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CLINICAL REVIEW

Transfusing blood safely and appropriately

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Blood transfusion is an essential part of modern healthcare and can be life saving when used appropriately. Blood services worldwide strive to provide a safe supply and work with hospitals to ensure that blood products are readily available for patients. Blood components such as red cells, platelets, fresh frozen plasma, cryoprecipitate, and granulocytes are prepared from whole blood donations or collected by apheresis. Plasma derivatives such as coagulation factor concentrates, immunoglobulins, and albumin are prepared from large pools of plasma under drug manufacturing conditions.

The process of getting a unit of blood from a donor to a patient is complex. Many steps are taken to ensure that the transfusion is as safe as possible. Although serious complications of blood transfusion are uncommon, patients should be transfused using evidence based guidelines. This will minimise any adverse effects and ensure that blood products, which are donated by volunteers and are costly and sometimes in short supply, are used appropriately. Every effort should be made to reduce or eliminate the need for transfusion by considering alternative approaches to patient management. Patients should be in clinical need of transfusion and should understand why transfusion is being recommended.

The aim of this review is to describe best practices for the safety of patients receiving blood transfusions, including ways to reduce unnecessary transfusions.

When is blood transfusion appropriate?

Blood transfusion should not be dictated by low blood counts, such as a low haemoglobin concentration or platelet count, alone or prolonged screening tests of coagulation, such as prothrombin time or activated partial thromboplastin time. Such findings should be used together with the patient's clinical status to determine whether transfusion is necessary.[1 2] Prospective randomised controlled trials of patients in intensive care,[3] cardiothoracic surgery,[4] repair of hip fracture,[5] and acute upper gastrointestinal haemorrhage[6] have studied whether patients can tolerate a restrictive transfusion strategy. They found that a threshold for red cell transfusion of 70-80 g/L haemoglobin was associated with equivalent or better clinical outcomes than when the threshold was 90-100 g/L. These data were recently summarised in a review of evidence based clinical trials, published clinical practice guidelines, and emerging pathways for improving blood utilisation and patient outcomes.[7]

A Cochrane review recommends that red cell transfusion is not essential until haemoglobin falls to 70-80g/L or less,[2] and even then the need for transfusion depends on the clinical circumstances. The same restrictive transfusion strategy is recommended for patients with a history of cardiovascular disease unless the patient has acute chest pain, cardiac failure, hypotension, or tachycardia that does not respond to fluid resuscitation.[2] However, the quality of evidence for some patients—including those with acute and chronic ischaemic heart disease, brain injury, and signs of inadequate tissue perfusion—is poor. Clinicians need to use judgment in these cases, and British Committee for Standards in Haematology (BCSH) guidelines recommend transfusion of red cells to maintain a target haemoglobin of 70-90 g/L.[8] Patients with platelet counts greater than 50×10^9/L or an international normalised ratio (INR) less than 2.0 can undergo invasive procedures without serious bleeding and do not need correction of these laboratory abnormalities before the procedure.[2]

Non-bleeding patients should be transfused with one dose of a blood component at a time—one unit of red cells or one therapeutic dose of platelets for adults, or a dose of plasma components based on the weight of the patient. They should then be reassessed clinically and by laboratory testing before further transfusions are ordered to achieve a haemoglobin, platelet count, or haemostasis test target value. Several

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Extra table on uncommon transfusion reactions supplied by the author (see http://www.bmj.com/content/347/bmj.f4303?tab=related#webextra)

Summary points

- Use of evidence based guidelines minimises the adverse effects of transfusion and wastage of products, which are donated by volunteers, costly, and sometimes in short supply
- Consider red cell transfusion only if haemoglobin is 80 g/L or less in haemodynamically stable patients, including asymptomatic patients with cardiovascular disease
- Patients with platelet counts greater than 50×10^9/L or an international normalised ratio less than 2.0 can safely undergo invasive procedures without correcting the abnormal laboratory values
- Use alternative approaches to patient management to reduce or eliminate the need for transfusion
- The safe and appropriate use of blood is facilitated by the use of information technology throughout the transfusion process
- Obtain and document informed consent for blood transfusion, including the risks, benefits, and alternatives

