

Ensuring Timely Completion of Type and Screen Testing and the Verification of ABO/Rh Status for Elective Surgical Patients

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• **Context.**—A blood bank can provide compatible blood for an elective surgical procedure, provided a blood sample is received by the laboratory with sufficient time to allow pretransfusion testing and acquire enough compatible red blood cell units. With the push for same-day admission surgical procedures, a patient's pretransfusion blood sample is often collected the morning of surgery. However, if blood is needed, compatible units might not be immediately available.

Objective.—To define and improve the process of completing presurgical/preadmission type and screen testing and verifying the ABO/Rh status of scheduled surgical patients before they receive a transfusion.

Study Design.—A list of surgical procedures that might necessitate blood transfusion was created. A checklist was used to ensure that the preoperative clinic nurse collects a baseline pretransfusion blood sample for type and screen testing from patients scheduled for a listed procedure. A

new pretransfusion specimen was received on the day of surgery, if needed, so that a current specimen would be available for compatibility testing and to verify the accuracy of the patient's ABO/Rh status in case blood was requested.

Results.—During the 1-year study period, 666 patients qualified for baseline type and screen testing. Cholecystectomy was the most commonly scheduled surgery. In 99% of cases, a baseline type and screen specimen was received in the laboratory at least 1 day before surgery. The interval between the preoperative clinic visit and date of surgery varied from same day (6 patients) to 3 months.

Conclusion.—Timely receipt of a presurgical specimen for type and screen testing and verification of a patient's ABO/Rh status can be ensured when clinical services collaborate and when the hospital blood utilization committee provides oversight to improve compliance.

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It is taken for granted that a blood bank will provide enough compatible blood for surgical procedures, particularly elective ones. A reason for this assurance is the successful use of maximum surgical blood order schedules, which guide clinicians and blood banks alike in predicting the number of units that will need to be cross-matched for commonly performed surgical procedures.¹ This strategy has made it easier for surgeons to accurately estimate and order the appropriate number of units for most surgical procedures. However, for a blood bank to provide an adequate supply of compatible blood for elective surgery, a patient's blood sample must be received by the laboratory with sufficient time before surgery begins to complete pretransfusion compatibility testing and to ac-

quire enough suitable red blood cell units (or blood components). With the push for same-day admission surgical procedures, it has become commonplace for a patient's pretransfusion blood sample to be collected the morning of surgery. Such a sample may represent the first and only specimen that the blood bank has for determining the patient's ABO/Rh status. The risk that a patient's ABO group might be determined by using a blood sample that contains the blood of a different patient is about 1 in 2000.² As a result, the blood bank laboratory has limited time to do the basic testing as well as perform additional testing to detect specimens containing the wrong person's blood or to explain any unexpected results.

In a survey of nearly 9000 type and screen (T&S) tests, nearly 35.5% of patients had a T&S specimen collected the same day as their surgery, and nearly one fourth of those T&S tests were not completed until after surgery began.³ When T&S testing is not completed before the patient is taken into the operating room, there is the potential danger that should blood be needed, optimally compatible blood will not be immediately available. This could result in a hemolytic transfusion reaction with associated morbidity or death.

Typically, pretransfusion compatibility testing includes determining the patient's ABO group and Rh (D) type, testing the patient's blood sample for unexpected red cell

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antibodies, and crossmatching donor red cells with the patient's serum or plasma.⁴ A minority of laboratories in the United States use computerized crossmatching for patients who are not alloimmunized.⁵ The entire procedure usually takes less than 60 minutes, depending on the testing methods used and institutional policy. However, there may be additional delays in providing compatible red cell units if clinically significant red cell antibodies are detected. These delays may be substantial if the detected antibodies are directed against high-frequency antigens or if the patient has autoantibodies or multiple antibodies. Therefore, surgeons should allow sufficient time for the laboratory to complete presurgical compatibility testing whenever there is a reasonable chance that the patient will require blood for an elective surgical procedure.

