Reprinted from *Transfusion* 1992;32:601–605.

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A report of 104 transfusion errors in New York State

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In New York State, significant incidents involving the collection, processing, or transfusion of blood must be reported. Incident reports received over a 22-month period involving transfusion of blood to other than the intended recipient or release of blood of an incorrect group were analyzed. Among 1,784,600 transfusions of red cell components, there were 92 cases of erroneous transfusion that met study criteria (1/19,000). There were 54 ABO-incompatible transfusions (1/33,000); three of these (1/600,000) were fatal. Correction for underreporting of ABO-compatible errors resulted in an estimate of 1 per 12,000 as the true risk of transfusion error. National application of New York State data results in an estimate of 800 to 900 projected red cell-associated errors in the United States annually. The majority of reported errors occurred outside of the blood bank (43% resulted solely from failure to identify the patient and/or unit prior to transfusion and 11% resulted from phlebotomist error), while the blood bank was responsible for 25 percent of errors and contributed, with another hospital service, to 17 percent. The risk of transfusion of ABO-incompatible blood remains significant, and additional precautions to minimize the likelihood of such events should be considered. **TRANSFUSION** 1992;32:601–606

Abbreviations: FDA = Food and Drug Administration.

MUCH CONCERN HAS BEEN VOICED in recent years regarding the risk of transfusion-transmitted disease, and much quality assurance effort has been directed toward appropriate testing and handling of blood after collection. However, blood administered to an unintended recipient can be just as deadly. This study presents an analysis of errors that occurred during a 22-month period and were made by the hospital blood bank, phlebotomist, and/or transfusionist at the time of administration, resulting in the administration of an incorrect unit of blood or of blood to an unintended recipient.

Materials and Methods

Regulations implemented in New York State in December 1989 require that incidents, accidents, and errors involving the transfusion of blood components and their derivatives be reported to the state health department. Reports submitted by the 285 regulated facilities of errors occurring between January 1, 1990 and October 31, 1991 and resulting in transfusion of an incorrect unit of blood or administration to other than the intended recipient were analyzed and categorized as to the result of and reason for the error. For each incident, we also recorded and analyzed the city, date, volume of blood administered, and size of the transfusion service in units per year. An estimate of the total number of transfusions in the state during this period was based on data collected separately by the department in individual facility reports. We assigned reports to categories on the basis of location of occurrence, size of the transfusion service, the ABO compatibility or incompatibility of blood, and the source of the error.

We based our estimate of the actual number of erroneous red cell transfusions on the assumptions that all incompatible transfusions were reported, but fortuitously compatible red cell transfusions to an incorrect recipient were underreported. This underreporting may have occurred because some such instances went undetected and some institutions were not aware that ABO-compatible mistransfusions must be reported. Using ABO frequencies specified by the American Association of Blood Banks,[1] we made calculations of the probability that, in a random mistransfusion to the wrong recipient, the red cells would fortuitously be compatible. The chance of a compatible transfusion was calculated as the sum of the frequencies of red cell-compatible blood groups coinciding: O × O, O × A, A × A, O × B, B × B, O × AB, A × B, A × AB, B × AB, and AB × AB (0.2025, 0.180, 0.160, 0.0495, 0.0121, 0.018, 0.044, 0.016, 0.0044, and 0.0016, respectively). We used this figure to estimate the actual rate of erroneous ABO-compatible transfusion and to make a corrected estimate of the true incidence of red cell transfusion to other than the intended recipient.

We also estimated the unreported ABO-compatible red cell transfusions for each type of error. The data were partitioned according to criteria used by the Food and Drug Administration (FDA) to analyze their fatality data, and the sources of errors were compared.

Results

A total of 104 significant errors were reported during the study period. Fifty-four (52%) resulted in the transfusion of ABO-incompatible red cells. Table 1 categorizes the reported incidents according to the nature of the transfusion. In most

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Received for publication November 13, 1991; revision received February 17, 1992, and accepted February 26, 1992.

