

Errors in Transfusion Medicine

Scope of the Problem

Jeanne V. Linden, MD, MPH

● **Error is ubiquitous whenever humans are involved in a process. Fortunately, most transfusion-related errors are benign. However, the risk of death due to acute hemolytic transfusion reaction rivals that of human immunodeficiency virus transmission and administration of the wrong blood or of blood to the wrong recipient has occurred at many facilities. Most blood misadministration errors are caused by failure to identify the recipient and blood unit adequately, although phlebotomy errors and blood bank errors also contribute. Many errors are multifactorial and may reflect underlying systems defects. Noncompliant specimen labels may be a cue to an increased risk of phlebotomy error. Autologous blood is not immune from error and poses infectious disease risks as well as the risk of hemolytic transfusion reaction; also, perioperatively recovered blood may pose a risk of air embolism if improperly handled.**

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The risk of error is a constant accompaniment to human participation in an activity. The most recognizable error is the active error, made by an individual who has not carried out the action he or she intended (a slip) or took the wrong action because of a lack of knowledge or incorrect planning (a mistake).¹ Less well appreciated is the latent error, which represents an underlying environmental problem or system defect that, when combined with an active error, contributes to an adverse event. It could be termed an *accident waiting to happen*. An example in the transfusion medicine arena is allowing the scheduling of two patients with the same or similar names for elective surgery on the same day, increasing the likelihood of a medication or transfusion error. Another example is intraoperative blood recovery devices that require manual expulsion of air from the bag, increasing the likelihood that this step will be overlooked. This review will identify some of the areas within transfusion medicine in which errors are most likely to have significant effects and will summarize some of the key reports regarding transfusion errors.

ERRORS IN BLOOD COLLECTION

Fortunately, most errors are benign. Even among blood bank errors and accidents reported to the Food and Drug

Administration (FDA) by blood collection facilities, most pose no significant risk to recipients. For the first quarter of 1998, 64.4% of the errors and accidents considered reportable by the FDA related to postdonation information not available at the time of collection; most of these posed little or no risk to recipients.² Nearly 10% concerned products that contained blood clots or were not maintained at the correct temperature. Another 10% concerned labeling errors, such as incomplete or discordant donor information (such as a missing Social Security number or birth date on an autologous unit), incorrect expiration date, and other incorrect labels; such events would be very unlikely to pose a significant risk to recipients.² Errors by blood collection facilities can result in the release of infectious units and some cases of human immunodeficiency virus infection in recipients have been attributed to error,³ but the many widely publicized errors resulting in the release of unsuitable units reflect a failure to withhold a safe, test-negative product because of a prior false-positive test result.⁴

FREQUENCY OF TRANSFUSION ERRORS

However, while benign errors are still the preponderance in transfusion service, there is the potential for a catastrophic outcome when an error in patient identification during administration or phlebotomy is coupled with preformed antibodies in the ABO system. A random unit administered to a random recipient without typing or cross-matching has more than a 1 in 3 chance of being ABO incompatible with the recipient.⁵ Such erroneous administrations occur not infrequently, but this risk is often unappreciated by patients. Most patients are concerned about the risk of human immunodeficiency virus transmission, but the risk of a fatal hemolytic transfusion due to error has been reported to be about the same: in the range of 1 in 600 000 to 1 in 800 000.^{5–7}

Sazama⁷ studied transfusion-related deaths reported to the FDA between 1976 and 1985. She identified 131 ABO-incompatible units implicated in fatal acute hemolytic transfusion reactions; 124 of these units were red blood cells or whole blood (the remainder contained plasma ABO-incompatible with the recipient's red blood cells). During the period studied, she reported about 100 million transfusions, or a rate of fatality of approximately 1 in 800 000 for red blood cell units. A breakdown of the errors identified is given in Table 1. The most frequent error leading to a fatal outcome was administration to other than the intended recipient, accounting for 49% of these cases. In many cases the usual safeguards had been bypassed for some reason; an example was removal of the patient's identification band during surgery, rendering wristband verification impossible. Sazama observed management system errors in many of the cases. These included an absence of proper written procedures and/or training of transfusion personnel and a lack of clear delineation of

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From Blood and Tissue Resources Program, Wadsworth Center, New York State Department of Health, Albany.

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Reprints: Jeanne V. Linden, MD, MPH, Blood and Tissue Resources Program, Wadsworth Center, New York State Department of Health, PO Box 509, Albany, NY 12201–0509.

