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Delta check for blood groups: A step ahead in blood safety

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Abstract:

BACKGROUND: Blood grouping is the single most important test performed by each and every transfusion service. A blood group error has a potential for causing severe life-threatening complications. A number of process strategies have been adopted at various institutions to prevent the occurrence of errors at the time of phlebotomy, pretransfusion testing, and blood administration. A delta check is one such quality control tool that involves the comparison of laboratory test results with results obtained on previous samples from the same patient.

MATERIALS AND METHODS: We retrieved the records of all transfusion-related incidents reported in our institute, between January 2008 and December 2014. Errors identified as "Failed Delta checks" and their root cause analyses (RCA) were reviewed.

RESULTS: A total of 17,034 errors related to blood transfusion were reported. Of these, 38 were blood grouping errors. Seventeen blood group errors were identified due to failed delta checks, where the results of two individually drawn grouping samples yielded different blood group results. The RCA revealed that all of these errors occurred in the preanalytical phase of testing. Mislabeling resulting in wrong blood in tube was the most commonly identified cause, accounting for 11 of these errors, while problems with correct patient identification accounted for 5 failed delta checks.

CONCLUSION: Delta checks proved to be an effective tool for detecting blood group errors and prevention of accidental mismatched blood transfusions. Preanalytical errors in patient identification or sample labeling were the most frequent.

Key words:

Delta check, preanalytic, root cause analysis, wrong blood in tube

Acute hemolysis, primarily the result of ABO incompatibility, continues to be an important cause of transfusion-related mortality and morbidity.[1] The process of blood transfusion involves several areas of human participation. Human error is therefore inevitable in this chain of events.[2] Transfusion laboratories have long focused their attention on quality control methods and quality assessment programs dealing with analytical aspects of blood testing. However, there is enough evidence to suggest that the steps most prone to error are in fact in the pre- and post-analytical phases.[3-5]

Blood grouping is the single most important test performed by each and every transfusion service. A blood group error has a potential for causing severe life-threatening complications.[6] A number of process strategies have been adopted at various institutions to prevent the occurrence of errors at the time of phlebotomy, pretransfusion testing, and blood administration.[7]

A delta check is one such quality control tool that involves the comparison of laboratory test results with results obtained on the previous samples from the same patient. Delta checking has been labeled as particularly useful tool in biochemistry and hematology laboratories, but its role in transfusion medicine has not been emphasized much.[8-10]

In the context of blood grouping, a delta check involves comparing the blood group result of a patient with a historical blood group result or comparing the results of two or more specimens that have been collected at different times.[10,11] Our institute has successfully implemented the policy of testing blood group using two separately drawn samples at all times before the first issue of blood and blood components. We present here our experience with delta checks for blood groups with the

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aim to assess its role in improving transfusion practice by adding a layer of safety to compatibility testing.

Materials and Methods

The transfusion policy followed at our hospital, mandates that before the first transfusion in the hospital, a sample for "Blood Group and Antibody Screen" be sent to the blood bank before arrangement of blood and blood components. In addition to this, at the time of blood arrangement (whether red cells or other components), another sample, drawn separately must be sent along with the blood requisition form for confirmation of blood group, i.e., for "Delta checking" of blood group results.

Since there is no centralized patient database allowing sharing of reports or patient data among hospitals in India, our center only considers a blood group reported at our blood bank as a historical blood group record. The procedure followed at our center for delta checking is depicted in Figure 1.

Blood grouping samples are preserved for up to 7 days in the department. In case, the error is reported within this period, the original sample is withdrawn and retested in the presence of senior technical staff and a doctor along with fresh samples, drawn under direct supervision of blood bank staff. The process adopted at our center for assessing transfusion-related events uses the widely tested criteria of incident reporting, root cause analysis (RCA) followed by identification of corrective actions as depicted in Figure 2.[12,13]

We retrieved the records of all transfusion-related incidents reported in our institute, between January 2008 and December 2014. Errors identified as "Failed Delta checks" and their RCAs were reviewed.

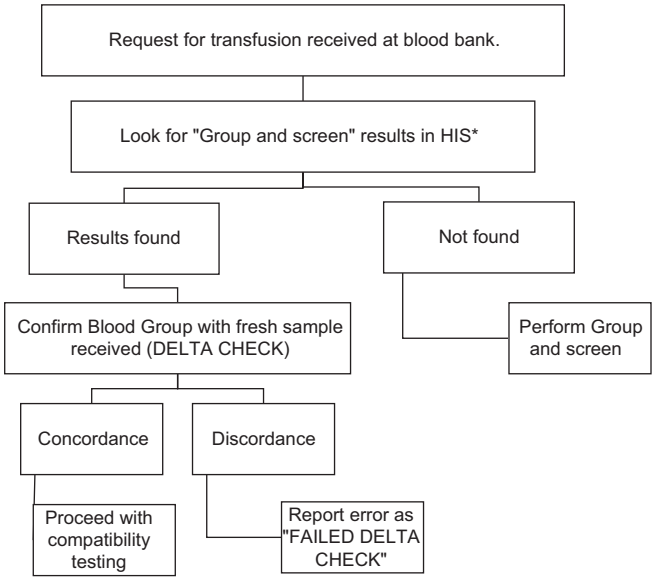

Figure 1: *Procedure followed for delta checking of blood group. *HIS: Hospital information system*