Sources and selection criteria

As well as using our personal reference collections, we searched the Cochrane database (www.cochrane.org), *Clinical Evidence* (http://clinicalevidence.bmj.com), *Best Practice* (http://bestpractice.bmj.com), and a library of systematic reviews in transfusion medicine (www.transfusionevidencelibrary.com). The review draws on multiple sources including national guidelines, peer reviewed original research publications including randomised controlled trials, and systematic reviews. Examples include transfusion guidelines from Australia and New Zealand, which were developed from a series of systematic reviews,[1] and a special collection of systematic reviews on avoiding unnecessary transfusion in the Cochrane Library.[2]

randomised controlled trials have shown that lower red cell transfusion thresholds do not lead to adverse recipient outcomes.[3-6] Consequently, a red cell transfusion of two units is no longer considered the "standard" dose in non-bleeding patients. This strategy does not apply to patients with severe bleeding, where urgent transfusion of multiple units of red cells, plasma, and platelets may be needed.

How should patients taking antiplatelet drugs or anticoagulants be managed perioperatively and in emergency situations?

The perioperative management of patients on antiplatelet drugs and anticoagulants involves balancing the risks of increased surgical bleeding and thromboembolic events. National Australian and New Zealand clinical practice guidelines and the American Societies of Thoracic Surgeons and Cardiovascular Anesthesiologists recommend that clopidogrel should be discontinued three to five days before surgery because of increases in perioperative bleeding, transfusion, reoperation, and hospital stay.[1 9] Point of care (bedside) haemostasis testing using thromboelastography and platelet mapping may help identify those patients taking clopidogrel who maintain normal platelet activity and haemostasis and do not need a preoperative waiting period.[8] Patients can continue to take aspirin, except for those undergoing neurosurgery or intraocular surgery.[1] In orthopaedic surgery, non-steroidal inflammatory drugs should be discontinued two weeks before surgery to reduce blood loss and transfusion.[1]

Warfarin may be continued as long as the INR is within the therapeutic range in patients undergoing minor procedures such as cataract surgery, minor dental procedures, upper gastrointestinal endoscopy, and colonoscopy with or without biopsy. However, in more complex procedures, when warfarin is discontinued to minimise the risk of bleeding, bridging therapy with heparin may be needed to reduce the risk of thrombosis. Specialist advice should be sought.[1 10]

Emergency reversal of anticoagulation with warfarin in patients with bleeding should be with 25-50 µg/kg prothrombin complex concentrate and vitamin K 5 mg intravenously.[11] There are no specific antidotes for the new direct thrombin (such as dabigatran) or Xa inhibitors (such as rivaroxaban). On the basis of animal studies, the BCSH recommends management with general haemostatic measures and consideration of treatment with prothrombin complex concentrate, activated prothrombin complex concentrate (such as factor VIII inhibitor bypass activity), or recombinant activated factor VII.[11]

What are the essentials of laboratory pre-transfusion testing?

Once the decision to transfuse has been made and the patient's blood sample is delivered to the transfusion laboratory for compatibility testing, the patient's ABO group and the presence of atypical (or non-ABO) red cell antibodies must be determined. Antibody screening is performed to determine whether a clinically relevant antibody is present. Once this testing is complete, compatibility between the patient's serum and the selected red cell unit has to be demonstrated using a serological or electronic crossmatch.

Establishing the recipient's ABO type

The patient's ABO type (or group) is determined using two complementary tests, the forward and reverse tests, and is based on the principle that adult recipients will have formed naturally occurring (expected) antibodies to the A or B antigens lacking on their red cells.

Forward test:

- Performed by separately mixing the patient's red cells with commercially available monoclonal antibodies to A and B antigens
- Agglutination of red cells after the addition of the antibodies to the patient's red cells indicates a positive reaction—one or both of the A or B antigens is present on the recipient's red cells.

Reverse test:

- Performed by separately mixing the recipient's plasma with commercially available human A and B red cells
- The identification of red blood cell agglutination after the addition of the patient's plasma to the red cells indicates a positive reaction—one or both of the anti-A or anti-B antibodies are present in the recipient's plasma.

Table 1⇓ provides a guide to interpreting the forward and reverse tests, and table 2⇓ provides a guide to selecting ABO compatible products.

Determining whether atypical red cell antibodies are present in the recipient's plasma

Although virtually all adults will have preformed antibodies to the A or B antigens (or both) not present on their red cells, atypical (non-ABO) red cell antibodies may be formed after exposure to allogeneic red cells through transfusion of cellular blood products or pregnancy. An antibody screen is performed using two or three commercially available red cells that express all of the important minor antigens between them.

