CHAPTER 7

Variation between hospitals in rates of reported transfusion reactions: is a high reporting rate an indicator of safer transfusion?

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ABSTRACT

Background and objectives

It has been suggested that the rate of reported transfusion reactions is positively correlated with safety of the transfusion chain in a hospital. We evaluated this assumption in the TRIP Dutch National Hemovigilance Office database taking reported incorrect blood component transfused as a proxy for unsafe transfusion.

Methods

Reports from 2006-2010 and annual numbers of transfused blood components from the 103 hospitals were analysed. The rate of transfusion reactions per 1000 blood components was calculated per hospital. Logistic regression analysis was performed between reporting of at least one incorrect blood component and tertile of transfusion reaction rate.

Results

Out of the 103 hospitals, 101 had complete data in some and 93 in all five years. In all, 72 had reported at least one incorrect blood component transfused; this was associated with blood use level and also with rate of reported transfusion reactions: odds ratio 4.2 (95% confidence interval 1.3-13.7) in the highest vs. the lowest tertile after adjustment for blood use level.

Conclusion

Hospitals in The Netherlands which report more transfusion reactions per 1000 units are also more likely to have reported incorrect blood component transfused. The data do not support that hospitals with a higher rate of transfusion reaction reports are safer.

INTRODUCTION

Blood transfusion is an essential part of modern health care without which many advances in medical and surgical treatment would not have been possible. Nevertheless, there is always the risk of an adverse reaction or of patient harm resulting from an error or other type of incident. Since the high-profile blood scandals of the 1980s and 1990s, national haemovigilance systems have been put in place to receive, register and analyse reports of transfusion reactions and adverse incidents in the blood transfusion chain from donor to recipient.[1-3] In the European Union, legislation requires member states to have a haemovigilance system to collate mandatory reports of serious adverse reactions and serious adverse events which may be associated with the quality or safety of blood or blood components for transfusion.[4]

The work of haemovigilance registries serves to document the occurrence of transfusion reactions as well as of errors and incidents in the transfusion chain. Haemovigilance systems highlight the risks associated with the transfusion of labile blood products, make recommendations for changes in practice and can trigger research. Some registries have presented evidence of decreases in reports of a particular type following interventions. Any decline in voluntary spontaneous reports must however be examined critically against other information, e.g. a different type of report which has remained static or increased.[5,6] The SHOT (Serious Hazards of Transfusion, the UK haemovigilance system) 2009 annual report comments: "….. the hallmark of an effective vigilance system, in that the participation in the scheme, and thus total reports, increases as users become engaged with the process while the number of serious incidents declines."[2] This suggests that reporting of non-serious events could be used as an indicator of transfusion safety when serious events are simultaneously declining, assuming that better reporting is associated with safety awareness and good surveillance of patients, thus a lower actual risk.

We studied whether the reports to the Dutch national haemovigilance system over a number of years support the assumption that a relatively high number of reported transfusion reactions in a hospital is associated with a lower likelihood of incorrect blood transfused (IBCT), taking this as a proxy for unsafe transfusion. We examined the outcome of the reporting of incorrect blood component transfused and analysed its associations with the rates of reporting transfusion reactions and different types of incidents.

MATERIALS AND METHODS

Study design

We performed a nationwide study using data that had been reported by the 103 Dutch hospitals to the TRIP (Transfusion Reactions in Patients) Dutch National Hemovigilance Office

(see below). From the database we extracted figures of reported transfusion reactions and incidents in 2006-2010. For each hospital the reported transfusion reactions and incidents were analysed in relation to the annual numbers of transfused blood components (red blood cells, platelet concentrates and fresh frozen plasma).

Transfusion setting

In The Netherlands there is a national blood service, Sanquin Blood Supply. In all but a few hospitals the blood transfusion laboratory holds a blood stock and performs blood grouping, immunohaematological investigations, blood component selection and compatibility testing, which may be in the form of electronic crossmatch.

Haemovigilance reporting

TRIP Dutch National Hemovigilance Office has been operational since 2003. Each hospital has a designated haemovigilance officer, who is generally a chief biomedical scientist or consultant haematologist. Hospitals submit reports either electronically or using a paper reporting form. Each year hospitals are asked for data on numbers of transfused blood components, at which time hospitals also confirm whether reports for the previous year are complete. Haemovigilance reporting to TRIP covers all types and levels of severity of transfusion reactions as well as errors and incidents within the transfusion chain. These are collected using standard definitions which are similar to the international definitions as developed by the International Haemovigilance Network and the haemovigilance working party of the International Society of Blood Transfusion (see Table A in the web version of this article).[7,8] The definitions for bacterial complications and that for severity grade 2 were modified slightly in 2008. Serious reactions are defined as those which are life-threatening or fatal or which cause long-term morbidity or (prolongation of) hospital admission/morbidity.