Table 1. *Incidence of transfusion of blood components to other than the intended recipient*

Component	Number	Percent
ABO-incompatible red cells (RBCs)	54	52
ABO-compatible red cells	34	32
Rh-positive RBCs to Rh-negative patient	4	4
ABO-incompatible fresh-frozen plasma	10	10
ABO-incompatible platelets	1	1
ABO-compatible platelets	1	1
Total incidents	104	100

cases, patients with ordered transfusions received blood of an incorrect group. In some cases, patients with no ordered transfusions received blood intended for another patient. In at least one case, two patients simultaneously received blood intended for the other. There was also one incident in which a group O plasmapheresis donor received a unit of group A red cells because there was no verification of the identity of the unit before the transfusion of "autologous" cells during a manual plasmapheresis procedure. Another incident occurred in which a bone marrow transplant recipient received incompatible red cells from a red cell-depleted marrow instead of cells from the intended marrow because of an identification error in the processing laboratory.

Table 2 lists the sources of reported errors. Sixty-one incidents (58%) were the result solely of errors outside the blood bank. The majority were due to the failure of the person administering the transfusion to verify the identity of the recipient and/or the blood unit, despite the fact that state regulation requires identification, and it is a standard part of hospital protocol. Phlebotomist errors, either in performing a venipuncture on the wrong patient or mislabeling the specimen, were also a prominent cause of transfusion error, with 12 incidents (11.5%). In 18 cases (17%), both the blood bank and another hospital service made errors or failed to detect an error made by the other. In 16 of these cases, the blood bank issued blood for a patient other than the one for whom blood was requested, and the transfusionist failed to notice the discrepancy.

There were 25 incidents (25%) in which only the blood bank made errors. In 11 cases, blood of the wrong group was chosen for release. There were also 13 blood grouping errors, 7 involving technical errors (2 errors in Rh typing) and 6 involving clerical or transcription errors (the wrong blood group was entered into the patient record and blood was released without the discrepancy being noted on crossmatch).

In summary, the blood bank contributed to the reported error 42 percent of the time, and other sections of the hospital contributed 75 percent of the time; in 17 percent of cases, both contributed. Because there is significant underreporting of errors that result in compatible transfusions, the blood bank contribution may be closer to 31 percent, with other sections contributing up to 87 percent (18% of errors may reflect contribution from more than one service).

Eleven errors occurred in the operating room, and five occurred in the emergency room. In one case, a physician intentionally ordered the transfusion of group B blood to a group A patient in an emergency situation. In one case, a hospital admitting clerk assigned the same patient identification number to two different newborn infants.

Three fatal incidents were attributed to acute transfusion reaction, for a rate of 3 per 600,000 red cell transfusions. Each resulted from the transfusion of a single unit or partial unit, but each involved a recipient with compromised health status. In one case, a verbal order was accepted for blood for a group O dialysis patient. The blood bank issued blood for a group B patient with the same last name and first initial, and the discrepancy was not noted at the bedside. The patient became hypotensive, developed disseminated intravascular coagulation, and died 3 days later. In the second case, the operating room staff administered a group A unit intended for another patient to a group O patient undergoing lobectomy for lung cancer. (Units reserved for several patients had been stored together.) The patient developed disseminated intravascular coagulation and died 13 hours later. In the third case, the blood

Table 2. *Sources of errors resulting in administration of incorrect blood or administration to other than the intended recipient*

Source of error	ABO-incompatible red cells	ABO-compatible red cells	Other components	Total Number	Total Percent
Outside blood bank					
Failure to identify patient	24	19	2	45	43
Phlebotomist error	10	1	1	12	11
Order sent with wrong patient name and no identification at bedside	2	1	0	3	3
Intentional administration in an emergency situation	1	0	0	1	1
Subtotal				61	58
In blood bank and outside					
Blood issued for another patient, error not detected at bedside	8	7	1	16	15
Inconsistent order sent, error not detected in blood bank	2	0	0	2	2
Subtotal				18	17
In blood bank					
Used wrong sample for testing	0	1	0	1	1
Blood of wrong group issued	0	4	7	11	11
Incorrect typing (technical error)	4	3	0	7	7
Incorrect typing (clerical error)	3	2	1	6	6
Subtotal				25	25
Total	54	38*	12	104	100

* Includes four cases of erroneous administration of Rh-positive red cells to Rh-negative recipients.

bank erroneously released a group A unit intended for another patient for transfusion to a group O patient. The transfusionist failed to verify the identification of the unit at the bedside, and 20 to 40 mL was administered. The 80-year-old patient had a cardiac arrest and died 30 minutes later.