The screen is performed in a similar way to the reverse test. The patient's plasma is incubated with commercially available screening cells and agglutination or haemolysis indicates a positive reaction—an unexpected antibody in the recipient's plasma has bound to its cognate antigen on the screening cells.

If the screen is positive, then additional reagent red cells are used to determine the specificity of the antibody. Manual and automated methods are available to perform the antibody screen; in general, it takes about one hour to complete and interpret the results of this test.

Antibody identification can take several hours or longer to complete depending on the number and nature of the antibodies that are present.

Crossmatching

For most recipients with no antibodies detected in a current or previous sample, the electronic crossmatch offers many advantages over the serological crossmatch (table 3⇓). In particular, it eliminates the need to have red cell units physically allocated to the recipient and thus unavailable for other patients. The electronic crossmatch can be completed and red cell units issued in less than five minutes after they are ordered; this streamlines the laboratory's inventory management without compromising patient care.

"Electronic remote blood issue" is an extension of electronic issue that enables the safe issue of blood under electronic control at blood refrigerators remote from the transfusion laboratory.[12] The hospital information technology network is essential to enable electronic remote blood issue and provide data on each step of the process.

Patients with atypical red cell antibodies require a serological crossmatch, and red cell units are typically allocated in advance because it may be difficult and time consuming to identify compatible units if additional antibodies are present. If urgent transfusion is needed and care would be compromised by waiting for a compatible unit, uncrossmatched units can be rapidly issued from the transfusion laboratory. These units are always group O, although the choice of RhD positive or negative units can depend on the age and sex of the recipient, and they have been shown to be safe even in patients with unexpected red cell antibodies.[13 14]

What hazards are associated with transfusion?

Transfusion carries important infectious and non-infectious hazards. Table 4⇓ summarises some of the most important of these.

The transmission of hepatitis and HIV by blood components is now rare in developed countries. Bacterial contamination of blood components is now the most common residual infectious hazard, but there have been no cases in the United Kingdom since 2009. Platelets are now screened for bacteria before release to minimise this risk.[15 16] Plasma derivatives have been subject to pathogen removal or inactivation treatments for many years, and these technologies are also increasingly being applied to blood components.

Haemovigilance is the reporting of adverse consequences of blood transfusion with the aim of learning how best to prevent and manage such consequences, typically on a national or regional level. Many complications and "near misses" are due to human error during the transfusion process. They are often caused by failure to properly identify the patient during pre-transfusion sample collection or before blood administration.[17]

How can errors in transfusion practice be minimised?

Efforts to reduce error have mostly relied on education and implementing procedures for good practice, learning from previous incidents, and training programmes. This approach has reduced, but not eliminated, the most serious event, which is ABO incompatible red cell transfusion.[17]

Several groups have taken advantage of new technology and developed electronic transfusion management systems for safe transfusion practice.[18-20] All healthcare professionals are familiar with barcode technology from its use in commerce, and blood components have been barcoded for many years.

One barcode patient identification system uses handheld computers for blood sample collection for compatibility testing and the administration of blood.[18] Baseline pre-implementation audits found poor practice in the key steps in the pre-transfusion bedside checking procedure, and these results were replicated in a multicentre international trial.[21] Significant improvements were found after the introduction of barcode patient identification.[18] Staff found the barcode identification system easy to operate and were less distracted when using it compared with standard bedside checking procedures. Implementation across a network of hospitals has been shown to be feasible and cost effective,[22 23] and electronic transfusion systems are now a recommended intervention in the NHS Quality, Innovation, Prevention and Productivity (QIPP) programme.[24] However, a survey carried out by the National Blood Transfusion Committee in 2008,[25] and repeated in 2011,[26] found that few hospitals in England were using barcodes or other electronic systems for patient identification for transfusion. Uptake is also sporadic in other developed countries, including the United States and Australia.

How do the most serious and common transfusion reactions present and how should they be managed?