Participation in haemovigilance reporting is regarded as the professional standard both in the national transfusion guideline and by the Healthcare Inspectorate.[9] Participation by the hospitals has been approximately 95% each year from 2006. Since 2008, in accordance with European legislation, the reporting of serious adverse reactions and serious adverse events in parallel to the Healthcare Inspectorate as competent authority has been mandatory. Hospitals are also mandated to have a patient safety management system. TRIP publishes annual reports which are publicly available on the website (www.tripnet.nl). Annually there is considerable variation in the rate of reports in relation to the number of blood components transfused in a hospital.[10]

Reporting of transfusion reactions, errors and incidents occurs in three broad domains: the clinical/ward domain, the hospital transfusion laboratory and the patient safety domain. There is variation between hospital protocols regarding investigation. Notably some but not all hospitals go beyond the minimum requirements of the national guideline and perform investigations for mild non-haemolytic febrile reactions (temperature rise >1<2 °C without chills or rigors) and (mild) allergic transfusion reactions.

Study outcome measures and statistical analysis

We used submission to TRIP of one or more reports of incorrect blood component transfused by a hospital as a proxy for poor safety. Incorrect blood component transfused is defined as any case where the patient is transfused with a blood component which did not meet all the requirements according to the hospital protocol for a suitable transfusion for that patient, or that was intended for another patient. As a secondary outcome measure we analysed the reporting by a hospital of at least one unintentionally ABO-incompatible transfusion.

As reporting parameters for each hospital we calculated the rate of all reported transfusion reactions per 1000 blood components and defined tertiles of the reporting rate. We also calculated the rates per 1000 blood components of non-haemolytic transfusion reactions (≥ 2°C and/or rigors), of mild febrile reactions (>1<2°C) and of all other reported transfusion reactions with the exception of new erythrocyte allo-antibodies. Yes/no variables were defined for reporting of new allo-antibodies, of near miss and of other incidents. The presence of a transfusion safety officer was classified as none, 1-4 years or all years. We further defined four levels of annual total blood use: <3000, 3000-6000, 6000-13000 and >13000 units and three levels of the proportion of platelet units out of total blood use: <2.5%, 2.5-5% and >5%. For an assessment of any changes in absolute rates of reports we analysed 2006-8 and 2009-10 separately, including all hospitals with at least four years of data.

Statistical analyses were performed using PASW Statistics 18.0.0 (SPSS inc., part of IBM Corporation, New York). The consistency of the rate of reported transfusion reactions in a hospital from year to year was assessed by performing linear regression of the rate of transfusion reactions in 2010 with that in 2009 and 2006-9 for all hospitals with four or five years of complete data, adjusting for the level of blood use. This was repeated without the adjustment but with exclusion of the hospitals transfusing fewer than 3000 units per year, as verification that the result was not driven by the smallest hospitals being least likely to have reported incorrect blood component transfused. To study the associations between reporting parameters and incorrect blood component transfused as well as reported ABO-incompatible transfusion we performed logistic regression with adjustment for blood use levels (categorical).

RESULTS

Information on both transfusion reactions and total transfused units was available from 101 of the 103 hospitals for one or more years in 2006-10, covering approximately 95% of national blood use. Table 1 summarises key figures about reporting according to the hospitals' total blood use level.

Table 1. General characteristics of blood use and reporting, 2006-10

Hospital blood use level[a]	Number of hospitals (n=101)	Total number of units transfused	Total reports[b]; rate per 1000 units	Interquartile range of hospital rates	IBCT[c] reports; rate per 1000 units	ABO-incomp. reports; rate per 1000 units
<3000	34	336,087	1141; 3.39	1.35-4.32	36; 0.11	4; 0.012
3000-6000	21	630,605	2047; 3.25	1.76-4.56	51; 0.08	9; 0.014
6000-13000	32	993,668	3351; 3.59	2.14-4.73	74; 0.07	9; 0.010
>13000	14	1,384,157	4611; 3.33	2.21-4.74	144; 0.10	16; 0.012

[a] Average total units of blood components per year (red blood cells, apheresis or 5-donor pooled buffy coat platelets, fresh frozen plasma)
[b] Total of reported transfusion reactions, new allo-antibodies, errors and incidents
[c] Incorrect blood component transfused

Hospitals' consistency from year to year

Ninety-nine hospitals had four (n=6) or five (n=93) years of data and were included in this analysis. Table 2 presents the explained variance in individual hospitals' rates of reported reactions in 2010 in comparison to rates of preceding years. Hospitals' previous rates were good predictors of the 2010 transfusion reaction rate. Comparing the 2010 to the 2009 rate and that in 2006-8 with adjustment for blood use level gave a value of R^2 of 0.55, indicating that approximately 55% of variance in the rate of reporting transfusion reactions is explained by the rates in the previous years. A similar result was obtained if only the hospitals transfusing over 3000 units per year were included.

