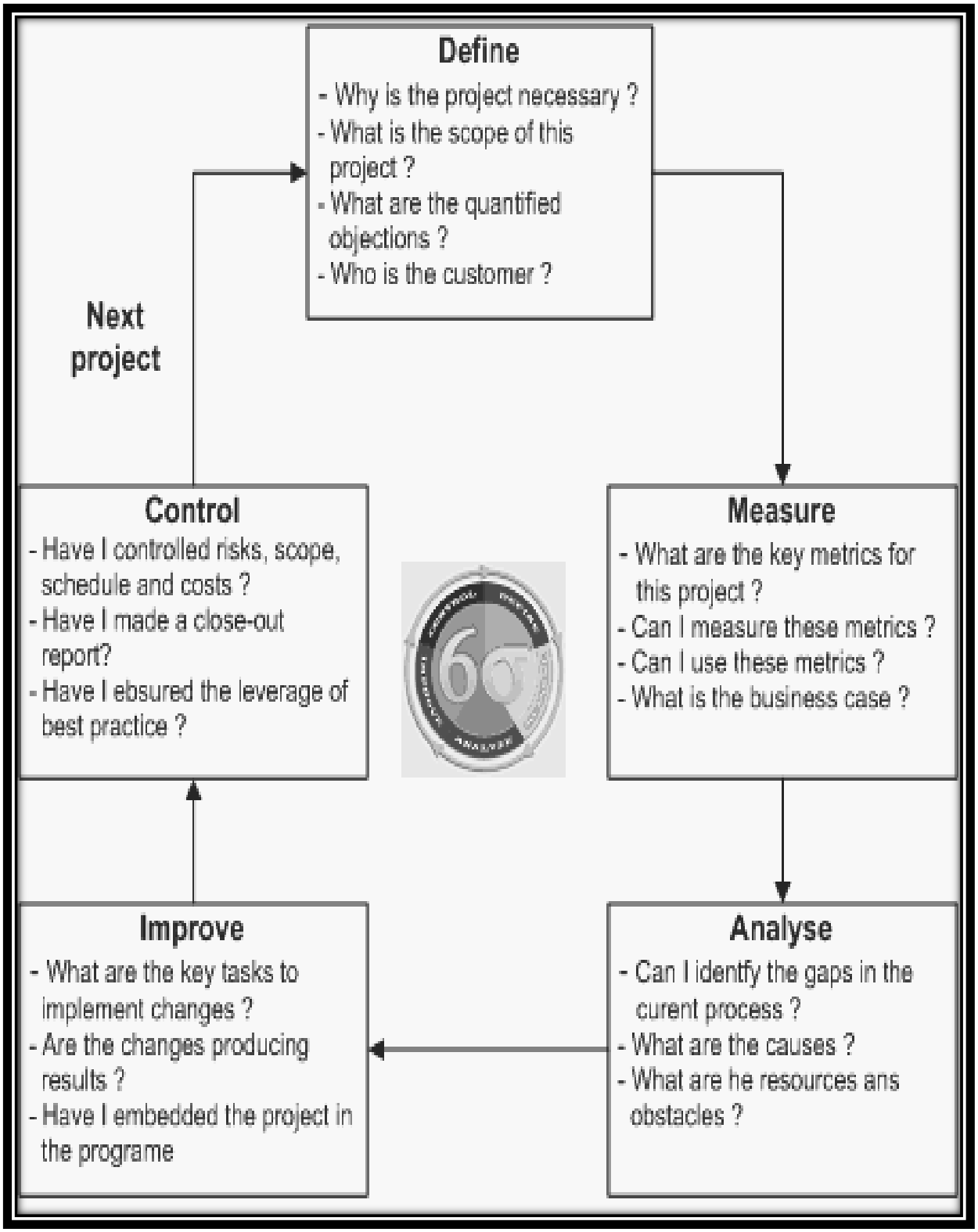


Figure 3.2 The DMAIC cycle as a methodology of Six Sigma

Source: "Sokovic M, Pavletic D, Pipan KK. Quality improvement methodologies–PDCA cycle, RADAR matrix, DMAIC and DFSS. Journal of achievements in materials and manufacturing engineering. 2010 Nov 1;43(1):476-83"

3.7(a) DEFINE:

This phase was about clearly defining the scope of the problem. It focuses on quantifying the problem and the underlying process to define how performance would be monitored. It involves identifying the stakeholders involved. The process was mapped to understand the existing sub-processes involved in the blood transfusion of a patient from the time blood request form & blood issue form is written at floor level by doctor to the time HCAs coming to blood issue counter with forms and going back to floor level with issued product.

A swim lane process map, also known as a swim lane diagram or cross-functional flowchart. It is a type of process mapping tool used to define the scope of problems.

A swim lane is a visual representation of a process that depicts the flow of activities across several functional areas or individuals (stakeholders) involved in the process. It provides a clear view of the responsibilities and handoffs between departments, teams, or roles within a process. In a swim lane process map, each functional area or role is represented by a horizontal lane, typically shown as a rectangular box. The activities within the process are depicted as vertical arrows or shapes that flow across the swim lanes. This layout helps illustrate the sequence of actions and interactions between different stakeholders.

These concepts of process mapping were applied here to depict the process flow of BRF and BIF in hospital, a swim lane was designed as follows:

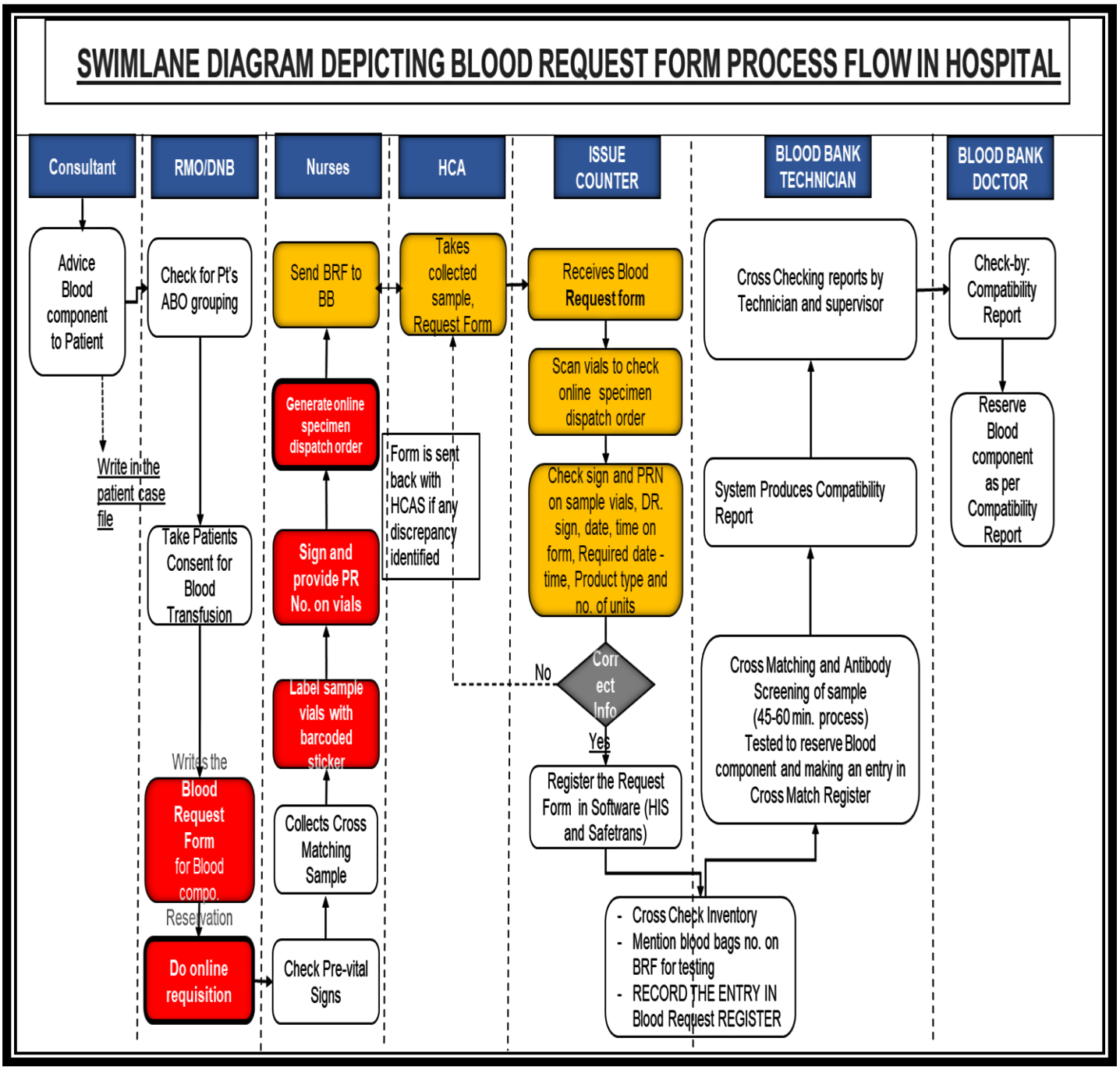


Figure 3.3

Source: "L Czégé, J. M. (2018). Process analysis and optimization"

