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Turnaround Time Analysis of Pre-Transfusion Testing and Blood Component Issue at a Tertiary Care Blood Storage Unit: A Retrospective Observational Study

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Abstract: ***Background**: Turnaround time (TAT) is an important quality indicator in transfusion medicine and reflects the efficiency of pre-transfusion testing and blood component issue. Timely availability of compatible blood components is essential for safe and effective patient care. **Objective**: To evaluate the turnaround time of ABO and Rh(D) blood grouping, compatibility testing, and blood component issue at a tertiary care blood storage unit and to identify opportunities for workflow improvement. **Materials and Methods**: This retrospective observational study was conducted in the Blood Centre RUHS Hospital attached GOVT, RDBP Jaipuria Hospital ,Jaipur from January to June 2026. A total of 2,700 blood requisitions were analyzed. ABO and Rh(D) blood grouping was performed using the conventional tube technique, while compatibility testing was performed using the Indirect Antiglobulin Test (IAT). Direct Antiglobulin Test (DAT) was performed whenever indicated according to departmental protocol. Data regarding patient demographics, clinical department, blood component requested, and pre-transfusion testing times were collected from blood storage unit registers and laboratory records. **Results**: The mean turnaround time for ABO and Rh(D) blood grouping was 10 minutes, while compatibility testing required a mean of 35 minutes. The overall laboratory TAT, defined as the time from receipt of the patient sample to completion of pre-transfusion compatibility testing, was 45 minutes. Male patients constituted 70% of the study population and female patients 30%. Packed Red Blood Cells (PRBCs) were the most frequently requested component, followed by Fresh Frozen Plasma (FFP) and Random Donor Platelets (RDP). **Conclusion**: The blood storage unit maintained an efficient pre-transfusion testing workflow, with an overall mean laboratory TAT of 45 minutes. Regular TAT monitoring, standardized testing procedures, appropriate inventory management, and continuous workflow optimization can support timely availability of compatible blood components and improve transfusion service quality.*

Keywords: Turnaround Time, Blood Centre, Transfusion Medicine, Blood Grouping, Crossmatch, Blood Components, Quality Indicators, Immunohematology, Patient Safety, Workflow Efficiency.

1. Introduction

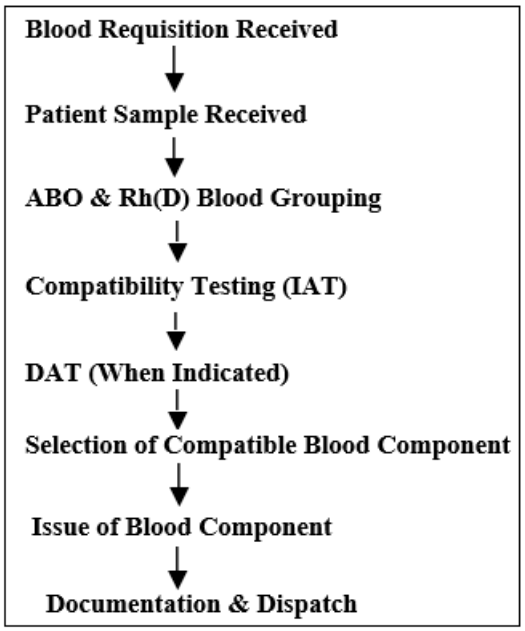
Blood transfusion services are an integral part of modern healthcare, ensuring the timely availability of safe and compatible blood and blood components for patients requiring emergency, surgical, obstetric, trauma, medical, and critical care support. The Blood Centre RUHS Hospital attached GOVT, RDBP Jaipuria Hospital, plays a crucial role in providing uninterrupted transfusion services through blood grouping, compatibility testing, blood component availability, and issue of blood components.

Turnaround time (TAT) is one of the most important quality indicators of blood centre performance and is defined as the time interval between receipt of the blood requisition and patient sample and the issue of compatible blood or blood components. A shorter TAT is essential for prompt clinical decision-making and improved patient outcomes, particularly in emergency situations where delays may adversely affect patient management.