Table 2. Consistency of transfusion reaction reporting rate in hospitals

Linear regression with rate of transfusion reactions in 2010	All hospitals (n=99)		Hospitals transfusing >3000 units p.a. (n=66)	
	R^2	Significance	R^2	Significance
2009 rate	0.509	P<0.001	0.301	P<0.001
2006-2008	0.377	P<0.001	0.481	P<0.001
2009, 2006-2008	0.553	P<0.001	0.498	P<0.001
2009, 2006-2008 and blood use level	0.553	P<0.001		

Trends in time

The total rate of reports to TRIP rose from 3.20 to 3.82 per 1000 blood components transfused from 2006-8 to 2009-2010, with the total number of transfusion reactions rising from 2.81 to

3.34 per 1000 units (Table 3). This is partly explained by increased reports of allo-antibodies (from 0.93 to 1.20 per 1000 units). There were nonsignificant rising trends for reporting febrile reactions and for the total of transfusion reactions in other categories (data not shown). The overall rate of incorrect blood component transfused remained similar from 2006-8 to 2009-2010 (0.096 and 0.092 per 1000 units in 2006-2008 and 2009-2010 respectively), as did that for ABO-incompatible transfusion (0.011 and 0.013 per 1000 units respectively). There was a rising trend of the rate of incorrect blood component transfused and unintended ABO-incompatible transfusion in the hospitals with the lowest rate of reported transfusion reactions and a declining trend in those with the highest rate (Table 3).

Table 3. Rates of reported transfusion reactions per period according to level of transfusion reaction reports

Level of hospital total transfusion reaction reporting[a]	2006-8	2009-10	Difference in rate (95% confidence interval)	
Lowest (<1.8/1000 units; n=28)				
Total transfusion reactions	1.19	1.32	0.13	(–0.05-0.30)
Incorrect blood component transfused	0.053	0.075	0.022	(–0.018-0.062)
ABO incompatible	0.011	0.019	0.008	(–0.011-0.027)
Middle tertile (1.8 - 3.7/1000 units; n=37)				
Total transfusion reactions	2.36	3.14	0.78	(0.60-0.95)
Incorrect blood component transfused ABO	0.090	0.080	–0.010	(–0.040-0.020)
incompatible	0.011	0.015	0.004	(-0.008-0.017)
Highest tertile (>3,7/1000 units; n=34)				
Total transfusion reactions	4.38	4.87	0.49	(0.23-0.76)
Incorrect blood component transfused	0.129	0.119	–0.011	(–0.053-0.032)
ABO incompatible	0.011	0.007	–0.004	(–0.015-0.007)
Overall (n=99)				
Total transfusion reactions	2.81	3.34	0.53	(0.40-0.65)
Incorrect blood component transfused	0.96	0.92	–0.004	(–0.026-0.018)
ABO incompatible	0.011	0.013	0.002	(–0.005-0.010)

[a] Rate of reports per 1000 blood components transfused; hospitals are classified according to the average rate of transfusion reaction reporting in 2006-2010

Whole period: odds of incorrect blood component transfused

The odds ratio for at least one report of incorrect blood component transfused rose with hospitals' annual blood use level and increased independently with higher levels of total transfusion reaction reports. The odds ratio (OR) was 4.2 (95% confidence interval (CI) 1.3-13.7) for the highest vs. the lowest tertile after adjustment for blood use level (Table 4). Reported incorrect blood component transfused was also significantly associated with the highest tertile of mild non-haemolytic febrile reactions (>1 <2°C) and with a hospital's reporting of allo-antibodies, near miss and/or other incidents. There was no association with platelet use level or with the proportion of serious reactions.

Table 4. Hospital reporting parameters and odds ratio (OR) of reported incorrect blood component transfused