This report describes a system that the blood utilization committee at Los Angeles County–University of Southern California (LAC-USC) Healthcare Network developed in collaboration with the operating room committee to define and improve the process of completing presurgical/pre-admission T&S testing and verifying the ABO/Rh status of scheduled surgical patients before they receive a transfusion.

MATERIALS AND METHODS

The LAC-USC Medical Center is an acute care hospital within the LAC-USC Healthcare Network. The network includes a general hospital, a women's and children's hospital (WCH), 3 comprehensive health centers (which are located off campus), and 2 outpatient clinics on the campus. All adult ambulatory care patients who are scheduled for elective surgical procedures undergo medical screening at a single preoperative clinic that is located on the medical center campus. Women who are scheduled for an obstetric/gynecology procedure register at the WCH and are seen in the preoperative clinic only for their preoperative evaluations. At the end of the clinic visit, the preoperative clinic staff returns all the patient's records to the WCH. The preoperative clinic has no records of preoperative evaluations for WCH patients because these patients are not registered at the clinic (to avoid double-billing). Thus, their records were not available from the preoperative clinic for review or inclusion in this study.

The interval between the preoperative clinic visit and the date of surgery varies. Before the system described in this report was implemented, many patients underwent surgical procedures for which transfusion was likely, but for which a T&S specimen was not submitted for testing until the morning of the surgery. In some cases, the laboratory did not receive the specimen until later during the day of surgery. In a few cases, no specimen was ever received. Several attempts at educating the physician staff failed to eliminate the occurrence of last-minute T&S testing.

In January 2003, a system was implemented to ensure the collection of a blood specimen for baseline T&S testing during the patient's visit to the preoperative clinic if there was a reasonable likelihood that blood would be needed for the scheduled procedure. The blood utilization and operating room committees developed a list of surgical procedures that would qualify for pre-admission/presurgery baseline T&S testing. The list was provided to the preoperative clinic staff, including physicians and nurses. The preoperative clinic was instructed to send a blood specimen for baseline T&S testing for each patient who was scheduled to have a procedure included in the list. The list is continually reviewed to ensure that it remains current, clear, and valid. Since it was first developed it has been revised twice. The latest version is shown in Table 1.

At LAC-USC Medical Center, the T&S samples are "good" for only 3 days because history regarding recent pregnancy or transfusion is not usually provided to the blood bank. If the preoperative clinic visit is more than 3 days before surgery, a second pretransfusion specimen must be collected when the patient is

Table 1. Procedures Requiring Presurgical/Pre-admission Type and Screen Testing

A. Burn	1. Debridement/grafting
B. Cardiac	1. Mitral valve repair 2. Aortic valve repair 3. Coronary artery bypass grafting 4. Aneurysm repair
C. General	1. Resection of visceral tumor 2. Resection of large soft tissue tumor 3. Cholecystectomy 4. Partial hepatectomy 5. Splenectomy 6. Whipple procedure
D. Head and neck	1. Radical neck dissection
E. Neurosurgery	1. Craniotomy 2. Spinal fusiinstrumentation
F. Obstetrics-gynecology	1. Pelvic exenteration/node dissection 2. Radical hysterectomy 3. Abdominal myomectomy 4. Elective cesarean section
G. Orthopedics	1. Open fractures 2. Pelvic/acetabulum ses 3. Spine 4. Tumor 5. Total joints
H. Plastics	1. Free flap
I. Thoracic	1. Lobectomy 2. Esophagectomy 3. Pneumonectomy
J. Urology	1. Cystectomy 2. Nephrectomy 3. Pelvic exenteration/node dissection 4. Radical prostatectomy 5. Open simple prostatectomy 6. Percutaneous nephrolithotomy
K. Vascular	1. Femoral distal bypass grafting 2. Carotid endarterectomy 3. Aneurysm repair