Results

During the period of analysis, a total of 269,448 blood grouping tests were performed by the department of transfusion medicine and 301,084 units of blood and blood components were issued within the hospital. A total of 17,034 errors related to blood transfusion were reported. These were categorized into preanalytic, analytic, and postanalytic errors depending on the step at which they occurred in the process [Table 1]. Of these 38 were blood grouping errors. Of the total number of blood group tests performed, 61,327 tests underwent delta checking at the time of blood arrangement. Seventeen (0.02%) of these tests failed the delta checks, where the results of two individually drawn grouping samples yielded different blood group results. This accounted for 0.099% of the total reported errors and 44.7% of all blood grouping errors identified. The details of these errors are provided in Table 2.

The major factors contributing to mislabeling resulting in wrong blood in tube (WBIT) (n = 11) was labeling the tubes away from the bedside or labeling by someone other than the phlebotomist and sampling multiple patients around the same time resulting in sample mix-ups and incorrect labeling, etc.

Problems with correct patient identification (n = 5) were usually a result of the phlebotomist either omitting or not completing the necessary patient identification steps at the time of sample collection.

Discussion

The institute of medicine defines error as "The failure of a planned action to be completed as intended or the use of a wrong plan to achieve an aim."[14]

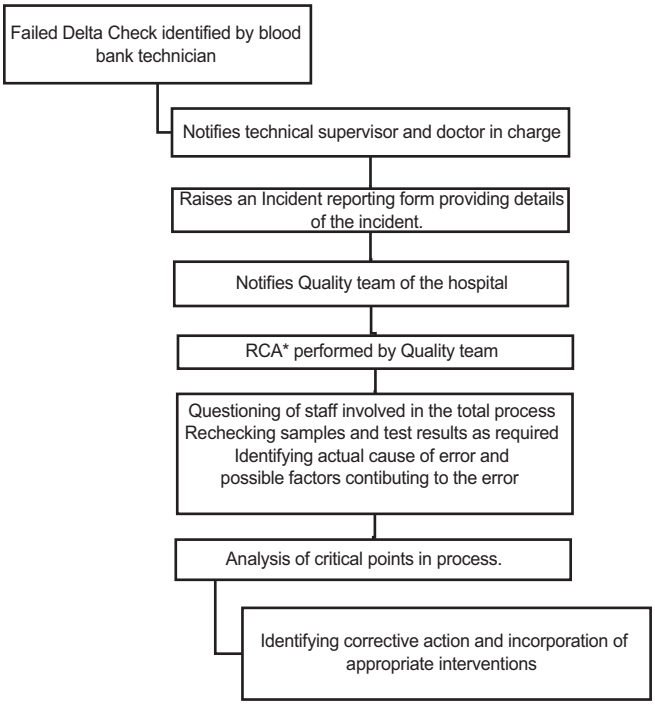

Figure 2: *Depicting process flow for reported errors. *RCA: Root cause analysis*

Errors can have significant consequences for the patient and a large majority of reported transfusion errors are preventable.[4,15] Error reporting (ER) is an effective way of handling medical errors. Various international accreditation bodies now require clear and effective incident reporting protocols to enhance measures for error trapping and error avoidance.[16]

Table 1: Distribution of all reported errors

Type of error (%)	Cause of error	Number
Preanalytical (*n*=13,866), 81.4	Wrong patient (incorrect identification, incorrect labeling, sample interchange)	128
	Incomplete/incorrect requisition forms (patient details/component requested/blood group/signature, etc., missing/incorrect)	11,879
	Insufficient, inappropriate or incorrectly labeled samples	1842
	Missing delta checks	17
Analytic (*n*=564), 3.3	Equipment error	128
	Special tests/procedures not done (antibody screening, irradiation, etc.,)	80
	Technical error (wrong test, sample mix-up)	356
Postanalytic (*n*=2604), 15.28		
Blood bank side	Wrong component issued	
	Delay in issue	92
	Incorrect labeling on unit/ compatibility	708
	Others	55
Clinical side	IV line/transfusion set issues	115
	Wrong patient/wrong component transfused	9
	Delays in starting transfusion	1465
	Transport/storage problems	21
	Blood issued mistakenly	122
	Others	9

Delta checking of blood groups is an essential component of our Hospital Transfusion Policy. We identified 17 blood group results which failed the delta checks during our period of analysis. All these were preanalytical errors, in keeping with literature reports confirming the preanalytical phase to be the most vulnerable period.[17]