The Blood Centre of Rajasthan University of Health Sciences (RUHS) Hospital, Jaipur, is a licensed blood centre storage unit with blood component facilities catering to all major clinical departments. The centre performs ABO and Rh(D) blood grouping using the conventional tube method, compatibility testing by the indirect antiglobulin test (IAT), Direct Antiglobulin Test (DAT) was performed whenever indicated according to departmental protocol. The blood centre receives approximately 480–550 blood requests per month, with an average workload of 10–15 crossmatch requests per day. Packed Red Blood Cells (PRBCs) constitute the majority of issued components, followed by Random Donor Platelets (RDPs) and Fresh Frozen Plasma (FFP).

Despite advances in transfusion medicine, delays in blood issue may occur because of incomplete requisition forms, sample-related issues, inventory constraints, additional immunohematological investigations, and increased laboratory workload. Continuous monitoring of turnaround time helps identify these bottlenecks, improve workflow efficiency, and strengthen quality assurance practices.

Therefore, the present retrospective observational study was undertaken in the Department of Immunohematology and Transfusion Medicine, RUHS Hospital, Jaipur, during January 2026 to June 2026 to evaluate the turnaround time of blood grouping, compatibility testing, and blood component issue, and to identify opportunities for improving the efficiency and quality of blood centre services.



2. Materials and Methods

Study Design
A retrospective observational study was conducted to evaluate the turnaround time (TAT) of blood Centre storage services.

Study Setting
The study was carried out in the blood storage unit of Rajasthan University of Health Sciences (RUHS) Hospital, Jaipur, a licensed blood Centre storage unit providing transfusion services to all clinical departments.

Study Duration
January 2026 to June 2026 (6 months).

Study Population
All blood requisitions received during the study period requiring blood grouping, compatibility testing, and issue of blood components were included.

Inclusion Criteria
- All blood requisitions received during the study period.
- Patients requiring blood grouping and compatibility testing.
- Requests for PRBC, FFP, and RDP.

Exclusion Criteria
- Incomplete requisition forms.
- Hemolyzed or clotted samples unsuitable for testing.
- Duplicate requests for the same patient.
- Requests cancelled before blood issue.

Pre-transfusion Testing Procedures
ABO and Rh(D) blood grouping was performed using the conventional tube technique. Compatibility testing was carried out using the Indirect Antiglobulin Test (IAT). Direct Antiglobulin Test (DAT) were performed whenever indicated according to departmental protocol.

Data Collection
Data were collected from blood storage unit registers and laboratory records.

The following information was recorded:
- Patient age and gender
- Department
- Blood group
- Blood component requested
- Time of requisition
- Time of sample receipt
- Time of blood grouping
- Time of compatibility testing
- Time of blood issue
- Total Turnaround Time (minutes)

Outcome Measures
Primary Outcome
- Overall Turnaround Time (TAT)

Secondary Outcomes
- Mean turnaround time (TAT) for ABO and Rh(D) blood grouping.
- Mean turnaround time (TAT) for compatibility testing (Indirect Antiglobulin Test).
- Total laboratory turnaround time from receipt of the patient sample to completion of compatibility testing.
- Distribution of blood component requests (PRBC, FFP, and RDP) during the study period.
- Assessment of workflow efficiency and opportunities for quality improvement in blood centre services.

Statistical Analysis
Data were entered into Microsoft Excel and analyzed using SPSS software. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages. Descriptive statistical analysis was performed Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequency and percentage.

Ethical Considerations
The study was conducted after approval from the Institutional Ethics Committee. Patient confidentiality was maintained by anonymizing all records.