The above swim lane diagram depicts process flow for blood request form (BRF). The process comprises of various phases or sub-processes. The red color box indicates problem points and yellow color box indicates repetition of steps in process flow.

The consultant, RMO/DNB, nurses, HCAs, issue counter, blood bank technicians and blood bank doctors are the stakeholders responsible for blood request form process.

The sub-processes are as follows:

- Consultants provide recommendations for blood transfusion. The reservation of blood components based on surgical needs, diagnosis and indication is advised. This information is communicated to the assigned nurse by the Resident Medical Officers (RMOs) or Diplomate of National Board (DNB) doctors.
- RMOs or DNB doctors write the blood request forms (BRFs) based on the patient's ABO group after obtaining consent from the patient's relatives. They also complete an online requisition for the BRF and hand it over to the assigned nurse.
- Nurses are responsible for collecting samples, labelling 2 vacutainers and BRFs with barcode, signature, and PRN no. Once an online specimen dispatch order is generated, the labelled vials are sent to the blood issue counter with Healthcare Assistants (HCAs) following standard operating procedures.
- HCAs bring two vacutainers (one with EDTA and one plain) along with the BRF to the blood issue counter.
- At the blood issue counter, the BRF and vacutainers are scanned to check online requisition and specimen dispatch status, following checks are performed for the BRF and sample:
    1. Verification of the sign and PRN number of the phlebotomist/nurse and the specimen number on the vacutainers.
    2. Verification of the sign and PRN number on the specimen number sticker attached to the request form.
    3. Matching of the patient's name, Unique Hospital Identification (UHID), and specimen number with the barcode on the vacutainer and the barcode on the request form.
    4. Noting the patient's age and sex.
    5. Observing the bed number.
    6. Observing the diagnosis, required date and time.
    7. Observing the indication for transfusion.
    8. Confirming the patient's blood group.
    9. Determining the required type of blood component.
    10. Verifying the number of units need to be reserved.

11. Identifying the type of request (routine, emergency, or reserved).
12. Name and signature of the doctor.

- All these are documented by blood issue counter manually in Blood Request Register and in hospital information system for billing.
- If any discrepancies or variations are found in these steps, the BRF and sample will not be accepted by the blood issue counter, and the HCA will be sent back to complete the necessary steps on the floor.
- Accepted samples are subsequently processed, after which the system provides a compatibility report.
- This report and blood component is saved for patients once a blood bank doctor checks-by it. Once compatibility report generated is valid for 3 days, after 3 days process needs to be repeated for patients.

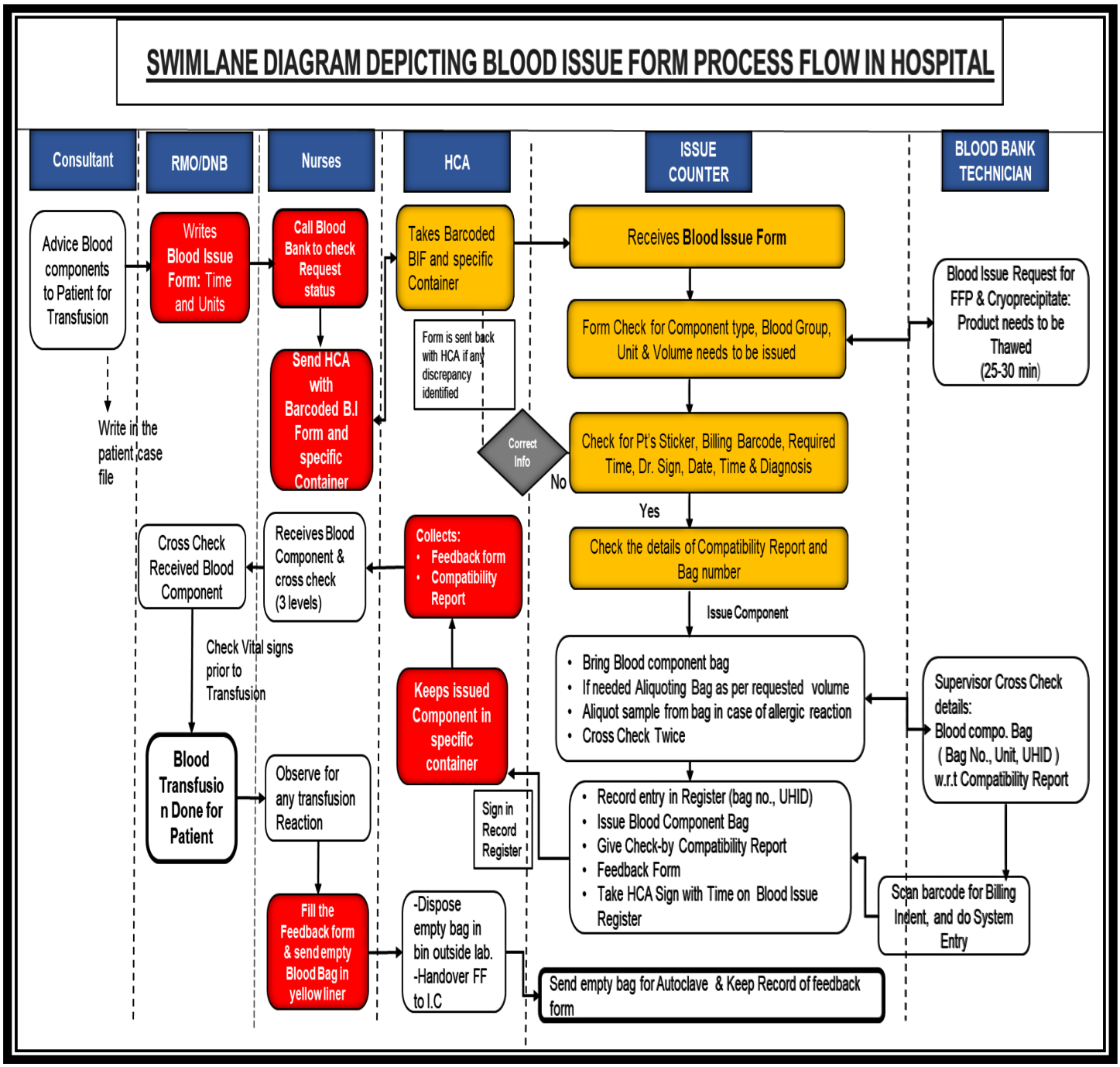


Figure 3.4

Source: "L Czégé, J. M. (2018). Process analysis and optimization"

The above swim lane diagram depicts process flow for blood issue form (BIF). The process comprises of various phases or sub-processes. The red color box indicates problem points and yellow color box indicates repetition of steps in process flow.

The consultant, RMO/DNB, nurses, HCAs, issue counter and blood bank technicians are the stakeholders for blood issue form process.