admitted for the scheduled surgery so that the laboratory has a current specimen for antibody screening and compatibility testing (in case a red blood cell transfusion is needed). The laboratory made certain that optimally compatible units were set aside before surgery for patients with red cell antibodies. When the patient's surgery was scheduled within 3 days of the specimen's date, red cell units were selected that were antigen negative for the corresponding clinically significant antibody and antihuman globulin crossmatched, in most cases. When the patient's scheduled surgery was more than 3 days after the specimen's date, the patients with antibodies were identified on the next day's surgery schedule by the blood bank technologists. Appropriate red cell units could be antigen typed or ordered from the blood vendor. These units were set aside for the patients in anticipation of their specimens' being resubmitted on the same day as their surgical procedures for rapid compatibility testing. The number of units requested was frequently listed on the surgery schedule, particularly for the cases that were more likely to need blood. For patients with antibodies or other special needs, at least another 2 units more than the number requested were set up. The transfusion medicine physician was consulted when the technologist

**To be completed by Pre-Op Nursing Staff
Place in Designated Quality Management Box**

SURGERY DATE _____ TYPE OF SURGERY _____

PHYSICIAN _____ PAGER # _____

Pre – OP
Appointment: Date _____ Time _____ Given by _____

Patient sent for: Type & Screen LABS EKG Chest X-Ray on: (date) _____

Patient given: Pain Brochure Paul Gann Act Brochure

Is Patient Jehovah Witness? Yes No

PRE – OP CHART FINALIZED FOR DELIVERY TO 5700

H & P Yes No RN Assessment Yes No EKG Yes No

Consents Yes No Anesthesia Assessment Yes No Chest X-Ray Yes No

MD Orders Yes No PFS/TAR Yes No Old History Yes No

LAB TESTS REVIEWED ON: _____ By _____ R.N.

IMPRINT I.D. CARD (NAME, MRUN, CLINIC/WARD)

Figure 1. Preoperative (Pre-Op) checklist used in Los Angeles County–University of Southern California Healthcare Network.

had questions or when the number of requested units was not stated on the surgery schedule.

Only patients who were scheduled to have procedures that qualified for the preoperative/preadmission baseline T&S test were included in the study. To ensure that a baseline T&S specimen is collected for all qualifying surgical procedures, a checklist was created that the clinic nurse completed for each patient seen in the preoperative clinic (Figure 1). Data on compliance with the new program were retrieved from the checklists and entered into a database. To verify that the preoperative clinic staff did not miss collecting a T&S specimen from any eligible patient,

the checklists were retrospectively compared with the actual surgical schedules for a period of 1 month in 2006. Blood bank records were reviewed to determine whether unexpected red cell antibodies were identified and how many patients actually received red cell transfusion during or immediately after the surgery. A summary of results was presented at the quarterly blood utilization committee meetings.

RESULTS

The data presented in this report were obtained from January through December 2003. During this period, 666

Service	Type of Surgery	No. of Patients
General	Cholecystectomy	103
Head and neck	Radical neck dissection	93
General	Cancer resection	91
Urology	Radical prostatectomy	78
Urology	Nephrectomy	49
Orthopedics	Total joints	40
Urology	Cystectomy	27
Orthopedics	Spine	26
Neurosurgery	Arteriovenous malformation	21
Neurosurgery	Aneurysm clipping	20
Orthopedics	Open fractures	15
General	Splenectomy	13
Cardiac	Aortic valve repair	11
Plastics	Free flap	11
Thoracic	Lobectomy	9
General	Whipple procedure	9
Urology	Pelvic exenteration/node dissection	9
Cardiac	Coronary artery bypass grafting	8
General	Partial hepatectomy	8
Orthopedics	Tumor	7
Vascular	Femoral distal bypass grafting	5
Orthopedics	Pelvic/acetabulum cases	3
Vascular	Aneurysm repair	3
Cardiac	Mitral valve repair	2
Cardiac	Aneurysm repair	2
Thoracic	Esophagectomy	2
Burn	Debridement/grafting	1
Total Patients Scheduled for Qualifying Surgeries		666

Type and Screen Specimen Collection Relative to Day of Surgery	% (No.) of Cases
Same day	1 (6)
1-3 d prior	17 (105)
4-7 d prior	32 (198)
1-2 wk prior	39 (244)
2-3 wk prior	8 (47)
3 wk-3 mo prior	3 (18)

patients were evaluated in the preoperative clinic for a surgical procedure listed in Table 1. Cholecystectomy was the most commonly scheduled surgery during the study period (Table 2). Compliance with the requirement to send a specimen for baseline T&S, based on review of the checklists, is shown in Figure 2. The date of surgery was set for 618 patients when they were seen in the preoperative clinic. In 99% of patients, T&S specimens were received at least 1 day before surgery (Table 3). The date of surgery was not determined for the remaining patients.