Figure 1: Age- Distribution of Study Population
Age- Distribution of Study Population
Illustrative distribution across age group based on the study population

Age- Group	Patients
10- 20	220
21-30	480
31- 40	610
41- 50	520
51-60	420
61-70	290
71-80	160

Figure 2: Department wise blood Requests

Department wise blood Requests

Percentage distribution of blood requisition by department

Department	Percentage
IPD	60
Trauma	15
Surgery	10
Emergency	8
Obstetrics & Gynecology	5
OPD	2

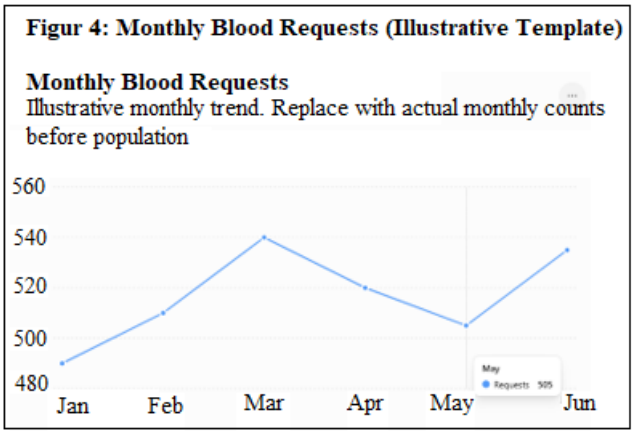


Table 1: Demographic Distribution

Variable	Number	Percentage
Male	1890	70.0%
Female	810	30.0%
Total	2700	100.0%

Table 2: Departments- wise Blood Requisitions

Department	Number
IPD	1620
Trauma	405
Surgery	270
Emergency	216
Obstetrics & Gynecology	135
OPD	54
Total	2700

Table 3: Blood Component Distribution

Component	Average Units/ Day
PRBC	10
FFP	3
RDP	2
Total	15

Table 4: Laboratory Tests Performed

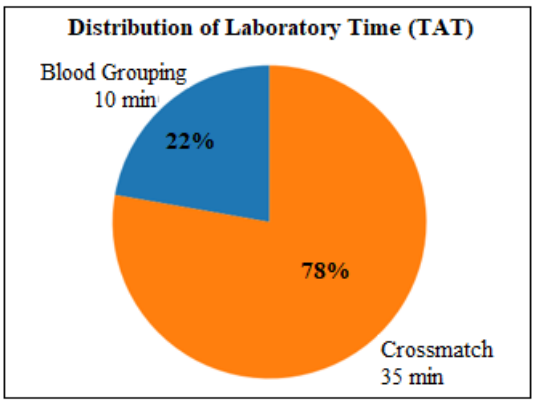
Test	Method
ABO Blood Grouping	Conventional Tube Technique
Rh(D) Typing	Conventional Tube Technique
Compatibility Testing	Inject Antiglobulin Test (IAT)
Direct Antiglobulin Test	Performed when indicated
Weak D Test	Performed for Rh- Negative Samples

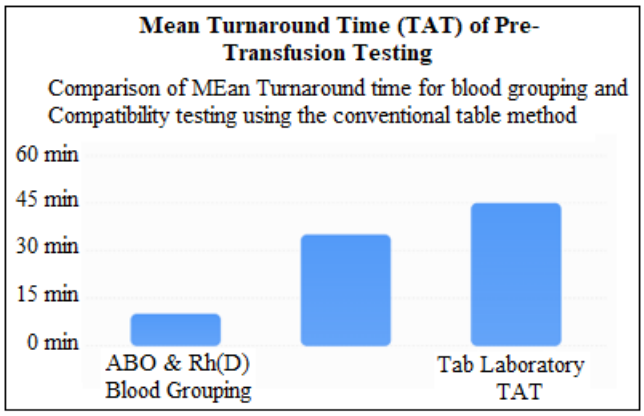
3. Results

During the study period (January 2026–June 2026), a total of 2,700 blood requisitions were received and analyzed for turnaround time (TAT) assessment. The blood centre processed requests from various clinical departments including emergency, surgery, medicine, obstetrics and gynecology, orthopedics, intensive care units, and other inpatient services