Proper sample collection and labeling is a key step to ensure patient safety during blood transfusion. A sample that may appear correctly labeled but which contains the blood of a different person than whose name is on the tube is referred to as "WBIT."[18] Literature reports state that the rate of mislabeled samples is 1000- to 10 000-fold more frequent than the risk of transfusion-transmitted viral infections.[19] Mislabeling resulting in WBIT was the most common cause of failed delta checks at our center. Dzik *et al.* reported the overall median corrected frequency of WBIT to be approximately 1 in 2000 samples.[19] Other reports have attributed nearly 35% of high-severity events (defined as those with the potential for patient harm) to mislabeled samples.[20] Therefore, establishment and enforcement of strict labeling guidelines and rejection of improperly labeled specimens are necessary to reduce blood grouping errors. Besides this, procedures such as delta checks that force validation of a patient's ABO/ Rh status can go a long way in improving transfusion safety.

Mistakes in properly identifying the patient at the time of sample collection are another major cause of blood grouping errors or failed delta checks. Failure of staff to follow protocols for patient identification at the time of sample collection can result from various factors. These include insufficient staffing, inadequate training of staff, fatigue, urgency, and distraction.[21,22]

The Joint Commission International (JCI) has listed correct patient identification as the first International Patient

Table 2: Details of errors reported as failed delta checks

Blood group (first sample)	Blood group (second sample)	Actual blood group (confirmed with subsequent samples)	Root cause analysis findings	Area where the error was traced to
O positive	AB positive	AB positive	Incorrect patient identification while sampling	Ward
AB positive	B positive	B positive	Mislabeling resulting in WBIT	Ward
B positive	AB positive	AB positive	Mislabeling resulting in WBIT	Ward
A positive	O positive	O positive	Fetal sample (sent from cord), contaminated with maternal sample	OT
AB positive	A positive	A positive	Incorrect patient identification while sampling	Health check (sample collection center)
O positive	A positive	A positive	Incorrect patient identification while sampling	OutPatient's (sample collection center)
O positive	B positive	O positive	Sample mix-up and mislabeling resulting in WBIT	Ward
B positive	O positive	B positive	Sample mix-up and mislabeling resulting in WBIT	Ward
B positive	O positive	O positive	Mislabeling resulting in WBIT	Outpatient's (sample collection center)
A positive	B positive	B positive	Mislabeling resulting in WBIT	Ward
A positive	B positive	B positive	Mislabeling resulting in WBIT	Ward
B positive	O positive	O positive	Mislabeling resulting in WBIT	Emergency room
B positive	A negative	A negative	Mislabeling resulting in WBIT	Outpatient's (sample collection center)
O positive	B positive	O positive	Incorrect patient identification while sampling	Ward
A positive	AB positive	A positive	Incorrect patient identification while sampling	Ward
O positive	O negative	O positive	Mislabeling resulting in WBIT	Outpatient's (sample collection center)
A positive	B positive	B positive	Mislabeling resulting in WBIT	Outpatient's (sample collection center)

WBIT: Wrong blood in tube, OT: Operation theater

Safety Goal and recommends the use of at least two patient identifiers to correctly identify the patient for any procedure, in this case phlebotomy. The two identifiers acceptable for patient identification include name and Unique Hospital Identification number for inpatients and name and date of birth for outpatients.[23]

Our center being a JCI accredited tertiary care hospital, has laid down clear guidelines for patient identification, sample collection, and specimen labeling. Regular staff training, an effective system of incident reporting and analysis, and a computerized system of sample receiving and reporting is also in place. In spite of these, errors have been reported, more commonly from the wards, where the nurse or the phlebotomist did not follow the patient identification steps or sample labeling and collection procedures. On questioning, it was evident that most of them were aware of the protocols and processes to be followed, but the errors either occurred due to hasty sample collection, overlooking the patient identifiers, labeling samples at the nursing station rather than at the bedside, or labeling multiple samples together after collection.

However, we need to emphasize here that even though delta checks were useful in detecting blood group errors (44.7% of blood group errors identified were as a result of failed delta checks), this could well be an underestimation of the actual WBIT samples being collected, either due to mislabeling or incorrect patient identification. WBIT samples may still be missed in cases where the blood groups of first and second samples are incidentally the same, but they belong to different individuals. Besides, only 61,327 of the total 269,448 blood group tests performed during the study period underwent delta checks, since this strategy was only used for patients who required transfusion. There could be other WBIT samples, possibly from outpatient departments or Health checks that did not undergo delta checking.

Conclusion

Delta checks proved to be an effective tool for detecting blood group errors and prevention of accidental mismatched blood transfusions. Preanalytical errors in patient identification or sample labeling were the most frequent. Our results also highlight the role of accreditation and strengthening ER and RCA systems in enforcing adherence to set protocols and improving transfusion safety.

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Conflicts of interest
There are no conflicts of interest.

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