Eleven incidents involved the administration of more than 1 unit of incompatible red cells. One group O patient received 6 units of group B red cells before developing an acute hemolytic transfusion reaction during the transfusion of the seventh unit. One group O patient received 3 units of AB red cells, with no reported adverse effects. A group A patient received 3 units of group B red cells, with no reported adverse effects. One patient received three full and one partial incompatible units on four separate days because of an erroneous original typing as group A, despite the absence of anti-A and anti-B (backtyping as group AB). Hemoglobinuria had been noted by the nursing staff but not reported to the blood bank.

As demonstrated in Table 3, we used the observed incidence of 54 ABO-incompatible transfusions in 1,784,641 red cell transfusions (3/100,000 or 1/33,000) to estimate the true number of erroneous transfusions that occurred. We assumed that all incompatible transfusions were reported and that there was underreporting of ABO-compatible erroneous transfusions we used, and an expected random compatibility rate of 64 percent. As seen in Table 3, the calculation yielded an estimated true incidence of 150 for the 1,784,641 red cell component transfusions during the period studied, or 1 per 12,000 transfusions.

Analysis of the data stratified by size of transfusion service revealed that transfusion errors occurred at facilities of all sizes, without a significant difference according to the size of the institution. One large institution reported three errors, one of which had a fatal outcome, during the period studied.

Table 4 illustrates an estimate of the projected incidence of ABO-compatible erroneous transfusion broken down by type of error. This estimate assumed 100 percent reporting of incompatible transfusion errors. Blood bank errors resulting in ABO-compatible mistransfusions were reported at a substantially higher rate than were errors arising outside the blood bank.

Table 5 shows a comparison of this study's data with data reported by Sazama[2] on fatalities reported to the FDA, with the error sources partitioned in the same fashion. The percentages of each type of error were similar for the FDA mortality data and this study's morbidity and mortality data.

Table 3. *Incidence of reported errors resulting in erroneous transfusion of red cell components or whole blood and estimate of true incidence*

	Number	Rate/100,000 red cell transfusions	Incidence
All reported errors	92	5.2	1/19,000
Reported ABO-incompatible errors	54	3.0	1/33,000
Reported ABO-compatible errors*	34	1.9	1/52,000
Adjusted ABO-compatible errors†	96	5.4	1/19,000
Adjusted total error incidence†	150	8.4	1/12,000
Reported fatal errors	3	0.2	1/600,000

* Not including the four cases of erroneous administration of Rh-positive red cells to Rh-negative recipients.
† Estimate based on 64 percent chance that a random transfusion to an unintended recipient would be compatible and assuming 100 percent reporting of incompatible erroneous transfusions.

Table 4. *Analysis of underreporting of compatible red cell transfusion errors*

Primary* source of error	ABO-incompatible red cells	ABO-compatible red cells		Estimated percent reported
		Reported	Projected†	
Phlebotomy and ordering	12	1	21	5
Blood bank	17	17	30	57
Transfusion administration	25	20	44	45
Total	54	38	95	40

* Compounded errors indicated in Table 2 have been partitioned to reflect source of initial error.
† Adjustments have been made as in Table 3 to reflect a 64-percent chance of random error resulting in a compatible transfusion.

Table 5. *Comparison of Food and Drug Administration (FDA) mortality data and New York State mortality and morbidity data for ABO-incompatible red cell administration*

Primary source of error	FDA* (1976–1985)		New York State (1990–1991)	
	Number	Percent	Number	Percent
Phlebotomy and ordering	13	10	12	22
Blood bank	45	33	17	32
Transfusion administration	77	57	25	46
Total	135	100	54	100

* As reported by Sazama.[2]

Discussion

This study demonstrates that there is still a significant risk of acute hemolytic transfusion reaction due to the transfusion of ABO-incompatible blood. The report estimates the overall incidence of transfusion-associated errors. Because these errors lead to morbidity much more often than to mortality, a data base such as that created by the New York State Department of Health, with its reporting mandate for incidents, accidents, and errors, was absolutely essential to this estimation. In addition, error definitions and a promulgated reporting format were necessary to data acquisition that would allow easy compilation for analysis.