Parameter (no. of hospitals; total n=101)		Incorrect blood component transfused (IBCT; ≥ 1 per hospital)					
		No (%) with IBCT		Crude OR (95% confidence interval)		Adjusted OR[b] (95% confidence interval)	
Blood use level[a]							
<3000	(34)	19	56%	1	(0.9-8.0)	N.A.	
3000-6000	(31)	24	77%	2.7	(0.8-9.0)		
6000-13000	(22)	17	77%	2.7	(0.9-24.5)		
>13000	(14)	12	86%	4.7			
Total transfusion reaction reporting level[c]							
<1.8	(30)	16	53%	1		1	
1.8-3.7	(37)	28	76%	2.7	(0.96-7.7)	2.5	(0.8-7.3)
>3.7	(34)	28	82%	4.0	(1.3-12.7)	4.2	(1.3-13.7)
NHTR reporting level[c,d]							
<0.52	(32)	20	63%	1		1	
0.52-0.80	(35)	27	77%	2.0	(0.7-5.9)	1.6	(0.5-4.8)
>0.80	(34)	25	74%	1.7	(0.6-4.7)	1.7	(0.6-5.0)
Mild febrile reaction[c,e]							
<0.25	(34)	19	55%	1		1	
0.25-0.66	(31)	24	77%	2.7	(0.9-8.0)	2.6	(0.8-8.3)
>0.66	(36)	28	80%	3.3	(1.1-9.5)	4.7	(1.5 - 15)
Transfusion reactions excluding allo-antibodies and febrile reactions[c]							
<0.37	(30)	20	66%	1		1	
0.37-0.73	(37)	24	65%	0.9	(0.3-2.5)	1.0	(0.3-2.8)
>0.73	(34)	28	82%	2.3	(0.7-7.5)	2.3	(0.7-8.1)
Serious-nonserious ratio							
0-0.04	(49)	32	65%	1		1	
0.04-0.08	(32)	26	81%	2.3	(0.8-6.7)	1.8	(0.6-5.5)
>0.08	(20)	13	70%	1.2	(0.4-3.8)	1.1	(0.3-3.7)
Reporting of near miss							
No	(62)	35	57%	1		1	
Yes	(39)	37	95%	14.3	(3.2-65)	14.2	(3.0-66)
Reporting of other incident							
No	(47)	22	47%	1		1	
Yes	(54)	50	93%	14.2	(4.4-46)	15.4	(4.2-56)
Allo-antibody reporting							
No	(27)	11	41%	1		1	
Yes	(74)	61	82%	6.8	(2.8-16)	5.8	(2.1-16)
Transfusion safety officer							
No	(23)	13	57%	1		1	
1 -4 years	(15)	12	80%	3.1	(0.7-13)	2.8	(0.6-13)
All years	(63)	47	75%	2.3	(0.8-6.1)	2.2	(0.8-6.1)

[a] Average total units of blood components per year (red blood cells, platelets, fresh frozen plasma)
[b] Odds Ratio adjusted for blood use in four levels
[c] rate of reports per 1000 blood components transfused
[d] non-haemolytic transfusion reaction (≥ 2°C and/or chills/rigors); see definitions in Table A
[e] >1<2 °C; see definitions in Table A

In a multivariable logistic regression model which included blood use level, the presence of a transfusion safety officer and the reporting variables, reported incorrect blood component transfused remained independently associated with reporting of allo-antibodies, with near miss, and with other incidents; it was also associated with mild febrile reaction reporting (OR 2.2, 95% CI 1.0-5.1; data not shown). Independently of the reporting of incorrect blood component transfused, the parameters representing a relatively high rate of reports tended to be associated with each other as well as with the presence of a transfusion safety officer.

Reported ABO-incompatible incorrect transfusion showed similar but weaker associations compared to all reported incorrect blood component transfused, both with and without adjustment for hospital blood use level (data shown in Table B in the web version of this article); because of the lower number of these reports the confidence intervals are wider.

DISCUSSION

In this study we first examined the consistency of hospitals' rates of reported transfusion reactions. It was found that approximately 55% of the variation could be explained from the rates in earlier years thus there is considerable consistency from year to year. This probably reflects hospitals' stable patient mix, transfusion reaction protocols and other factors relevant for reporting practice, e.g. safety awareness in the blood transfusion laboratory, nurse alertness and organisational safety culture. The consistency supports our pooling of each hospital's data over several years.

As our main study question we investigated the hypothesis that higher numbers of less serious reports are an indicator for fewer very serious adverse transfusion reactions and events, as proposed in the 2009 SHOT Annual Report. We examined the reporting of incorrect blood component transfused as a proxy for unsafe transfusion and observed that this is more likely in hospitals which have a relatively high rate of reported transfusion reactions or which report to TRIP on allo-antibodies, on near miss or other incident(s). The breakdown of "total transfusion reactions" given in Table 4 shows that the positive association of reported incorrect transfusions with level of reports of transfusion reactions may be driven more by the reports of mild non-hemolytic transfusion reactions than by those of non-hemolytic transfusion reactions. None of the associations is negative, i.e. none supports the hypothesis. While we cannot exclude the possibility that the hospitals with a higher rate of transfusion reactions may have more incorrect transfusions to report, a more likely explanation is that reporting of incorrect blood component transfused is more reliable in hospitals with strong awareness and reporting culture in the clinical areas, in the blood transfusion laboratory and in the domain of patient safety. In any case the data do not provide evidence that hospitals with higher rates of reported transfusion reactions are safer. The most serious incorrect transfusion events, those where

an ABO-incompatible unit is transfused, showed similar but non-significant associations. We observed no change in the overall rate of reported incorrect blood component transfused or of ABO-incompatible transfusions, nor was this demonstrated in the subgroup of hospitals with higher rates of reported transfusion reactions. The suggestive declining trend in the group with most transfusion reactions (Table 3) is driven by a small number of hospitals and should be interpreted with extreme caution.