The sub-processes are as follows:

- Consultants' advice patient for blood transfusion.
- Resident Medical Officers or (RMOs) or Diplomate of National Board (DNB) doctors write the blood issue form (BIF) based on the patient's ABO group. Type of component required date and time is mentioned on form based on surgery, diagnosis, and indication. This form is handed over to the assigned nurse, nursing team lead.
- Nurses call blood issue counter to check the status of blood component.
- Nurses are responsible for patient stickers and barcode labelling as per required component. BIF and container as per type of component is sent to the blood issue counter with Healthcare Assistants (HCAs) following standard operating procedures.
- HCAs takes BIF along with container to the blood issue counter.
- PRBC blood component issued in a cold box or insulated carrier box with ice packs within the box which will keep the temperature under +10 °C.
- Thawed frozen components are transported in a well-insulated box without ice packs.
- At the blood issue counter, the BIF is accepted only after following checks are performed:

1. Verification of the name and sign of prescribing doctors
2. Matching of the patient's name, Unique Hospital Identification (UHID), and barcode on the issue form with type of component required.
3. Observing the patient's age and sex.
4. Recording the bed number.
5. Observing the diagnosis, required date and time.
6. Observing the indication for transfusion.
7. Checking relevant laboratory parameters.
8. Confirming the patient's blood group.
9. Determining the required type of blood component.
10. Verifying the number of units required. One HCA will be issued with one component.
11. Identifying the type of request (routine, emergency, or reserved).

- All these are documented by blood issue counter manually in Blood Issue Register and in hospital information system for billing.
- If any discrepancies or variations are found in these steps, the BIF and sample will not be accepted by the blood issue counter, and the HCA will be sent back to complete the necessary steps on the floor.
- Accepted BIF are subsequently issued with blood component bag.
- HCAs goes back to floor level with issued blood component bag in container.

3.7(b) MEASURE:

This is the data collection phase of the study.

The focus was on measuring and describing the problem using process and performance data and metrics. The main objective was to understand the current state of the process, before implementing any changes. This data serves as a standard against which any improvements resulting from interventions could be measured. This is a key step as the data collected will be used throughout the life of the project.

In this phase, the primary measure was to determine the total TAT of sample acceptance, type of blood component issue at blood issue counter for delivery from blood center to floor levels by HCAs.

TAT of sample acceptance and issue of blood components		
Sr. No.	**Process Name**	**TAT Time**
1	Sample acceptance for Cross Match	10 Minutes
2	PRBC	15 Minutes
3	Aliquot PRBC	20 Minutes
4	SDP	15 Minutes
5	Pooled Platelet	15 Minutes
6	Platelet	10 Minutes
7	FFP	45 Minutes
8	Cryoprecipitate	45 Minutes

Table. 3.1

Overall, the Data Collection Phase focused on quantitatively assessing the problem by capturing relevant metrics and establishing a baseline for comparison and improvement.

Study Tool: The blood request form and blood issue form are used as reference tools and data collected using tracking sheet in MS Excel.

The data used in the study was entered into a defined Excel sheet.

FOR BLOOD REQUEST FORM:

i. T1: Total Time Taken by Blood Issue Counter for BRF and sample acceptance.

FOR BLOOD ISSUE FORM:

i. T1: Time difference between HCA arriving at BIC to BIC accepting BIF.

ii. T2: Time difference between BIF acknowledged to issue blood component.

iii. T3: Time difference between HCA arriving at BIC to HCA leaving BIC with blood component.

Data Collection:

- **Primary Data Collection Technique:** Real – time tracking with a mobile stopwatch focusing on HCAs and blood issue counter actions.
- **Secondary Data Collection Technique:** Information gathered from Blood Request and Blood Issue Forms.

For Blood Request Form:

i. Collecting patients UHID No., Name of patient, location, required time and date, no. of units and type of request: Routine/Emergency/Reserved mentioned on form by doctor.

ii. Real – time tracking of HCAs arrival at blood issue counter with blood request form and sample.

iii. Real – time tracking of total time taken by blood issue counter to acknowledge the blood request form and sample.

For Blood Issue Form:

i. Collecting patients UHID No., Name of patient, location, required issue date and time, type of blood component and type of request: Routine/Emergency/Reserved mentioned on form by doctor.
ii. Real – time tracking of HCAs arrival at blood issue counter with blood issue form.
iii. Real – time tracking of time taken to acknowledge the Blood Issue form at issue counter.
iv. Real – time tracking of total time taken by HCAs leaving blood issue counter with issued blood product/ component.

3.7(c) ANALYZE:

The phase seeks to isolate the problem by analyzing current performance. The root cause of the problem is determined through analysis (both quantitative and qualitative).

- Analysis done for Blood Request Form and Blood Issue Form followed by WHY-WHY or 5-WHY analysis to identify the root cause.
- Analysis done are as follows:

FOR BLOOD REQUEST FORM:

BLOOD REQUEST FORM (BRF): It is a laboratory requisition form used by doctors to request blood samples for cross matching and reserve blood components.

1. Calculated number of Blood request form and sample acceptance request which were within and beyond the benchmark TAT of 5 minutes for sample size (N) = 96

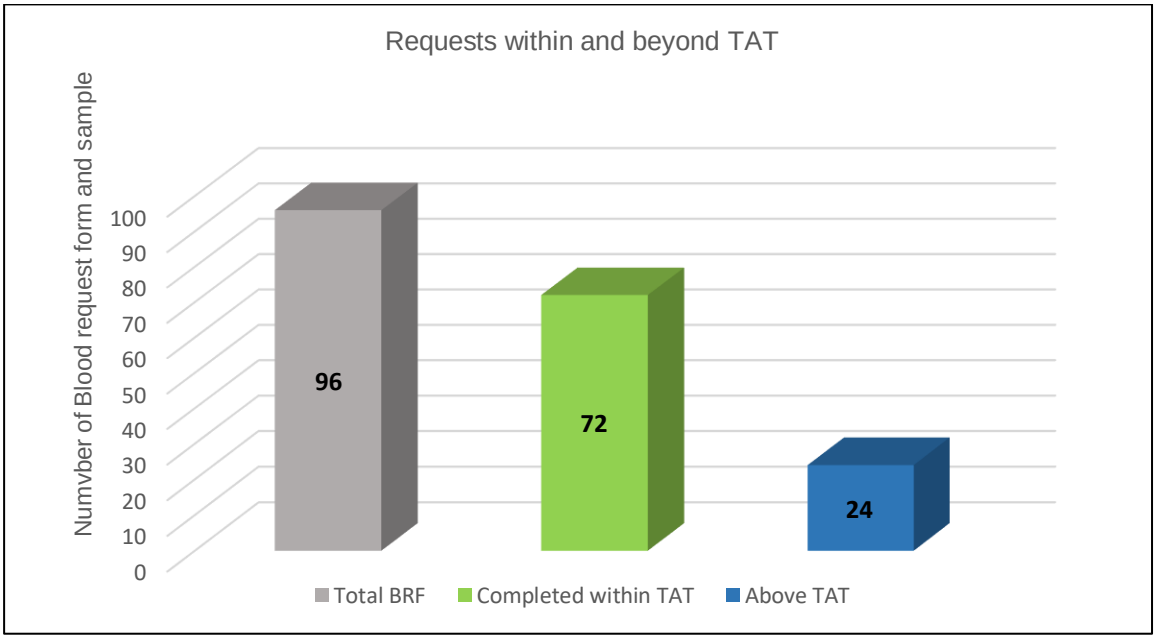


Figure 3.5

Interpretations:

- Above graph represents number of Blood request form & sample accepted within standard TAT (5 mins)
- It's been observed 75% request (72) were accepted within 5 mins and 25% request (24) were accepted beyond 5 minutes
- Observed delay caused due to following reasons:
  - Incomplete and Incorrect forms
  - Heavy inflow of requests
  - Protocol not followed or HCA unaware of protocol

2. Calculating average, maximum, minimum TAT by blood issue counter for Blood request form and sample acceptance for sample size (N) = 96