We made the assumption that there was perfect compliance in the reporting of ABO-incompatible red cell transfusions, so as to adjust the numbers of ABO-compatible but erroneous red cell transfusions to allow the estimation of the totality of associated errors. Hence, the actual rate of significant transfusion errors may be higher, because of the possibility of underreporting of ABO-compatible red cell transfusions. The calculated in-

cidences are then, at best, lower boundaries to the true transfusion-associated risks.

Several anecdotal reports of morbidities and mortalities and error analyses concerning such have been made in the international literature. Torsiglieri et al.[3] identified the source of error and professional responsibility in a comprehensive review of incidents of incompatible blood transfusion in Italy. In 1981, an editorial[4] highlighted the disastrous results of mistransfusion in Great Britain. Depastas[5] classified errors identified in Germany and recommended a "safe transfusion protocol." Moyes and coauthors[7] reported a single case in South Africa. Murphy and McClelland[8] published a review of five transfusion reactions, based on a 24-month study in a large teaching hospital in the United Kingdom, and Bacon and Young[9] reported four cases from Australia. Several reports from the United States[10-12] found that the majority of transfusion errors occur at the bedside. Women have been reported to be twice as likely as men to develop hemolytic reactions in response to the transfusion of incompatible blood,[13] and group O patients have been reported to be at especially high risk for severe reactions.[14] Our report differs from previous reports in that it is a comprehensive review of incidents occurring at institutions of all sizes in both urban and rural areas.

A report of blood grouping errors on US Army identification cards and tags[15] demonstrated a prevalence of incorrect blood grouping (ABO and/or Rh) on an astounding 11.0 percent of identification cards and 10.6 percent of identification tags. If blood were to be collected and transfused on the basis of these records, without any further grouping and typing or compatibility testing, the authors estimated that 7.9 percent of transfusions would be ABO incompatible. Errors detected in that study varied with grouping technique, being highest for the slide method and lowest for automated methods, but most were attributable to clerical or transcription errors.

The best error analyses to date of risks in the civilian population have been those that have dissected the fatality reports to the Bureau of Biologics (now the Center for Biologics Evaluation and Research) of the FDA, although this data base is limited by including only deaths and not "near misses." Since 1975, this agency has required that all registered and licensed blood establishments report deaths associated with the transfusion or collection of blood or with plasmapheresis. This data base, access to which is guaranteed by the Freedom of Information Act, has been reviewed over time by several authors, listed chronologically with the total number of fatalities (in parentheses) available for review at the time: Honig and Bove[16] (1980: 70), Myhre[14] (1980: 113), Camp and Monaghan[17] (1981: 126), Edinger[18] (1985: 275), and, most recently, Sazama[2] (1990: 355). Each of these reports categorized errors slightly differently. Therefore, we chose to compare our data with those in the recent and comprehensive review by Sazama, whose partitioning scheme is similar to ours. As indicated in Table 5, the qualitative assessment of error responsibility appears to be similar, with approximately one-half of the errors primarily in transfusion administration and one-half in the blood bank and phlebotomy areas.

With respect to fatalities attributed to transfusion, current New York State data for the 22-month reporting period show an incidence of slightly under two fatalities per million red cell units transfused. This figure is consistent with the incidence of ABO-incompatible transfusion fatalities reported to the FDA between 1976 and 1985 (average, 1.43 fatalities/million red cell units transfused).

Table 4 suggests that there is a significant differential in the degree of underreporting of ABO-compatible mistransfusions according to the various types of errors. To verify this possibility, we restructured Table 2 to group error types into categories based on primary source of error. We calculated the number of errors that would be expected for each source, using the previously noted 64:36 percent ratio for the compatibility or incompatibility of a randomly chosen unit. Table 4 suggests that phlebotomy and ordering errors are grossly underreported, with only 5 percent reported.