The SHOT comment refers to trends noted at the national level and could be explained by increased reporting by some hospitals coinciding with national improvement from adoption of recommendations. The question posed in this study examines whether the trend holds at the hospital level: if improvements are detectable, is it in the hospitals where rates of reported transfusion reactions are higher, where one regards this as an indicator that haemovigilance reporting is functioning well. What can explain our failure to demonstrate this – plausible and attractive – trend described by SHOT? Firstly, national haemovigilance reporting is a tool for monitoring events and not a direct means of improving safety. The Dutch system, launched in 2003, is relatively young and to date, neither the occurrence of the most serious reactions (Grade 3 and 4) nor that of ABO incompatible transfusions has shown any decline in the TRIP data. With the exception of TRALI following the male-only plasma intervention[6] there has not yet been any improvement as regards the occurrence of serious transfusion reactions, but more notably also not of errors.

The SHOT haemovigilance system was launched in 1996 and the declining trend of the proportion of transfusion-related serious morbidity and deaths has only gradually become apparent: the number of ABO incompatible red blood cell transfusions has dropped since approximately 2004 compared to the preceding eight years. The apparent improvement is ascribed chiefly to better application of safety procedures and recommended practices as laid down in national guidelines.[11] Similarly the French haemovigilance system, active since 1994, reports that the rate of ABO-incompatible transfusions leading to reactions was lower in 2006-2010 than in 2000-2005, although the difference does not reach statistical significance.[12] In France the bedside ABO compatibility check by the transfusing nurse has been in place since 1985 and the bedside verification of patient and unit identity was designated as a distinct mandatory task by a ministerial circular in 2003. The trend of reduction of the most serious events in the world's two oldest haemovigilance systems would be consistent with the explanation that it takes time for improved transfusion safety awareness, extra training and gradual implementation of recommended practices to lead to such improving trends.

The Dutch figures in absolute terms show that we must not seek the explanation in a greater safety level from the outset. The rate of total reported incorrect blood component transfused

(2010 data) is 6.9 per 100,000 units distributed in the United Kingdom,[13] probably similar in France (total of "serious adverse events with transfusion of LBP declared on the AR as Grade 0" and "serious adverse events with transfusion of LBP that caused an RAE of a grade >0" is 5.6 per 100,000 units[12]) and 8.3 in The Netherlands. Ireland to our knowledge has the highest national rate of reported incorrect blood component transfused at 45 per 100,000 units[14] (number of "SAE/IBCT" minus unnecessary transfusions and storage/expiry problems). The rates of ABO incompatible transfusion over the last four years are 0.38 in the UK, 0.36 in France, 1.13 in Ireland and 1.11 in The Netherlands (rates calculated from the annual reports [2,9,11,12]). Of all events, the ABO-incompatible incorrect transfusions are among the most serious so should be least subject to under-reporting. The cited figures make it likely that reporting of incorrect blood component is not exhaustive in The Netherlands and secondly that there is room for improvement in the avoidance of ABO incompatible transfusions. We are not of the opinion that variation in reporting level could be reduced by regulatory requirements. In The Netherlands the overall rate of reports in 2006-10 ran at approximately 3 per 1000 blood components transfused, which is similar to or slightly above that in France with its mandatory system for reporting all transfusion reactions as well as serious adverse events in the transfusion chain. Regional variation in the rate of reporting has been noted both in the UK with reporting of only serious events but comparable regulations to The Netherlands, and France.[12,13]

A strength of this study is that it reviews several years of data in a haemovigilance system with near-complete participation. To our knowledge it is the first thorough analysis by a haemovigilance system of whether having more reports of transfusion reactions is an indicator for better hospital-level transfusion safety. It suggests greater reliability of reporting incorrect blood component transfused in hospitals with high levels of reports in various domains. In so far as success for a haemovigilance system depends on capturing information which will provide relevant signals to the transfusion professionals, this is in line with the statement that a successful haemovigilance system receives increasing numbers of less serious reports.

The study is limited by the fact that we lacked knowledge of what specific hospital factors influenced reporting on the one hand, and transfusion safety on the other. A further possible limitation is the change of definitions in the course of the study period, however this did not affect the specific categories from which the analysed parameters were calculated.