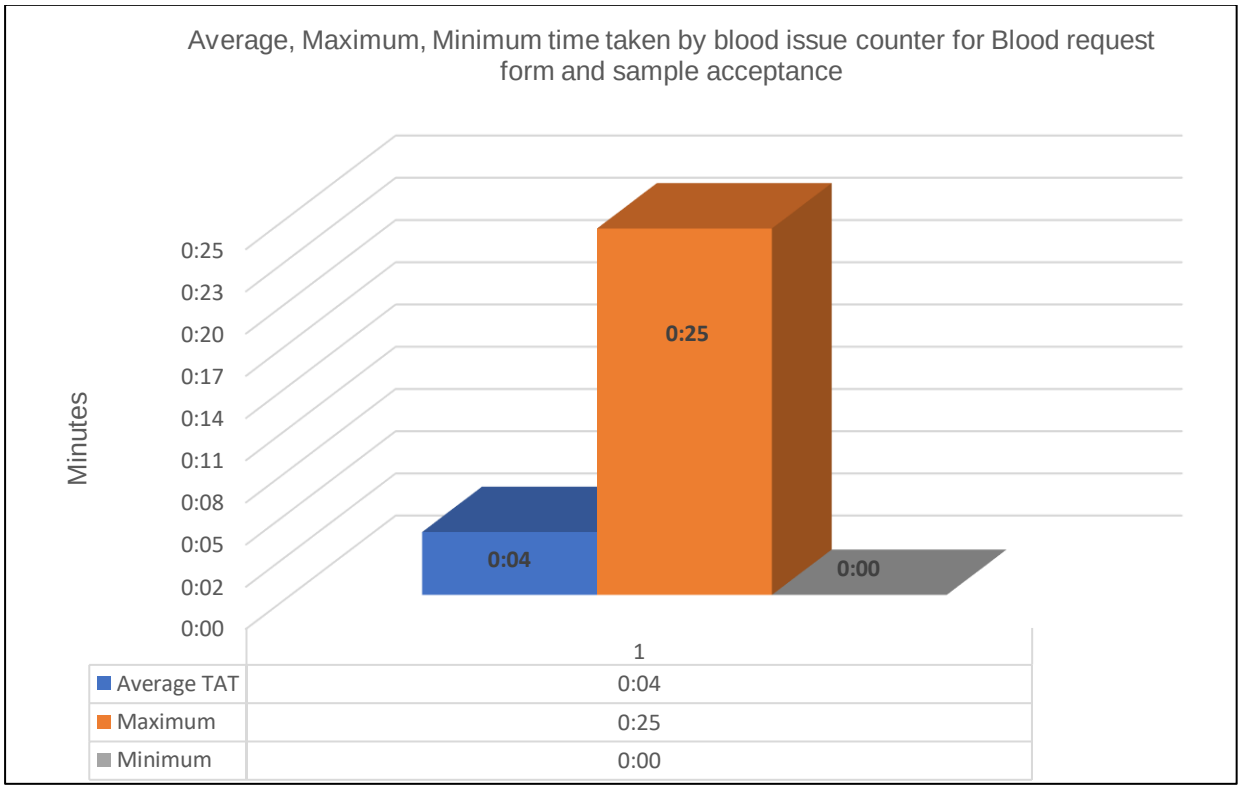


Figure 3.6

Interpretations:

- Above graph represents the average time of 4 mins taken by BIC to process a request
- Highest time observed as 25 mins at Blood issue counter to process a request and also noted immediate responsiveness in some cases

3. Pareto Analysis was done to calculate the frequency or occurrence of errors for different categories of sample size (N) = 96. Pareto Analysis is a statistical technique used in decision-making for the selection of a limited number of tasks that produce significant overall effect. The Pareto Principle (also known as the 80/20 rule) the idea is that by doing 20% of the work one can generate 80% of the benefit of doing the entire job.

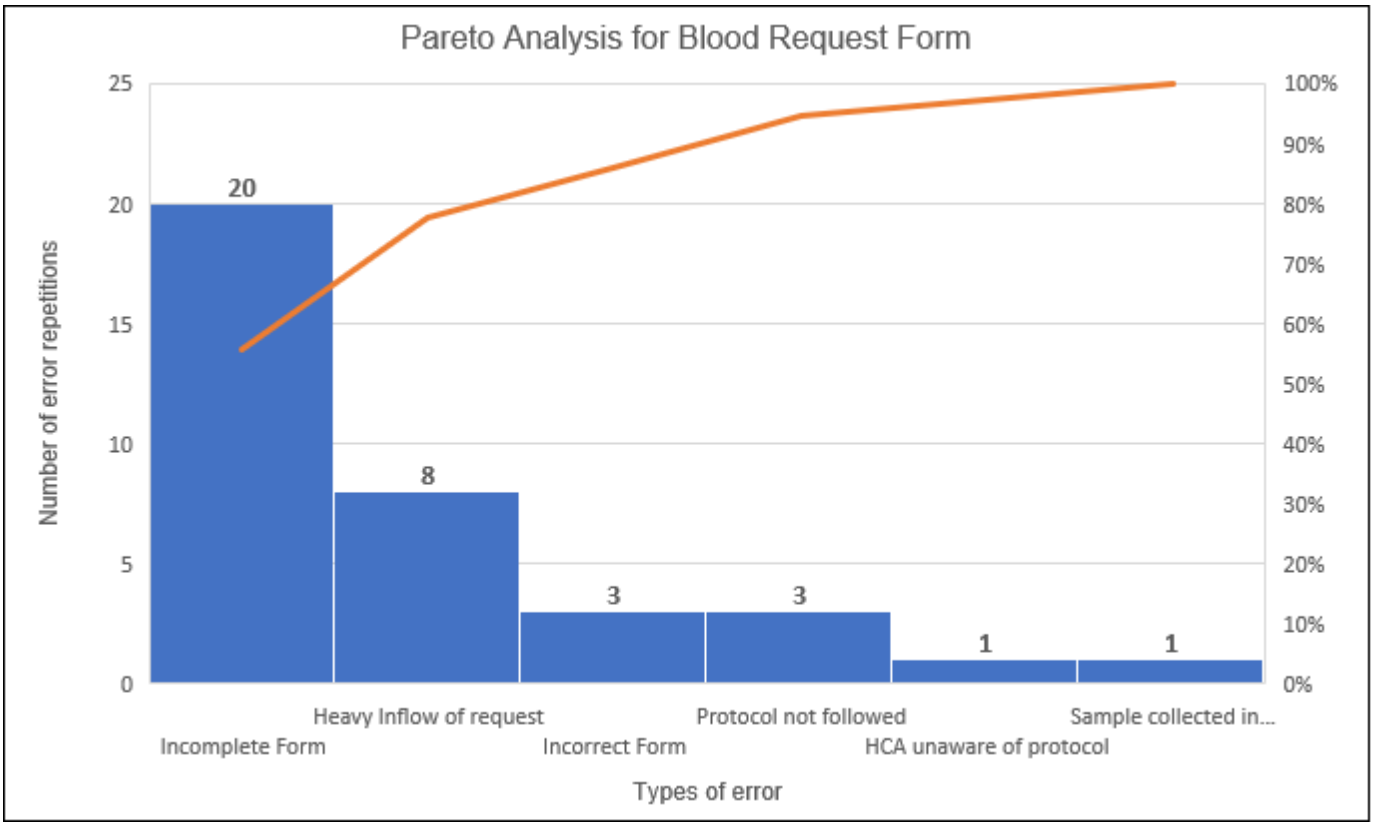


Figure 3.7

Interpretations:

Pareto Analysis reveals that 80% of the variation in blood request form is due to

1. Incomplete or Incorrect forms written by doctor or nurse
2. Heavy inflow requests at blood issue counter

From the above analysis, it was concluded that the following were the 3 major reasons of delay in acceptance of BRF and sample acceptance by blood issue counter:

- **Incomplete forms:** RMOs/DNBs are responsible for writing blood issue forms, online form requisition and nurses are responsible for sample collection, online order dispatch, sending BRF and sample to BIC with HCAs as per existing protocol, but this is not followed, results in an increase in incomplete form numbers and multiple rounds by HCAs to blood issue counter for acceptance of BRF and sample, followed by issue of blood component. following are the underlying cause of error-