The mean turnaround time for ABO and Rh(D) blood grouping was 10 minutes. Compatibility testing by the indirect antiglobulin test was completed within a mean duration of 35 minutes. The overall laboratory TAT was defined as the time from receipt of the patient sample to completion of pre-transfusion compatibility testing. The mean overall laboratory TAT was 45 minutes, the average laboratory turnaround time from receipt of the patient sample to completion of pre-transfusion testing was 45 minutes. Blood components were issued immediately after completion of compatibility testing following proper verification and documentation.

Among the study population, male patients constituted 70% of the study population, reflecting the case mix of the clinical departments included in this study, while female patients accounted for 30%. The majority of requests originated from inpatient departments, reflecting the high demand for transfusion support in hospitalized patients.





Packed Red Blood Cells (PRBCs) were the most frequently requested blood component, accounting for approximately two-thirds of all blood component requests, followed by Fresh Frozen Plasma (FFP) and Random Donor Platelets (RDP). This distribution reflects the routine transfusion requirements of surgical, trauma, and critically ill patients.

Routine ABO and Rh(D) blood grouping, compatibility testing using the Indirect Antiglobulin Test (IAT), and additional Direct Antiglobulin Test (DAT), whenever indicated, were successfully performed according to

departmental protocol before the issue of compatible blood components.

Overall, the blood centre maintained an efficient workflow for processing blood requisitions, with continuous monitoring of turnaround time facilitating prompt blood component issue and identifying areas requiring workflow optimization.

4. Discussion

Turnaround time is a recognized quality indicator for blood centre services and directly influences patient management.in this study, laboratory TAT was defined as Time from receipt of patient sample to completion of pre-transfusion compatibility testing n the present study, approximately 2,700 blood requisitions were evaluated over six months. The majority of requests originated from inpatient departments, reflecting the high demand for transfusion support in hospitalized patients. Male patients constituted 70% of the study population, reflecting the demographic distribution of patients requiring transfusion support at the study institution. Packed Red Blood Cells were the most frequently issued component, accounting for approximately two-thirds of all daily blood component requests, followed by Fresh Frozen Plasma and Random Donor Platelets. This utilization pattern is comparable with reports from tertiary care hospitals where PRBCs remain the most commonly transfused blood component.

The use of conventional tube technique for ABO and Rh(D) grouping, combined with Indirect Antiglobulin Test-based compatibility testing and routine testing for samples, supported standardized pre-transfusion testing while maintaining an efficient pre-transfusion testing workflow.

Regular monitoring of turnaround time enables early identification of workflow delays, improves communication between clinicians and the blood centre, and enhances patient safety through timely availability of compatible blood components.

5. Conclusion

In the present study, the mean TAT for ABO/Rh(D) grouping was 10 minutes, while compatibility testing required a mean of 35 minutes, resulting in an overall laboratory TAT of 45 minutes from sample receipt to completion of pre-transfusion testing. Continuous monitoring of blood grouping, compatibility testing, and blood component issue helps identify operational delays and supports quality improvement initiatives. Efficient laboratory workflow, standardized testing procedures, and effective inventory management contribute to timely blood component availability and improved patient care.

6. Limitations

- The study was conducted in a blood storage unit where blood component preparation was not performed, and components were procured from the parent blood centre. Therefore, component preparation and manufacturing TAT could not be assessed
- Results may not be generalizable to all institutions.
- Seasonal variations in workload were not evaluated.
- As the analysis focused on routine blood centre services, specialized transfusion procedures and advanced component processing were beyond the scope of the study.

7. Recommendations

- Routine TAT audits should be incorporated into the blood centre quality management system.
- Electronic requisition and laboratory information systems may further reduce processing time.
- Continuous staff training and workflow optimization should be encouraged.
- Future multicentre prospective studies are recommended to establish benchmark TAT standards for transfusion services.

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