Table 1. Errors Identified in Fatal Acute Hemolytic Transfusion Reactions Reported to the Food and Drug Administration, 1976–1985*

Type of Error	Reports, %
Collection and ordering	
Sample drawn from wrong person	3
Misidentification of specimen or requisition	6
Blood bank	
Confusion of samples and records	10
Wrong unit released	6
Testing error	13
Blood given to the wrong person	49
Error, nature unclear	6
No error	8

* Adapted from Sazama.⁷

responsibilities (eg, clearing the operating room refrigerator of unneeded blood at the end of a case). She also noted several cases where patients had tried to alert nursing staff that the wrong type blood was hanging, but staff ignored these warnings.⁷

Mummert and Tourault⁸ updated Sazama's report, focusing on 150 fatalities reported to the FDA from 1990 to 1992. They reported that ABO-incompatible red blood cell transfusion continued to be the primary cause of preventable transfusion death and concluded that one third of the deaths could have been prevented by adherence to proper procedure. They identified failures in the following areas: (1) accuracy of patient identification; (2) recognition of the signs of a transfusion reaction and appropriate action to discontinue the transfusion; (3) verification that equipment in use was functioning properly before and during use; and (4) training of employees in adherence to standard operating procedures. They noted that failure to recognize a reaction in progress contributed to a fatal outcome in many of these cases and that unapproved equipment, such as microwave ovens, used for warming had caused hemolysis in several cases.⁸

With coworkers, I studied reports submitted during the first 2 years of mandatory reporting of transfusion-related errors, accidents, and incidents in New York State.⁵ Unlike the FDA fatality database, these reports included all identified significant errors, even if there was no adverse outcome. Based on identified and reported errors, the rate of erroneous transfusion was estimated at 1 per 12 000 units overall, with 1 per 33 000 resulting in an ABO-incompatible red blood cell transfusion and 1 per 600 000 resulting in a fatal acute hemolytic transfusion reaction.⁵ A breakdown of the sources of error is shown in Table 2. These findings are consistent with Sazama's findings for fatal errors. Notably, 20% of the events involved compound errors; that is, an opportunity to detect the primary error was missed through a second error. As in Sazama's report, more than half of the incidents were attributable solely to errors by staff outside the blood bank—either nursing staff or phlebotomy staff. Some specific contributory factors identified included the use of automated labels for specimen tubes, insufficient segregation of units in operating room refrigerators, scheduling of surgery of two patients with the same or similar names for the same day, an identification number allocation system that allowed assignment of the same number to two different newborns, and use of telephone orders for blood.⁵

In the United Kingdom, McClelland and Phillips⁹ sent a questionnaire to 400 transfusion services. A total of 245

Table 2. Sources of Errors in New York State Resulting in Administration of Incorrect Blood or Administration to Other Than the Intended Recipient*

Source of Error	Reports, %
Outside blood bank	
Failure to identify patient	43
Phlebotomy error	11
Incorrect order, with no identification at bedside	3
Subtotal	58
In blood bank and outside	
Blood issued for another patient, not detected at bedside	15
Inconsistent order sent, not detected in blood bank	2
Subtotal	17
In blood bank	
Used wrong sample for testing	1
Blood of wrong group issued	11
Incorrect typing (technical error)	7
Incorrect typing (clerical error)	6
Subtotal	25

* Adapted from Linden et al.⁵

(61%) responded; these facilities perform about three quarters of the blood transfusions in Great Britain. Half responded from memory without reviewing any records. The 245 facilities reported 111 incidents in which patients received the wrong blood: 21% were phlebotomy errors, 5% were laboratory errors, and 74% were blood administration errors. They observed an overall error rate of 1 per 29 000 units and calculated rates of outcomes per red blood cell unit transfused: 1 per 550 000 for death, 1 per 275 000 for morbidity, and 1 per 36 000 for no adverse effect. The authors noted that this self-reported survey elicited admission of errors from only one third of respondents and concluded that a national reporting system should be established.⁹

In a prospective study, the Belgium SANGUIS group traced transfused units for 6 elective surgical procedures at 3 hospitals.¹⁰ The authors detected 7 misidentifications (0.2%) resulting in administration to the wrong recipient among 3485 units. Another 155 errors included administration of allogeneic units before autologous units (5), misrecordings (61), mislabeling (6), and failures to document adequately the transfusion (83). No systems checks to prevent error were in place and practices differed from the United States, but this study suggests that the true error rate far exceeds those that are detected and reported.