Sr No.	Types of Error observed for Incomplete Blood Request Form
1	Indications not mentioned on form
2	Gamma irradiations not mentioned
3	Form Barcode without Sign-PRN
4	Doctor name not mentioned
5	Barcode not sticked on form
6	Date & Time not mentioned
7	Diagnosis Missing in the form
8	Doctor Signature Not mentioned
9	Age, Gender & Relatives number not mentioned
10	Required time not mentioned
11	phlebotomist sign and PRN missing
12	Blood Component not mentioned
13	Online Order not dispatched
14	HCA Sent without sample
15	Specimen barcode without Sign-PRN
16	Specimen sent without barcode

Table 3.2

- **Heavy inflow of requests at blood issue counter:**

The blood centre only has one blood issue counter, which is staffed by a single technician on a daily schedule. This technician is in-charge of all normal and emergency blood requests, sample acceptance, blood issue paperwork, and component issues. To accommodate each request, technicians must go through a series of cross-inspections on the form, inventories to issue blood components,

and processes for blood bag checks. Incomplete and erroneous forms, as well as any protocol errors in form, add to the processing time, resulting in high wait times for HCAs.

- **Incorrect forms:** As per existing protocol RMOs/DNBs for writing blood issue forms, online form requisition and nurses are responsible for sample collection, online order dispatch, sending BRF and sample to BIC with HCAs, but this is not followed. following are the underlying cause of error-

Sr No.	Types of Error observed for Incorrect Blood Request Form
1	Wrong Date mentioned
2	Wrong Blood Component mentioned
3	Wrong Blood Volume mentioned
4	Wrong Bar Code sticked
5	Wrong order details mentioned
6	Wrong Blood Group mentioned
7	Wrong Gender mentioned
8	Wrong required time mentioned
9	Form Overwriting
10	Wrong Patient UHID mentioned

Table 3.3

FOR BLOOD ISSUE FORM:

BLOOD ISSUE FORM (BIF): It is a form used by doctors to request the issue of reserve blood component from Blood Centre

i. Analysis done for PRBC, SDP, RDP, Platelets and Granulocytes:

1. Calculated number of Blood issue form requests which were within and beyond the benchmark TAT of 20 minutes for sample size (N) = 92

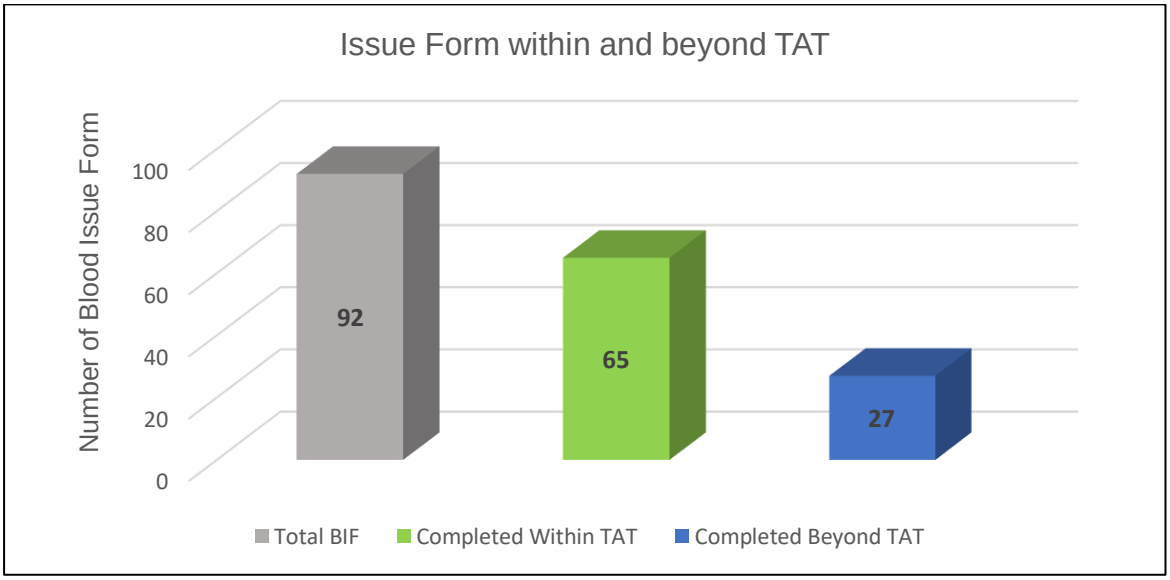
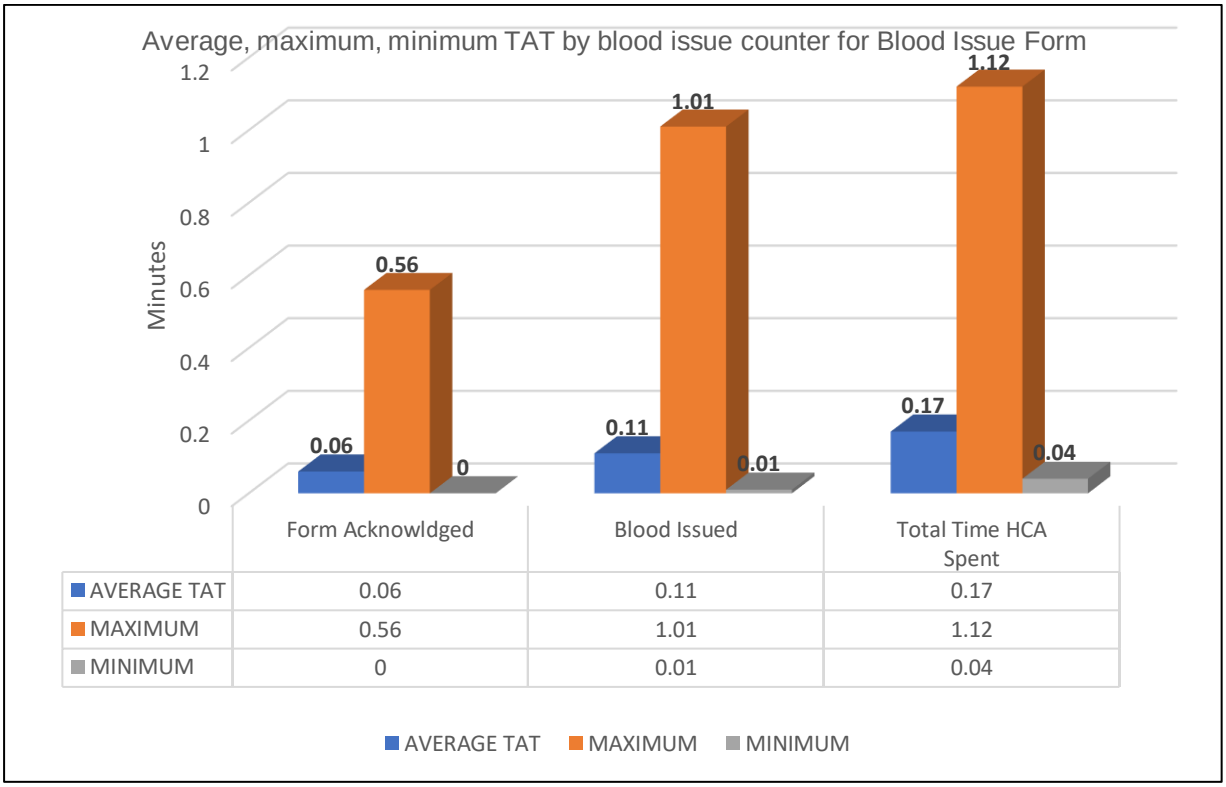


Figure 3.8

Interpretations:

- Above graph represents number of Blood issue form requests completed within standard TAT (20 mins – component issue & aliquot bag)
- It's been observed 71% request (65) were completed within 20 mins and 29% request (27) were completed beyond 20 minutes
- Observed delay caused due to following reasons:
  - Incomplete and Incorrect forms
  - Heavy inflow of requests
  - Protocol not followed or HCA unaware of protocol