The cited comment in the SHOT 2009 report referred to the ratio of reports of very serious morbidity or death to the less serious events, as well as to a progressive (absolute) decline of ABO incompatible red cell transfusions. Our use of reported incorrect blood component transfused as an indicator for unsafe transfusion is a slightly different approach. These events (and among them, the ABO incompatible transfusions) constitute the most clearly

avoidable transfusion hazards, but are only one way in which transfusion can be unsafe. Avoidable transfusion reactions as another possible indicator merit future study, however only a minority of transfusion reactions (e.g. transfusion-associated circulatory overload) are currently avoidable by improvements in the clinical part of the transfusion chain. Avoidance of unnecessary transfusions represents a third dimension of safety with potential for improving patient outcomes and saving money. Reports of errors and incidents involving unnecessary transfusion are captured by some haemovigilance systems. Our haemovigilance system is soon to collaborate with hospitals to collect and provide benchmarking of basic indicators on observance of transfusion triggers.

CONCLUSION

In conclusion, a high reporting rate of transfusion reactions is associated with increased odds of reporting incorrect blood component transfused. This may be explained by better surveillance and more complete reporting, although it cannot be excluded that hospitals with higher rates of transfusion reactions may have more incorrect transfusions to report. The data do not support the hypothesis that a higher rate of reporting transfusion reactions is an indicator for greater safety in the transfusion chain.

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REFERENCE LIST

(1) Carlier M, Vo Mai MP, Fauveau L, Ounnoughene N, Sandid I, Renaudier P: [Seventeen years of haemovigilance in France: assessment and outlook]. Transfus Clin Biol 2011; 18(2):140-150.

(2) Taylor C (Ed.), Cohen H, Mold D, Jones H. et al. on behalf of the Serious Hazards of Transfusion Steering Group. SHOT Annual Report 2009; 2010.

(3) de Vries RR, Faber JC, Strengers PF: Haemovigilance: an effective tool for improving transfusion practice. Vox Sang 2011; 100(1):60-67.

(4) European Commission: Directive 2002/98/EC of the European Parliament and of the council setting standards of quality and safety for the collection, testing, processing, storage and distribution of human blood and blood components; 2003.

(5) Robillard P, Delage G, Karl IN, Goldman M: Use of hemovigilance data to evaluate the effectiveness of diversion and bacterial detection. Transfusion 2011; 51(7):1405-1411.

(6) Wiersum-Osselton JC, Middelburg RA, Beckers EA, van Tilborgh AJ, Zijlker-Jansen PY, Brand A, van der Bom JG, Schipperus MR: Male-only fresh-frozen plasma for transfusion-related acute lung injury prevention: before-and-after comparative cohort study. Transfusion 2011; 51(6):1278-1283.

(7) TRIP definitions, https://www.tripnet.nl/pages/en/definities.php, accessed 25 March 2012.

(8) Robillard P on behalf of the Haemovigilance Working party of the International Society for Blood Transfusion. Proposed standard definitions for surveillance of noninfectious adverse transfusion reactions (2011). Available at http://www.ihn-org.com/wp-content/uploads/2011/06/ISBT-definitions-for-non-infectious-transfusion-reactions.pdf and http://www.isbtweb.org/fileadmin/user_upload/WP_on_Haemovigilance/ISBT_definitions_final_2011__4_.pdf (Accessed 25 March 2012).

(9) CBO Quality Organisation for Health Care, Blood Transfusion Guidelines (2011), English translation in preparation. Dutch version available at http://www.cbo.nl/Downloads/1420/richtlijn%20bloedtransfusie%2011-10-2011.pdf, accessed 25 March 2012

(10) Transfusion Reactions in Patients (TRIP) Dutch National Hemovigilance Office on behalf of the TRIP board: TRIP Annual Report 2010; ISBN 978-90-78631-12-5, 2011.

(11) Murphy MF, Stanworth SJ, Yazer M. Transfusion practice and safety: current status and possibilities for improvement. Vox Sanguinis 2011; 100:48-59.

(12) Agence française de securité sanitaire de produits de santé (Afssaps): Rapport d'Activité Hémovigilance 2010; http://www.afssaps.fr/content/download/34794/454597/version/2/file/Rapport-Hemovigilance-2010.pdf (accessed 25 March 2012).

(13) Knowles S (Ed.) and Cohen H on behalf of the Serious Hazards of Transfusion Steering Group. The 2010 Annual SHOT Report; 2011.

(14) National Haemovigilance Office (NHO): NHO Report 2008/2009; http://www.giveblood.ie/Clinical_Services/Haemovigilance/Publications/NHO_Report_2008_2009.pdf (accessed 25 March 2012).