The distribution of error sources depicted in Table 2 is based on reported errors. Because we believe that phlebotomy and administration errors were more underreported than errors by blood banks, this distribution is probably not representative of all errors that occurred. Blood banks appear to have been reasonably diligent in detecting and reporting, while transfusion administration areas were less so. Thus, according to the data in this report and FDA data, as presented in Table 5, it appears that quality assurance activities in the blood bank have been largely effective, while much more attention must be paid to transfusion-related activities on the hospital floor. The underreporting of phlebotomy and administration errors is symptomatic of the lack of control of blood bank professionals over transfusion-related activities elsewhere in the hospital.

In theory, errors that might cause fatalities should be the same errors that cause morbidity and that result in fortuitously compatible mistransfusion. However, to the extent that the nursing staff's failure to monitor the patient and intervene early contributes to an increase in mortality versus morbidity, that carelessness could be expected to be a more prominent feature of fatal errors than of all errors. Table 5 does show a larger percentage of nursing errors in the FDA fatality reports than in the New York State error data.

Some institutions in this study reported more than one incident, but most had only one. It is possible that increased vigilance after one of these incidents lowers the

risk at that particular institution, at least for a time. After such an occurrence, measures may be adopted to prevent these mishaps from recurring. The increased awareness associated with required incident reporting may also serve to decrease risk by prompting implementation of error-avoidance measures.

Various suggestions have been made for the prevention of different types of errors. Reich et al.[19] reported a decrease in clerical errors as a result of the installation of an adequate computer system in the blood bank. The importance of appropriate quality assurance and proficiency testing programs has been stressed by Pinkerton and coauthors[20] and Beal.[21] Rachel et al.[22] even suggested confirmatory bedside blood grouping to decrease transfusionist errors.

On the basis of the types of errors observed in this report, we suggest some actions that may decrease the risk of acute hemolytic transfusion reaction:

1. Implementation of a policy requiring the verification of the identity of each unit and transfusion recipient by two staff members (with documentation) and frequent in-service training to ensure compliance;
2. Adjustment of protocol to increase the frequency of monitoring of transfusion recipients and to add in-service programs to better train staff to recognize reactions and to initiate early intervention;
3. Limitation of the staff members permitted to perform phlebotomy for blood bank specimens and the provision of careful training and continuing education for such personnel;
4. Implementation of a policy requiring the hand labeling of blood bank specimens at the bedside;
5. Implementation of a policy requiring a written request with patient name and identification number prior to the release of any blood components;
6. Implementation of a policy to ensure that blood units stored in the operating room for numerous patients are carefully separated;
7. Minimization of the release of blood on the basis of type and screen alone, without at least an immediate-spin crossmatch;
8. Consideration of a policy to release only 1 unit at a time, per floor or hospital unit, to reduce the chance of units being mixed up;
9. Use of a separate blood bank wristband system; and
10. Use of a commercially available blood bag and lock system.

One of the deaths followed the issuance of blood solely as the result of a telephone request. Because many patients' names are similar, it seems prudent always to require both a written order and a written notation (by the technologist issuing the blood) in a log of the patient's name and identification number, with the match verified by checking blood bank records. Staff shortages may prevent issuance of only 1 unit at a time per floor, but such a policy could prevent the mix-up of units transfused at the same time. This is not practical, however, for the operating room or emergency room, where many errors occur. Adequate refrigerator capacity for careful segregation of units stored in the operating room would help avoid errors there.

A blood bank wristband system or blood bag-locking device,[23] if fully used, could be expected to have prevented 75 percent of the erroneous transfusions reported in this study and would have prevented all three deaths. Such systems could also have reduced the suspected, unreported compatible transfusion errors. While errors in the blood bank could still occur, such systems are one means of avoiding the major sources of error resulting in inadvertent administration to an unintended recipient. However, this study demonstrates that blood administration personnel cannot be relied on assiduously to verify wristband identification.

While transmissible diseases continue to command much of the attention of transfusion medicine professionals, vigilance must be maintained on transfusion services so that preventable transfusion errors are avoided. Most errors occur on the hospital floor (made by nursing staff or phlebotomists) and may be beyond the direct purview of the director of the transfusion service, but it should be possible to implement and enforce policies designed to minimize the chance of such errors.

Acknowledgments

The authors thank Kathleen Wagner for technical assistance in review and compilation of incident reports and Kathleen Sazama, MD, JD, for providing additional detail regarding FDA fatality reports.

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