2. Calculating average, maximum, minimum TAT by blood issue counter for Blood Issue Form for sample size (N) = 92



	Form Acknowldged	Blood Issued	Total Time HCA Spent
AVERAGE TAT	0.06	0.11	0.17
MAXIMUM	0.56	1.01	1.12
MINIMUM	0	0.01	0.04

Figure 3.9

Interpretations:

- Above graph represents the average time of 6 mins, maximum time of 56 mins and immediate responsiveness at Blood issue counter to accept Blood issue form.
- Above graph represents the average time of 11 mins, maximum time of 1 hour 1 min and minimum time of 1 min at Blood issue counter to issue blood component
- Above graph represents the average time of 17 mins, maximum time of 1 hour 12 min and minimum time of 4 mins HCA had to spent at Blood issue counter
- Observed delay caused due to following reasons:
  - Incomplete and Incorrect forms
  - Heavy inflow of requests
  - Protocol not followed or HCA unaware of protocol
  - Calls not answered at nurse station

ii. Analysis done for Fresh Frozen Plasma (FFP) & Cryoprecipitate (Cryo):

3. Calculated number of Blood issue form requests which were within and beyond the benchmark TAT of 45 minutes for sample size (N) = 16

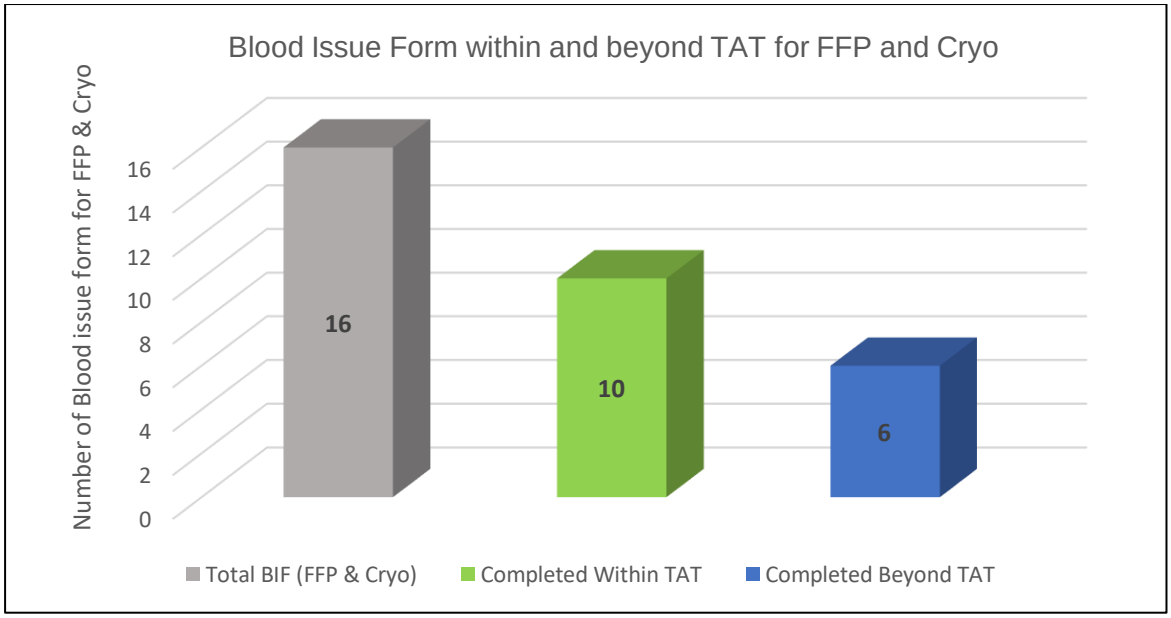


Figure 3.10

Interpretations:

- Above graph represents number of Blood issue form requests completed within standard TAT (45 mins)
- It's been observed 62% request (10) were completed within 45 mins and 38% request (6) were completed beyond 45 minutes
- Observed delay caused due to following reasons:
  - Incomplete and Incorrect forms
  - Heavy inflow of requests
  - Protocol not followed or HCA unaware of protocol

4. Calculating average, maximum, minimum TAT by blood issue counter for Blood issue Form for sample size (N) = 16

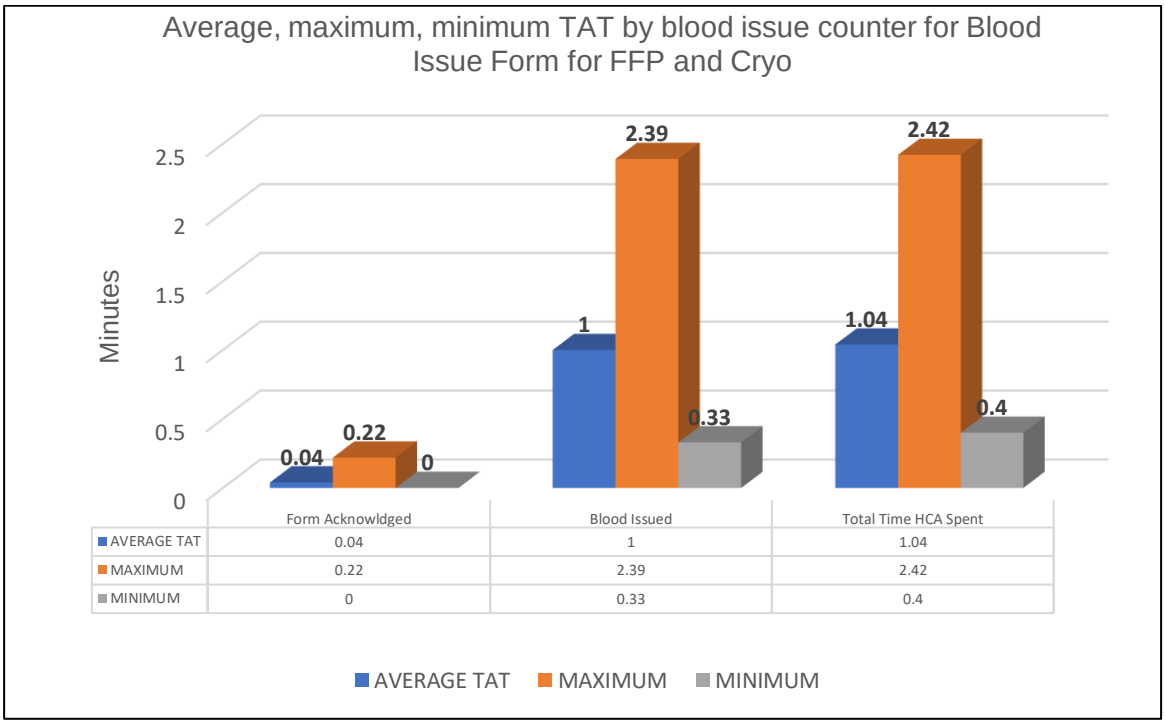


Figure 3.11

Interpretations:

- Above graph represents the average time of 4 mins, maximum time of 22 mins and immediate responsiveness at Blood issue counter to accept Blood issue form
- Above graph represents the average time of 1 hour, maximum time of 2 hour 39 mins and minimum time of 33 min at Blood issue counter to issue blood component
- Above graph represents the average time of 1 hour 4 mins, maximum time of 2 hour 42 mins and minimum time of 40 mins HCA had to spent at Blood issue counter
- Observed delay caused due to following reasons:
  - Incomplete and Incorrect forms
  - Heavy inflow of requests
  - HCA not sent back after 45 mins

5. Pareto Analysis was done to calculate the frequency or occurrence of errors for different categories of sample size (N) = 108. Pareto Analysis is a statistical technique used in decision-making for the selection of a limited number of tasks that produce significant overall effect. The Pareto Principle (also known as the 80/20 rule) the idea is that by doing 20% of the work one can generate 80% of the benefit of doing the entire job.

iii.