The interval between the baseline T&S testing and date of surgery varied from the same day (6 patients) to 3 months. A retrospective comparison of actual surgical schedules and checklists for a period of 1 month revealed that of 375 reviewable cases, the preoperative clinic staff missed only 1. That patient was scheduled for a possible free-flap procedure for breast reconstruction and thus qualified for a baseline T&S specimen, but the staff failed to collect it.

The results of antibody screening of the preoperative clinic specimen are displayed in Table 4. Twenty-three (3.5%) patients had a positive result on an antibody screening test or a positive result on a direct antiglobulin test in the current specimen or in a previous specimen. Twelve patients had a history of positive serum antibody test results, positive direct antiglobulin test results, or special needs for antigen-negative red cell units. Eleven had no history and could have suffered delay in blood availability while their pretransfusion testing problem was resolved. Of the group, 21 (91.3%) required antihuman globulin crossmatches and 4 (17.4%) required transfusion either intraoperatively or shortly after surgery. Ten patients had clinically significant antibodies, and 2 of them needed blood. The other 13 had antibodies of little clinical significance. Interestingly, a delayed hemolytic versus serologic transfusion reaction was discovered in patient 12's blood sample because of a newly discovered anti-E.

COMMENT

Ensuring the timely receipt of a preoperative T&S blood specimen has become a problem with the advent of morn-

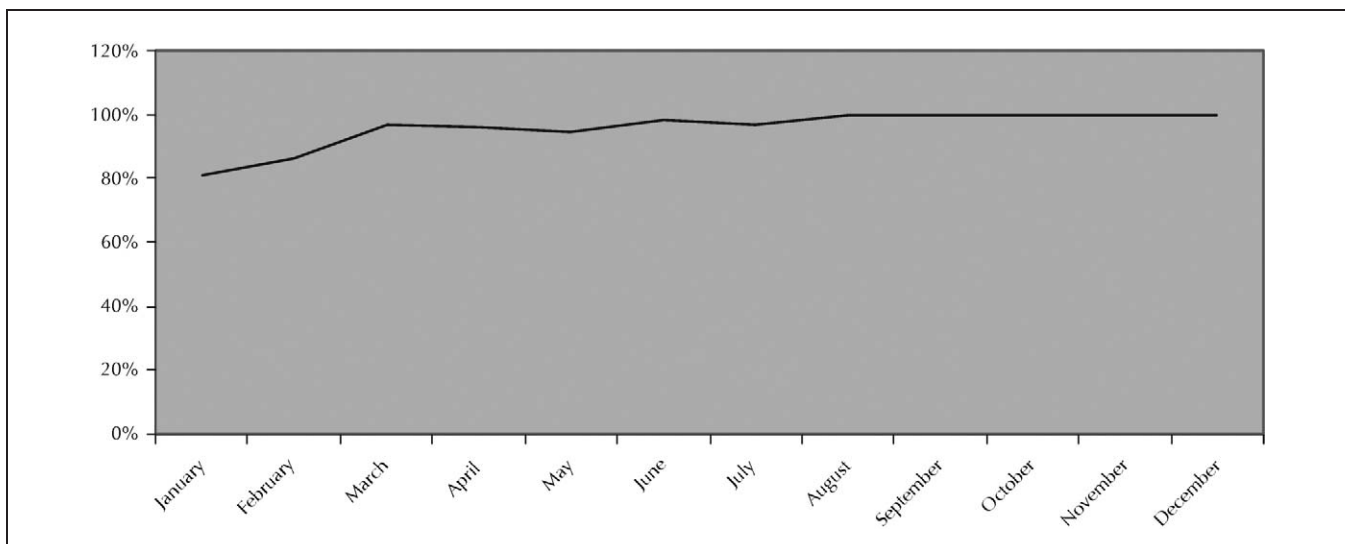


Figure 2. Compliance with ordering type and screen testing from preoperative clinic for qualifying elective surgical procedures in 2003.