Serious transfusion reactions are rare, but they can be fatal, and any patient who unexpectedly deteriorates during or after transfusion should be immediately and carefully assessed for the possibility of a transfusion reaction.[27] The figure⇓ and table on bmj.com provide examples of common and less common transfusion reactions and their presentation and management, respectively. Intravascular haemolysis due to ABO incompatible red cell transfusion, anaphylaxis, and transfusion related sepsis may all present suddenly and dramatically with cardiovascular collapse. Fevers, chills, and rapid development of disseminated intravascular coagulation can be seen in both intravascular haemolysis and sepsis. Immediate careful clinical examination and laboratory testing, including collection of new samples for

repeat blood group and antibody screening, are needed to confirm or exclude a "wrong blood" event. Whenever a patient becomes acutely ill during transfusion, the transfusion should be halted while initial clinical assessments and laboratory investigations are performed (box). Non-transfusion related events (such as drug reactions, pulmonary embolism, or worsening of the patient's underlying condition) can also occur during transfusion and cause symptoms and signs that may be initially difficult to distinguish from a transfusion reaction.

Blood cultures from the patient and cultures of the transfused unit are essential when investigating suspected bacterial contamination. If the reaction is severe, empirical antibiotics should be started promptly.

Transfusion reactions should be investigated by the treating clinical team with the support of the hospital transfusion service. All incidents should be reviewed by the hospital transfusion committee and reported to the relevant haemovigilance programme—for example, the Serious Hazards of Transfusion scheme in the UK. Near miss events related to "wrong blood in tube" and other procedural errors are unfortunately common in hospitals. For example, one "wrong blood in tube" event occurred per 1986 samples in an international study,[28] and one in 1303 samples in a UK study.[29] Such events should be viewed as opportunities to learn and to put in place measures to prevent or reduce further events.

What is current transfusion practice?

Over the past decade, increasing awareness of the complications and costs of transfusion has encouraged hospitals to investigate how to reduce the use of blood. In England, the demand for red cell units, which increased steadily during the 1990s, decreased substantially by about 18% from 2002-03 to 2007-08, with a slower but continuing decline since then.[7] The reasons for this reduction are not entirely clear, but it was probably associated with Department of Health initiatives,[30] better evidence for restrictive strategies for red cell transfusion,[7] and an increase in the price of blood supplied to hospitals by NHS Blood and Transplant. By contrast, the demand for platelets and fresh frozen plasma has been increasing in England.

Considerable inappropriate use of blood has been documented in large regional and national audits of the use of red cells, fresh frozen plasma, platelets, and cryoprecipitate (table 5⇓).[31] It persists despite improvements in the evidence base for the use of blood, the existence of numerous guidelines for transfusion, and many initiatives to reduce the inappropriate use of blood. The high level of inappropriate use of blood and the variation in practice between different hospitals and clinical teams suggest that blood usage could be further reduced without compromising and, indeed, probably improving, patient safety.[32]

What strategies are in place to minimise inappropriate transfusion?

The use of computerised physician order entry (CPOE) systems, whereby blood product prescribers enter orders using a computer system linked to the laboratory information database, provides an opportunity for education on evidence based transfusion thresholds at the time that a transfusion order is placed. Thus the CPOE can function as a clinical decision support system.[33-35]

One such system provides an onscreen warning when a prescriber tries to order products for a patient whose earlier laboratory results suggest that the transfusion is not indicated.[36] These alerts can improve patient safety and reduce unnecessary transfusions by drawing the prescriber's attention to a potentially overlooked laboratory test result or the fact that the test was not ordered. Transfusion alternatives or weight based dose adjustments can also be suggested.[37] The threshold at which an alert is triggered can vary by the indication for transfusion selected by the prescriber, so different evidence based thresholds can be used in different clinical situations. One large healthcare system in the US found that almost 25% of alerted plasma orders were cancelled, as were nearly 15% of alerted red cell orders.[38]

How can the use of transfusion be reduced?

The identification and treatment of anaemia in advance of elective surgery requires a blood count to be performed at least 30 days before surgery, rapid review of the results, and active treatment if a correctable cause of anaemia, such as iron deficiency anaemia, is identified.

In the operating theatre, several strategies can minimise or eliminate the need for allogeneic transfusion, the most effective of which is intraoperative autotransfusion.[39] This technique involves the collection of shed surgical or obstetric blood and its filtration, washing, concentration and re-administration once a sufficient quantity of blood has been collected. Only surgery involving high blood loss—such as cardiac, vascular, and orthopaedic procedures—warrants it use.[36] Current evidence indicates that intraoperative cell salvage is not contraindicated in surgery for cancer and can also be used successfully in obstetric and paediatric cases.[40] Postoperative cell salvage involves the recovery and reinfusion of blood collected by surgical drains; blood can be washed or unwashed before reinfusion.