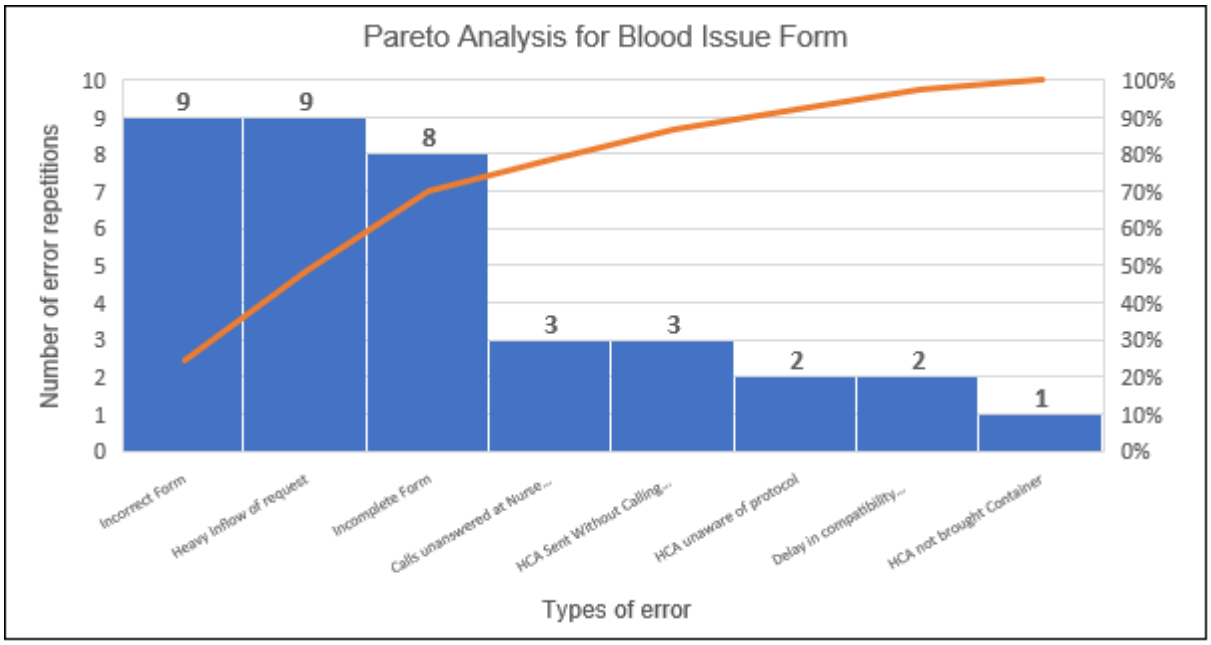


Figure 3.12

Interpretations:

Pareto Analysis reveals that 80% of delay in acceptance of Blood issue form by blood issue counter is due to

1. Incorrect forms by doctor or nurse.
2. Heavy inflow requests at blood issue counter.
3. Incomplete forms written by doctor or nurse.

From the above analysis, it was concluded that the following were the 3 major reasons of delay in acceptance of BIF by blood issue counter:

- **Incorrect forms:** As per existing protocol RMOs/DNBs are responsible for writing blood issue forms and nurses are responsible for sending BIF with HCAs to BIC, but this is not followed. following are the underlying cause of error-

Sr No.	Types of Error observed for Incorrect BIF Form
1	Wrong Date mentioned
2	Wrong Blood Component mentioned
3	Wrong Blood Volume mentioned
4	Wrong Bar Code sticked
5	Wrong order details mentioned
6	Wrong Blood Group mentioned
7	Wrong Gender mentioned
8	Wrong required time mentioned
9	Form Overwriting
10	Wrong Patient UHID mentioned

Table 3.4

- **Heavy inflow of requests at blood issue counter:**

  The blood centre only has one blood issue counter, which is staffed by a single technician on a daily schedule. This technician is in-charge of all normal and emergency blood requests, sample acceptance, blood issue paperwork, and component issues. To accommodate each request, technicians must go through a series of cross-inspections on the form, inventories to issue blood components, and processes for blood bag checks. Incomplete and erroneous forms, as well as any protocol errors in form, add to the processing time, resulting in high wait times for HCAs.

- **Incomplete forms:** RMOs/DNBs are responsible for writing blood issue forms and nurses are responsible for sending BIF with HCAs to BIC according to existing protocol, but this is not followed, results in an increase in incomplete form numbers and multiple rounds by HCAs to blood issue counter for acceptance of BIF, followed by issue of blood component. following are the underlying cause of the error-

Sr No.	Types of Error observed for Incomplete BIF Form
1	Indications not mentioned on form
2	Gamma irradiations not mentioned
3	Form Barcode without Sign-PRN
4	Doctor name not mentioned
5	Barcode not sticked on form
6	Date & Time not mentioned
7	Diagnosis Missing in the form
8	Doctor Signature Not mentioned
9	Age, Gender & Relatives number not mentioned
10	Required time not mentioned
11	Phlebotomist sign and PRN missing
12	Type of blood component needed not mentioned

Table 3.5

WHY- WHY or 5-WHY ANALYSIS

The tool used was the why-why analysis or the 5 why analysis. The tool works by repeatedly asking the question "Why?" to determine the fundamental cause of an issue. The multiple questioning analyses the problem at a deeper level and so helps in identifying the root cause of the problem. Each layer of the problem is important in order to determine the underlying cause.

REASONS	WHY	WHY	WHY	WHY	WHY
Delay in availability of HCA on floor resulting in patient dissatisfaction. Ref: Patient Feedback Form	HCA spends majority of their time in 1) Pharmacy 2) Blood Issue Counter	Long waiting time at blood issue counter	Incomplete forms and Incorrect forms	1) Doctors / Nurses are not following protocol. 2) New staff not aware about the protocol	1) Over sight error 2) Need of staff sensitization

Table 3.6

3.7(d) IMPROVE:

The results of the analyse phase are applied in the improve phase to develop preliminary design change recommendations. During the control phase, these recommendations are tested, confirmed, and institutionalised. Consideration was given to improvements, and brainstorming was done to find solutions to the problem statements that were among the most controllable reasons of delay.

To discuss the factors found during the analysis phase meeting was conducted including all the stakeholders' members responsible for errors and delay in delivery system are as follows:

Members attended are:

- Head Blood Centre
- Blood Technician Supervisor
- Head Clinical Quality
- Clinical Administration Managers Team
- Head of Nursing Administration
- Deputy General Managers Nurses
- General Manager Nurses
- HCA Supervisor

PROBLEM STATEMENT 1: Delay due to Incorrect and Incomplete documentation:

- **Staff Responsible:** Clinical Admin Managers, Junior Medical Staff
- **Recommendation:** Clinical Administration team needs to take training sessions to provide better understanding on existing protocols for blood and blood components, regular monitoring and inform all Junior medical staff to not involve nurses for writing and online requisition of BRF and BIF.

PROBLEM STATEMENT 2: Delay due to Incorrect and Incomplete documentation:

- **Staff Responsible:** Nurse Managers and Nurses
- **Recommendation:** Nurse managers are informed about the type of errors-delayed online order dispatch, filling of BRF, BIF and asked to provide training sessions for better understanding on existing protocols for blood and blood components, regular monitoring. Nursing staff on the floor to be updated with observation and immediate corrective action to be taken.

PROBLEM STATEMENT 3: Delay due to heavy inflow of requests at blood issue counter

- **Staff Responsible:** Blood Center or Blood issue counter

- **Recommendation:** Blood center head was asked to prioritize of HCAs by Blood Centre or BIC who are coming with BIF for FFP and cryoprecipitate components as it requires thawing of 30-35 minutes before issue.

PROBLEM STATEMENT 4: Lack of regulation of Standard Operating Procedures (SOPs) need to be followed by nurses for blood request or blood issue.

- **Staff Responsible:** Nurse Managers and Nurses
- **Recommendation:** Nurse Managers were asked to provide regular session for provide better understanding of SOPs, also asked to design an induction programme with the help of blood center for new joining staff. The sessions should include brief about protocols for sample collection, barcodes used for different type of components request and issue, to provide sign-PRN on form and sample, type of container required for PRBC, FFP and to send HCA to BIC after calling.