Table 4. Antibodies and Blood Usage in Patients With Positive Antibody Screen/Direct Coombs Tests*

Case No.	Previously Known Antibody?	Antibody Identification		Hemolytic Potential? S vs I	Blood Usage Units
		Direct Antiglobulin Test	Indirect Antiglobulin Test		
1	Y		K1	S	4 RBC
2	Y	Positive for autoantibody		I	3 RBC
3	N		Lea	I	0
4	Y	History of DAT positivity (autoantibody)	Fya and autoantibody	S	0
5	Y	Positive for passive anti-D	Negative	I	0
6	Y	History of DAT positivity (autoantibody)	Negative	I	0
7	N	Positive for passive anti-D	Passive anti-D and cold antibody	I	0
8	N		Lea	I	0
9	Y		Lea	I	0
10	N		C	S	0
11	N		D, E	S	0
12	N	Positive for autoantibody	Anti-E, DHTR vs DSTR discovered	S	0
13	N		D	S	0
14	N		K1	S	0
15	N		Cold antibody, roleaux	I	0
16	Y	History of DAT positivity (autoantibody)	Negative	I	0
17	Y	History of DAT positivity (passive anti-D and autoantibody)	Negative	I	0
18	Y	Positive for autoantibody	E, C, Fyb, and autoantibody	S	0
19	N		K1, S	S	6 RBC
20	Y		Leb	I	2 RBC
21	Y	Positive for passive anti-D	D	I	0
22	Y		D	S	0
23	N		D due to passive anti-D	I	0

* S indicates significant; I, insignificant; RBC, red blood cell; DAT, direct antiglobulin test; DHTR, delayed hemolytic transfusion reaction; and DSTR, delayed serologic transfusion reaction.

ing admissions for same-day surgery.⁶ Preoperative samples that are collected the same day as a scheduled surgery may not be completely tested by the blood bank until the patient is being prepared for surgery or is actually in surgery. If the blood bank discovers that the patient has an antibody but blood is immediately needed, the delivery of blood might be inappropriately delayed or the blood bank may have to issue uncrossmatched or incompatible blood, which has a risk of a hemolytic transfusion reaction. According to one study, in 21 of 309 patients scheduled for elective surgical procedures, a preoperative T&S sample was not tested before surgery; late samples and lack of information on the request form regarding the date and time of surgery were the main causes of failure to complete T&S testing.⁷ To address a similar situation, one institution established a requirement that a pretransfusion specimen be drawn and submitted the evening or day before surgery. When this was not possible, a 3-hour delay before the start of surgery was recommended.⁸ We report a system that ensures timely collection and receipt by the blood bank of a baseline T&S sample on patients scheduled to undergo selected elective surgical procedures.

We created a list of surgical procedures with a reasonable probability of requiring blood and implemented the use of a checklist to ensure that a T&S sample is collected when a patient is seen in the preoperative clinic for one of the listed procedures. The clinic specimen served as the baseline specimen if there was no previous record of testing. At LAC-USC Medical Center, these samples are "good" for only 3 days; thus, a second pretransfusion specimen is required for patients whose baseline blood sample has expired at the time the patient is admitted for the scheduled surgery. The aforementioned process has achieved essentially 100% success in providing baseline T&S samples for scheduled elective surgical procedures, and had the extra benefit of providing a second, separately