Point of care or near care laboratory testing may help determine the need for platelet and plasma transfusions in patients undergoing surgery or those with major blood loss.[7] Use of thromboelastography has been shown to reduce blood loss during cardiac surgery and to improve the post-surgical course, but more data are needed to determine whether its use improves patient outcomes.[41]

The finding in the CRASH-2 trial that the antifibrinolytic drug, tranexamic acid, reduced mortality in trauma with no increase in thromboembolic events has increased the use of this drug in several other clinical scenarios.[42] It has now been used in traumatic brain injury,[43] and as a topical agent in total joint replacement.[44] A recent systematic review has clearly shown that antifibrinolytic drugs reduce blood loss and transfusion requirements in a wide range of surgical patients.[45]

In the medical or intensive care environment, different strategies can be used to minimise the need for transfusions. Of primary importance is to minimise phlebotomy. Blood should be collected only when the test result will guide clinical decision making. Point of care testing also has the advantage of using microlitres rather than millilitres of blood.

Active management of anaemia can avoid the need for transfusion in medical patients. Iron deficiency anaemia can usually be managed with oral iron, although some patients with chronic gastrointestinal blood loss are better managed with intravenous iron. Intravenous iron is also needed to treat functional iron deficiency (inadequate iron supply to the bone marrow in the presence of sufficient iron stores).

Immediate response for all serious transfusion reactions

- Stop the transfusion
- Assess the patient's clinical status
- Re-check patient identification details on wristband
- Verify that the product being transfused is intended for that patient
- Call for assistance
- Inform the blood transfusion laboratory and ask for advice about investigation and management

How can the involvement of patients reduce the need for transfusion?

Patient participation in transfusion decision making is central to delivering patient centred care. When a transfusion is being proposed, the patient should understand why. Verbal and written information should be presented in a way that enables the patient to understand the anticipated benefits and risks and the available alternatives. A transfusion plan should be agreed between clinician and patient and documented in the medical record. When this is not possible (for example, when the patient is unconscious), the patient's representative should participate in this process of obtaining informed consent.

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Additional educational resources

Resources for healthcare professionals

Transfusion Evidence Library (http://transfusionevidencelibrary.com)—Database that provides access to high quality evidence based information in transfusion medicine; it consists of systematic reviews and randomised controlled trials.

Serious Hazards of Transfusion (www.shotuk.org)—SHOT is the UK's haemovigilance scheme, which provides recommendations for patient safety

National Blood Transfusion Committee (NBTC), England (www.transfusionguidelines.org.uk/index.aspx?Publication=NTC&Section=27)—The NBTC promotes good transfusion practice by providing information and advice to hospitals and blood services, including on patient blood management

Murphy MF, Pamphilon D, Heddle N, eds. Practical transfusion medicine. 4th ed. Wiley-Blackwell, 2013. This book provides a user friendly comprehensive guide to transfusion medicine

Resources for patients

NHS Blood and Transplant (http://hospital.blood.co.uk/library/patient_information_leaflets/leaflets/index.asp)—Information for patients about blood transfusion

Tables

Table 1| Interpretation of the forward and reverse tests*

	Forward		Reverse	
Interpretation	**Anti-A**	**Anti-B**	**A_1 cells**	**B cells**
A	+	–	–	+
B	–	+	+	–
O	–	–	+	+
AB	+	+	–	–

+: red blood cell agglutination; –: no agglutination.

Table 2| Selection of ABO compatible red cells and platelets

Recipient ABO group	Compatible plasma	Compatible red cells	Compatible platelets	
			First choice	Second choice
A	A, AB	A, O	A, AB	B, O
B	B, AB	B, O	B, AB	A, O
O	O, A, B, AB	O	O	A, B, AB
AB	AB	O, A, B, AB	AB	A, B, O

Because platelets express the same A and B antigens as red blood cells, it is best to issue platelets that are compatible with the recipient's naturally occurring anti-A or anti-B antibodies.