Table A. TRIP (2008) definitions of transfusion reactions and incidents (published online only)

Nonhaemolytic transfusion reaction (NHTR)

Rise in temperature of ≥ 2°C (with or without rigors/chills) during or in the first two hours after a transfusion, with no other relevant symptoms or signs; OR rigors/chills with or without a rise in temperature within the same time limits. No evidence (biochemical or blood group serological) for haemolysis, and no alternative explanation.

Mild (nonhaemolytic) febrile reaction

Rise in temp. >1°C (<2°C) during or in the first two hours after a transfusion with no other relevant symptoms or signs; optional reporting to TRIP. Haemolysis testing and bacteriology negative if performed.

Acute haemolytic transfusion reaction

Symptoms of haemolysis occurring within a few minutes of commencement of until 24 hours subsequent to a transfusion: one or more of the following: fever/chills, nausea/vomiting, back pain, dark or red urine, decreasing blood pressure or laboratory results indicating haemolysis within the same period.

Biochemical haemolysis testing positive; blood group serological testing possibly positive; bacteriology negative.

Delayed haemolytic transfusion reaction

Symptoms of haemolysis occurring longer than 24 hours after transfusion to a maximum of 28 days: unexplained drop in haemoglobin, dark urine, fever or chills etc.; or biochemical haemolysis within the same period. Biochemical testing and blood group serology confirm this.

If new antibodies are found without biochemical confirmation of haemolysis, report as new allo-antibody.

TRALI (Transfusion-related acute lung injury)

Dyspnoea and hypoxia within six hours of the transfusion; chest X-ray shows bilateral pulmonary infiltrates.

There are negative investigations (biochemical or blood-group serological) for haemolysis, bacteriology is negative and no other explanation exists. Depending on the findings of tests of leukocyte serology, report is classified as immune-mediated or unknown cause.

Transfusion-associated circulatory overload (TACO)

Dyspnoea, orthopnoea, cyanosis, tachycardia >100/min. or raised central venous pressure (one or more of these signs) within six hours of transfusion, usually in a patient with compromised cardiac function. Chest X-ray consistent.

Anaphylactic transfusion reaction
Rapidly developing reaction occurring within a few seconds to minutes after the start of transfusion, with features such as airway obstruction, in and expiratory stridor, fall in blood pressure ≥ 20 mm Hg systolic and/or diastolic, nausea or vomiting or diarrhoea, possibly with skin rash.

Haemolysis testing and bacteriology negative, test for IgA and anti-IgA.

Other allergic reaction
Allergic phenomena such as itching, redness or urticaria but without respiratory, cardiovascular or gastrointestinal features, arising from a few minutes of starting transfusion until a few hours after its completion. Haemolysis testing and bacteriology negative if performed.

New allo-antibody
After receiving a transfusion, demonstration of clinically relevant antibodies against blood cells (irregular antibodies, HLA or HPA antibodies) that were not present previously (as far as is known in that hospital).

Post-transfusion bacteraemia/sepsis
Clinical symptoms of bacteraemia/sepsis arising during, directly after or some time subsequent to a blood transfusion, for which there is a relevant, positive blood culture of the patient with or without a causal relation to the administered blood component.

Post-transfusion viral infection
A viral infection that can be attributed to a transfused blood component as demonstrated by identical viral strains in donor and recipient and where infection by another route is deemed unlikely.

Haemosiderosis
Iron overload induced by frequent transfusion with a minimum ferritin level of 1000 micrograms/l, with or without organ damage.

Post-transfusion purpura (PTP)
Serious self-limiting thrombocytopenia possibly with bleeding manifestations (skin, nose, gastrointestinal, urinary tract, other mucous membranes, brain) 1-24 days after a transfusion of a red cell or platelet concentrate, usually in a patient who has been pregnant. Investigations: HPA antibodies and HPA typing of patient.

Transfusion-associated graft versus host disease (TA-GvHD)
Clinical features of graft versus host disease such as erythema which starts centrally, watery diarrhoea, fever and rise in liver enzymes 1-6 weeks (usually 8-10 days) after transfusion of a T-cell containing (non-irradiated) blood component. Skin (and liver) biopsies can support diagnosis.

Other transfusion reaction
Transfusion reaction which does not fit into the categories above

Incorrect blood component transfused (IBCT)
All cases in which a patient was transfused with a component that did not fulfil all the requirements of a suitable component for that patient, or that was intended for a different patient. TRIP requests institutions to report these cases, even if there are no adverse consequences for the patient.