collected pretransfusion sample in 82% of cases. This allowed us to verify the ABO/Rh status of patients before they receive a transfusion. In these cases, the second sample was needed because the baseline sample had expired. This is an important safety check to help prevent potentially fatal ABO hemolytic transfusion reactions—approximately 1 in 2000 blood samples submitted to the blood bank laboratory contain the wrong patient's blood, which could lead to mistyping of the patient's blood.² In fact, during the study period, the preoperative specimen submitted for the same-day surgery contained the wrong patient's blood in one case. The error was caught and corrected because there was a historical record on file, which showed the discrepant ABO/Rh results (A positive vs B positive). Thus, it is beneficial, when possible, to test two separately collected specimens so that elective surgical patients' ABO/Rh status can be verified before the patients receive a transfusion; a third specimen may be needed to resolve any discrepancy. Compliance with the redesigned process has remained at 100% for more than 3 years (data not shown).

Since the date of scheduled surgery was provided to the blood bank in most cases, enough time was generally available for the blood bank to set aside compatible units for patients who were found to have clinically significant antibodies. Ten patients were at risk for a hemolytic transfusion reaction if, by chance, red cells that possessed the antigen or antigens to which the patients had antibody had been released on an emergency uncrossmatched basis. Of the other 13 patients with clinically less significant antibodies or a current specimen negative at antibody screening (but who had special needs for antigen-negative red cells or antihuman globulin-crossmatched blood), 2 required transfusion. However, the other 11 of 13 patients who did not receive blood still benefited by having optimally compatible units immediately available had it been

necessary to transfuse blood in these patients with special needs.

As a result of this study, we have posted a calendar in the blood bank laboratory where patients with antibodies are listed on the dates of their scheduled surgery. This system provides extra advance notice that a patient with particularly challenging special blood needs will soon be having surgery. The technologist will review the next day's surgery schedule to confirm that these patients are still scheduled for surgery the next day. In addition, all patients on the schedule with anticipated blood needs will be checked to see whether any require special selection of blood units. If the patient's pretransfusion specimen is less than 3 days old, compatibility testing can be completed the night before surgery. If the specimen is not "in dates," an adequate number of antigen negative units can be selected and set aside for that patient; thus, when the new specimen is received on the day of surgery, compatibility testing can be completed expeditiously. Our institution does not use a maximum surgical blood order schedule because case-related complexity varies and we normally keep a large red cell inventory as a buffer. However, for "special needs" patients on the surgery schedule for whom the number of red cell units needed is not specified, the case is brought to the attention of the transfusion medicine physician or the patient's physician to decide on the appropriate number of units to be set up. Since we routinely maintain a large in-house blood inventory, we do not require that the blood order actually be placed at the time of the preoperative clinic visit. During periods of blood shortage or for community hospitals with smaller blood inventories, however, blood orders submitted in advance of scheduled surgery would help assure an adequate daily blood inventory for patient needs.

It could be argued that the aforementioned program demonstrated only minimal benefit since of the 10 patients who had newly discovered clinically significant antibodies, only 1 patient actually required a transfusion. Thus, of more than 600 patients, only 1 patient avoided the risk of an unanticipated delay in their blood transfusion despite all the labor invested by nursing and laboratory staff. For this reason, other operational solutions might be considered, such as extending the length of time a T&S specimen can be stored for pretransfusion testing. Many institutions now store these samples for 7 days or longer, provided the patient has not received a transfusion or been pregnant in the previous 3 months.⁹⁻¹¹

The program is continuously monitored so that timely

improvements can be made as needed. While a preoperative T&S specimen was collected in 100% of the patients who were scheduled to have a procedure that qualified for the program for the past year, in 2 cases the blood bank received a request for blood but had no preoperative T&S specimen. The incidents involved a patient who was scheduled to undergo craniotomy and another patient who had splenectomy for treatment of warm autoimmune hemolytic anemia. Investigation discovered that the list of qualifying procedures did not include craniotomy and included splenectomy only for immune thrombocytopenic purpura. The institution's operating room committee reviewed the list and proposed to amend the list as shown in Table 1. The updated list was approved by the blood utilization committee.

The collaboration among clinical services and departments, as well as oversight provided by the blood utilization committee, is responsible for the continuing success of the program.

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