PROBLEM STATEMENT 5: Delay as HCAs are not aware about protocols.

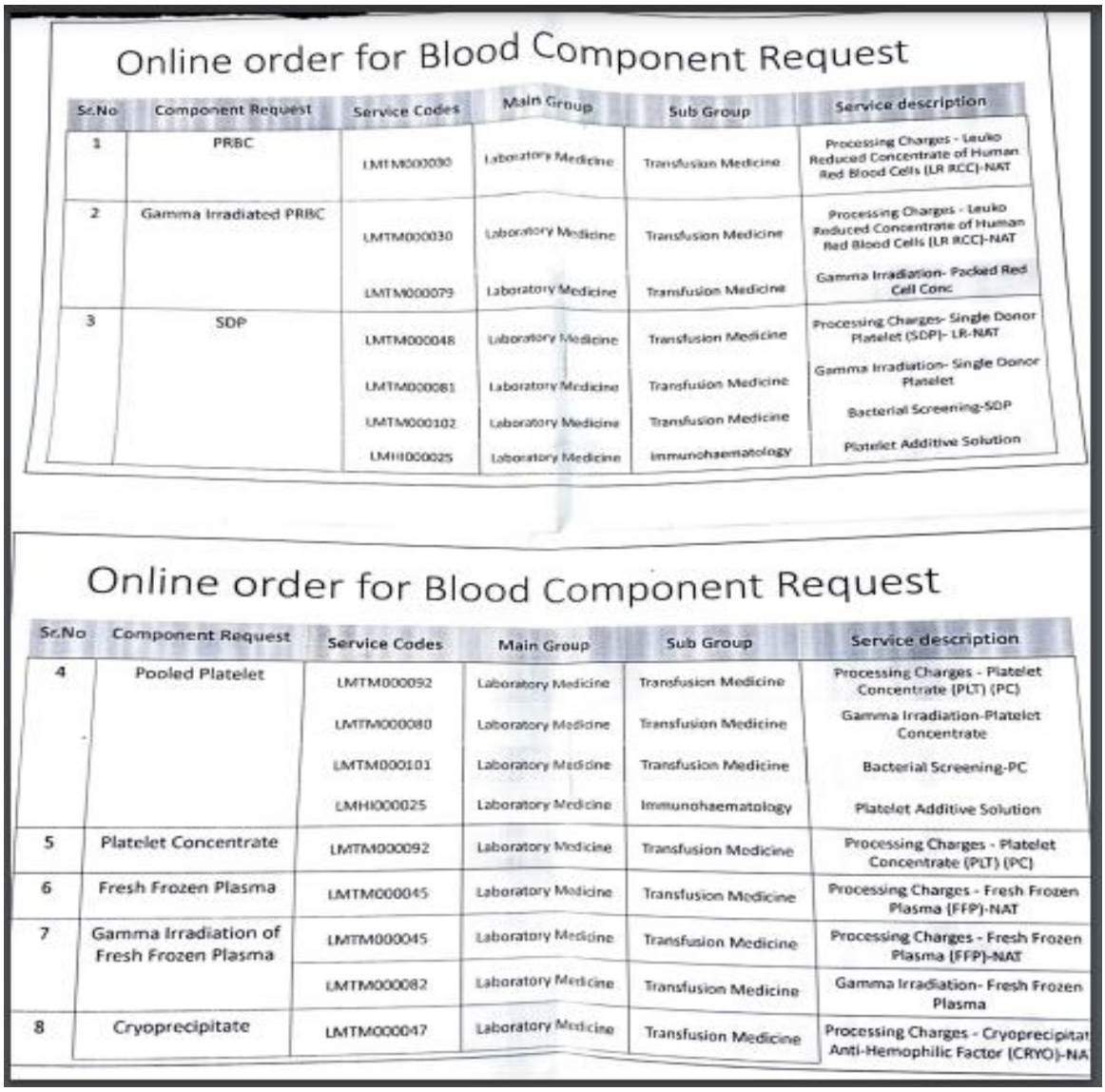
- **Staff Responsible**: HCA Supervisor and HCA staff
- **Recommendation:** Training sessions to HCAs for coming forward in line in case of BRF and BIF with FFP and cryo component.

3.7(e) CONTROL:

In the control phase the interventions suggested as recommendations in the improve phase can be applied to the existing process. Control phase focuses on the measurement of improvement after the interventions are applied. The same parameters should be recorded and analyzed to find the level of improvement with the interventions done.

This phase also monitors the continuous implication of the interventions for quality improvement of the discharge process.

To control the reason of delay result of barcode errors, wrong barcode for wrong component. This template/poster was circulated for all floor wings with service codes for Online order of Blood Component for doctors and nurse.



Online order for Blood Component Request

Sr.No	Component Request	Service Codes	Main Group	Sub Group	Service description
1	PRBC	LMTM000030	Laboratory Medicine	Transfusion Medicine	Processing Charges - Leuko Reduced Concentrate of Human Red Blood Cells (LR RCC)-NAT
2	Gamma Irradiated PRBC	LMTM000030	Laboratory Medicine	Transfusion Medicine	Processing Charges - Leuko Reduced Concentrate of Human Red Blood Cells (LR RCC)-NAT
		LMTM000079	Laboratory Medicine	Transfusion Medicine	Gamma Irradiation- Packed Red Cell Conc
3	SDP	LMTM000048	Laboratory Medicine	Transfusion Medicine	Processing Charges- Single Donor Platelet (SDP)- LR-NAT
		LMTM000081	Laboratory Medicine	Transfusion Medicine	Gamma Irradiation- Single Donor Platelet
		LMTM000102	Laboratory Medicine	Transfusion Medicine	Bacterial Screening-SDP
		LMHI000025	Laboratory Medicine	Immunohaematology	Platelet Additive Solution

Online order for Blood Component Request

Sr.No	Component Request	Service Codes	Main Group	Sub Group	Service description
4	Pooled Platelet	LMTM000092	Laboratory Medicine	Transfusion Medicine	Processing Charges - Platelet Concentrate (PLT) (PC)
		LMTM000080	Laboratory Medicine	Transfusion Medicine	Gamma Irradiation-Platelet Concentrate
		LMTM000101	Laboratory Medicine	Transfusion Medicine	Bacterial Screening-PC
		LMHI000025	Laboratory Medicine	Immunohaematology	Platelet Additive Solution
5	Platelet Concentrate	LMTM000092	Laboratory Medicine	Transfusion Medicine	Processing Charges - Platelet Concentrate (PLT) (PC)
6	Fresh Frozen Plasma	LMTM000045	Laboratory Medicine	Transfusion Medicine	Processing Charges - Fresh Frozen Plasma (FFP)-NAT
7	Gamma Irradiation of Fresh Frozen Plasma	LMTM000045	Laboratory Medicine	Transfusion Medicine	Processing Charges - Fresh Frozen Plasma (FFP)-NAT
		LMTM000082	Laboratory Medicine	Transfusion Medicine	Gamma Irradiation- Fresh Frozen Plasma
8	Cryoprecipitate	LMTM000047	Laboratory Medicine	Transfusion Medicine	Processing Charges - Cryoprecipitat Anti-Hemophilic Factor (CRYO)-NA

Figure 3.13

In this study due to time constraints, the control phase could not be completed further.

CHAPTER 6: CONCLUSION

The study was conducted at a multi-specialty hospital to optimize turnaround time of the blood component delivery system using the Six Sigma DMAIC technique. The first five phases of DMAIC (Define, Measure, Analysis, Improve, Control) were successfully completed, and various tools such as process mapping, pareto analysis and why-why analysis were employed. The six-sigma approach was used with an aim to improve the efficiency of the delivery process of blood components.

The findings of this study have important implications for patient care and healthcare efficiency. By reducing these, hospital can ensure timely access to blood components, leading to improved patient outcomes and satisfaction. The study provides valuable insights for healthcare administrators to identify areas for improvement and optimize the blood component delivery system.

CHAPTER 7: REFERRENCES

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