Table 3| Differences between serological and electronic crossmatching

Criteria	Serological crossmatching	Electronic crossmatching
Patient population	Recipients with current or past antibodies	Recipients without current or past antibodies
Process	Red blood cells from potential donor unit are physically mixed with recipient's plasma	ABO group of potential donor unit and recipient are entered into computer
Result when selected unit is compatible	No red blood cell agglutination or haemolysis seen	The computer determines whether the selected unit is compatible with recipient's ABO type
Time taken to complete	45-60 minutes (not including the time needed to locate antigen negative units)	<5 minutes

Table 4| **Some complications of transfusion and their approximate frequency. Data taken from the Serious Hazards of Transfusion scheme**[17]

Transfusion risk	Frequency in the UK (units transfused)
ABO incompatible red cell transfusion	1/180 000
Incorrect blood component transfused (excluding ABO incompatible red cell transfusions)	1/13 000
Serious acute transfusion reaction	1/7000
Transfusion related acute lung injury	1/150 000
Transfusion associated circulatory overload	1/450 000
Transfusion associated graft versus host disease	Rare since implementation of universal leucocyte reduction of blood components in the UK in 1999
Post-transfusion purpura	Rare since implementation of universal leucocyte reduction of blood components in the UK in 1999
Transfusion transmitted infection:	
HIV	1/6.25 million
Hepatitis B virus	1/1 million
Hepatitis C virus	1/100 million

Table 5| Summary of the inappropriate use of blood from large regional and national audits of blood use in England[31]

Title	Year	Hospitals (N)	Cases audited (N)	Inappropriate use	Guideline standard
Red cells in hip replacement	2007	139/167 (83%)	7465	48% of patients	British Orthopaedic Association (2005)
Upper gastrointestinal bleeding	2007	217/257 (84%)	6750	15% of red blood cells, 42% of platelets, 27% of fresh frozen plasma	British Society of Gastroenterology (2002)
Red cell transfusion	2008	26/56 (46%) hospitals in two regions	1113	19.5% of transfusions	BCSH (2001)
Fresh frozen plasma	2009	186/248 (75%)	5032	43% of transfusions to adults, 48% to children, 62% to infants	BCSH (2004)
Platelets in haematology	2011	139/153 (91%)	3296	27% of transfusions	BCSH (2003)
Cryoprecipitate	2012	43/82 (52%) from 3 regions	449	25% of transfusions	BCSH (2004)

Data taken from the NHS Blood and Transplant/Royal College of Physicians national comparative audit of blood transfusion programme.[31]
BCSH=British Committee for Standards in Haematology.

Figure

Reaction/event	Known or postulated mechanism(s)	Presentation	Management and prevention
Febrile non-haemolytic reactions	HLA antibodies or reaction to inflammatory cytokines in transfused components (or both)	Fever, chills, rigors	Usually short lived and not serious (although unpleasant for the patient)
			Symptomatic management with antipyretics/analgesics if prolonged or severe rigors
			In process or prestorage leucocyte reduction of blood components (bedside leucocyte reduction of limited benefit)
Minor allergic reactions	Reaction to plasma proteins	Hives and itching	Minor reactions usually short lived
	Rarely, reaction to drug or foodstuff ingested by blood donor		Symptomatic management with antihistamines if needed
			If recurrent and troublesome, pretreatment with antihistamine/steroid may be indicated
Transfusion associated circulatory overload (TACO)	Circulatory (volume) overload	Dyspnoea, tachypnoea, pulmonary oedema, tachycardia, and hypertension due to hypervolaemia	Infants, older patients, and those with comorbidities (such as cardiac and renal impairment) are particularly vulnerable to TACO
			Check pre-transfusion volume status and monitor fluid balance carefully
			Transfuse only one unit at a time and review after each unit
			Diuresis between units if transfusing multiple units, but TACO may occur after only a single unit transfused
Incorrect blood component transfused, or wrong dose or rate of transfusion	Product intended for another patient or did not meet the patient's special requirements (for example, required irradiated components)	Variable–most are "no harm" events, but do have potential for serious patient harm	These are usually due to: • Procedural errors (such as failure to properly identify the intended recipient) • Poor communication between members of clinical teams or between clinical teams and the transfusion laboratory • Errors in prescription or interpretation of product type, dose, or infusion rate
	Wrong product, dose, or rate prescribed or administered		Careful patient identification and attention to detail at blood prescription, pre-transfusion specimen collection, testing, and blood administration steps
			Electronic solutions to properly identify the intended recipient and blood component

Common transfusion reactions and transfusion process problems: presentation and management