WRISTBAND ERRORS

A College of American Pathologists study, the 1991 Q Probes' Wristband Identification Error Reporting module, assessed inpatient wristband practices in 712 hospitals.¹¹ The authors reported 67 289 errors among 2 463 727 patients checked. The median error rate was 2.2%, with some facilities having error rates exceeding 10%. The most prevalent error was wristband absence (49.5% of errors), followed by more than one wristband with conflicting information (18.3%), wristbands containing erroneous information (8.6%), wristbands with incomplete information (7.5%), wristbands with illegible information (5.7%), and wristbands containing another patient's identifying information (0.5%). The authors reported finding lower error rates at hospitals with policies of refusing phlebotomy until identified errors were corrected (in place in two thirds

of hospitals) and at those in which the nursing service actively monitored for errors.¹¹

SPECIMEN LABELING ERRORS

The active error of inadequately labeled specimens may also raise the suspicion of active error in identification. Lumadue and coworkers¹² reported that specimens that failed to meet the criteria for specimen acceptance at their institution were 40 times more likely to have a blood grouping discrepancy when compared with historic or subsequent patient data. During a 1-year period, 14 discrepancies (0.035%) were identified among 40 274 correctly labeled specimens, while 7 (1.4%) were found among 496 rejected specimens that were nonetheless tested ($P < .0001$). The authors concluded that strict adherence to labeling requirements would result in a significant decrease in erroneous blood grouping due to phlebotomy errors.¹²

BLOOD STORAGE PLACEMENT ERRORS

Shulman and Kent¹³ studied the frequency of errors in the placement of blood units in the blood bank refrigerator. At one large institution, they found a placement error rate of 0.12% or 1 per 862 (112 units of 96 581), with about one third of these having the potential for ABO-incompatible transfusion if released without careful double checking. The authors expressed particular concern about the potential for Rh errors, since such errors would likely not be detected during compatibility testing if an inappropriate unit were selected. They noted particular concern about units released uncross-matched in emergency situations.¹³

AUTOLOGOUS BLOOD

While most errors discussed herein involve allogeneic units, autologous units are not immune from mishandling. There may be infectious disease risks if units are transfused to another person, as well as the ever-present risk of hemolytic transfusion reaction due to ABO-incompatible blood. The benefit of autologous donation may be lost if allogeneic units are transfused when autologous units are available. In a review of 251 228 preoperative autologous donations (of which 124 601 were transfused), this program reported 3 errors in collection (2 ineligible units crossed over and 1 incorrectly labeled) and 6 transfusion errors involving 8 units, with a calculated risk per transfused unit of 1 in 16 000.¹⁴ Two patients received blood of another patient and one nearly received blood of another (the error was detected by an astute anesthesiologist). In one case signs and symptoms consistent with an acute hemolytic transfusion reaction were recognized and ignored; they were attributed to other causes since the patient "was receiving his own blood back." In a Canadian study, Goldman and coworkers¹⁵ identified one "autologous" unit transfused to the wrong recipient of 16 873 collected at one blood center. They also reported 112 other errors, nearly half of which would have resulted in the unit not being available when needed (received too late or sent to the wrong hospital), for an error rate of 1 per 149 units.¹⁵

A College of American Pathologists survey (the 1992 Comprehensive Transfusion Survey, Set J-C) found that 34 (0.9%) of 3852 facilities surveyed admitted having issued autologous blood to the wrong recipient in the previous year on at least one occasion. Twenty facilities (0.5%) in-

dicated that the unit had been transfused. The American Association of Blood Banks reported that 22 (1.2%) of 1820 respondents to an anonymous questionnaire indicated that one or more autologous units had erroneously been transfused to the wrong recipient in their institution during 1993.¹⁶ Twenty percent of respondents reported that units had been transfused in the wrong order (ie, an allogeneic unit when autologous was available).

PERIOPERATIVELY RECOVERED BLOOD

Even blood recovered intraoperatively or postoperatively is not safe. In fact, such blood may pose an increased risk. In 64 500 intraoperative blood recovery procedures during a 4-year period in New York State, there were 2 fatal air embolisms, 1 unexplained fatality, 2 patients who received another patient's blood, and 1 case where the blood was mislabeled.¹⁴ One fatal air embolism was observed in 30 000 postoperative blood recovery procedures. Reported separately were 2 additional cases of fatal air embolism associated with perioperative blood recovery. Four of these 5 fatal air embolisms were related to errors and were preventable.¹⁷ The incidence observed was 1 per 30 000 intraoperative blood recovery procedures. In some cases, a latent system error that required manual evacuation of air from the infusion bag was identified as a contributory factor.¹⁷

CONCLUSION

Errors occur not infrequently in transfusion and have the potential for morbidity and mortality. The majority of errors occur outside the blood bank; many involve multiple errors and missed opportunities for detection. Awareness of the types of errors that occur and investigation to identify underlying contributory causes can be useful in developing plans for corrective and preventive action.

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