Positive bacterial screen
The blood service reports a positive bacteriological screen, but bacterial contamination of the relevant material is not confirmed by a positive culture result on the same material or other products made from the same donation

Bacterial contamination of a blood component
Relevant numbers of bacteria in a (remnant of) blood component or in the bacterial screen bottle of a platelet component, or in material from the same donation, demonstrated in the approved way with laboratory techniques, preferably including typing of the bacterial strain or strains.

Look-back by the supplier
Retrospective notification of a possibly infectious donation, leading to investigation of the recipient for that infection, but where no infection is demonstrated in the recipient.

Viral contamination of blood component
Retrospective analysis by Sanquin demonstrates viral contamination of an already administered blood component, previously screened and found negative.

Near miss
Any error that, if undetected, could have led to a wrong blood group result or issue or administration of an incorrect blood component, and which was detected before transfusion.

Please indicate where the error arose, any further errors or failed checks, and how the error was discovered.

Haemolysed product
Occurrence of clinical signs / symptoms in a patient associated with the presence of free haemoglobin in a transfused product (from recovered blood).

Heparinisation
Clotting problems associated with incomplete removal of added heparin during automated blood recovery method.

Other incident
Error or incident in the transfusion chain that does not fit into any of the above categories, for instance patient transfused whereas the intention was to keep the blood component in reserve, or transfusing unnecessarily on the basis of an incorrect Hb result or avoidable wastage of a blood component.

Table B. Hospital reporting parameters and odds ratios (OR) of ABO incompatible transfusion report(s) (published online only)

Parameter (no. of hospitals)		ABO incompatible transfusion reported (≥ 1 per hospital)					
		No (%) with ABO-incompatible Tf		Crude OR (95% CI)		Adjusted OR[#] (95% CI)	
Blood use level*							
<3000	(34)	3	9%	1		N.A.	
3000-6000	(31)	8	26%	3.6	(0.9-15.1)		
6000-13000	(22)	5	23%	3.0	(0.6-14.3)		
>13000	(14)	9	64%	18.6	(3.7-93)		
Total transfusion reaction reporting level[c]							
<1.8	(30)	6	20%	1		1	
1.8-3.7	(37)	11	30%	1.7	(0.5-5.3)	1.4	(0.4-4.9)
>3.7	(34)	8	24%	1.2	(0.4-4.1)	1.1	(0.3-4.0)
NHTR reporting level[c, d]							
<0.52	(32)	7	22%	1		1	
0.52-0.80	(35)	11	31%	1.6	(0.5-4.9)	0.89	(0.26-3.0)
>0.80	(34)	7	21%	0.93	(0.28-3.0)	0.67	(0.18-2.5)
Mild febrile reaction[c,e]							
<0.25	(34)	5	15%	1		1	
0.25-0.66	(31)	13	42%	4.2	(1.3-13.7)	5.1	(1.3-19.9)
>0.66	(36)	7	19%	1.4	(0.4-14.9)	2.8	(0.7-12)
Transfusion reactions excl. allo-antibodies and febrile reactions[c]							
<0.37	(30)	4	13%	1		1	
0.37-0.73	(37)	11	30%	2.8	(0.8-9.8)	2.8	(0.7-10.6)
>0.73	(34)	10	29%	2.7	(0.7-9.8)	1.8	(0.4-7.8)
Serious-nonserious ratio							
0-0.04	(49)	8	16%	1		1	
0.04-0.08	(32)	10	31%	2.3	(0.8-6.8)	1.7	(0.5-5.4)
>0.08	(20)	7	35%	2.8	(0.8-9.1)	2.6	(0.7-10.2)
Reporting of near miss							
No	(62)	11	18%	1		1	
Yes	(39)	14	36%	2.6	(1.0-6.5)	2.0	(0.7-5.6)
Reporting of other incident							
No	(47)	6	13%	1		1	
Yes	(54)	19	35%	3.7	(1.3-10.3)	2.7	(0.9-8.4)
Allo-antibody reporting							
No	(27)	2	7%	1		1	
Yes	(74)	23	31%	5.6	(1.2-25.9)	4.3	(0.8-21.7)
Transfusion safety officer							
No	(23)	3	13%	1		1	
1 or more years	(15)	6	40%	3.6	(1.2-10.5)	4.4	(0.8-24.6)
Yes	(63)	16	25%	1.8	(0.8-4.0)	2.0	(0.5-8.4)
Period (n=99)							
2008-8	(99)	16	16%	1		1	
2009-10	(99)	15	15%	0.9	(0.4-2.0)	0.9	(0.4-2.1)

[a] Average total units of blood components per year (red blood cells, platelets, fresh frozen plasma)
[b] adjusted for blood use in four levels
[c] rate of reports per 1000 blood components transfused
[d] NHTR-non-haemolytic transfusion reaction
[e] >1 <2 °C