TRANSFUSION ERROR SURVEILLANCE SYSTEM (TESS)

2012 - 2016

REPORT

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Également disponible en français sous le titre :
Système de surveillance des erreurs transfusionnelles (SSET) : Rapport 2012-2016

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Publication date: March 2021

Suggested citation: Public Health Agency of Canada. *Transfusion Error Surveillance System (TESS), 2012-2016 Report*. Centre for Communicable Diseases and Infection Control, Infectious Disease Prevention and Control Branch, Public Health Agency of Canada; 2021.

Cat.: HP40-77/2021E-PDF
ISBN: 978-0-660-37635-6
Pub.: 200468

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Foreword

The Centre for Communicable Diseases and Infection Control (CCDIC) of the Public Health Agency of Canada (PHAC) is pleased to present the Transfusion Error Surveillance System (TESS), 2012-2016 Report. This report presents transfusion error surveillance data submitted between 2012 and 2016 by participating Canadian sentinel hospitals.

The TESS is a voluntary surveillance system established by PHAC to capture non-nominal data on errors occurring at any point in the transfusion chain, including those detected before or after the transfusion of blood components and fractionated plasma products to the patient and those that may or may not have resulted in adverse transfusion reactions. The overall objective is to identify potential areas for improvement in the transfusion chain and ultimately, improve transfusion processes and patient safety in Canada.

CCDIC, in partnership with participating provinces and territories, is responsible for the collection, management, and analysis of data, and the production of reports to support evidence-based public health decisions.

Acknowledgment

The development of the Transfusion Error Surveillance System (TESS) would not have been possible without the collaborative support and continued commitment of the many transfusion safety officers, medical laboratory technologists, and other healthcare professionals in hospitals and Blood Transfusion Services. Their dedication to reducing errors and increasing patient safety has led to the collection and analysis of 2012-2016 TESS data.

Abbreviations

AHTR	Acute Haemolytic Transfusion Reaction
DC	Distributor Codes
DHTR	Delayed Haemolytic Transfusion Reaction
FNHTR	Febrile Non-Haemolytic Transfusion Reaction
IM	Inventory Management
IVIG	Intravenous Immunoglobulin
MS	Miscellaneous
PC	Product Check-in
PR	Product Request
PS	Product Selection
RP	Request for Pick-up
SC	Sample Collection
SH	Sample Handling
SOP	Standard Operating Procedure
SR	Sample Receipt
ST	Sample Testing
TACO	Transfusion Associated Circulatory Overload
TESS	Transfusion Error Surveillance System
UI	Unit Issue
UM	Unit Manipulation
US	Unit Storage
UT	Unit Transfusion

Executive Summary

The Transfusion Error Surveillance System (TESS) was initiated by the Public Health Agency of Canada (PHAC) in 2005, in conjunction with 11 hospitals, to monitor errors occurring in the transfusion chain. Currently, 15 hospitals in 4 Canadian provinces and territories (P/Ts) participate in the surveillance as sentinel sites and report all errors to PHAC on a quarterly basis.

Overall, a total number of 50,925 errors were reported from 2012 to 2016. The most frequent errors reported were related to sample collection (SC) (n=17,485; 34.3%), unit transfusion (UT) (n=7,040; 13.8%), and sample handling (SH) (n=5,721; 11.2%). The majority (n=48,256; 94.8%) of all errors did not reach the patient (near-miss events).

Of the 2,669 errors that reached the patient (actual events), approximately 97.5% (n=2,602) caused no harm at the time of reporting. Two point five percent (n=67) caused some harm to the patient (recipient), which were errors related to product request (PR) (n=49), UT (n=15), and product selection (PS) (n=2), and sample testing (ST, n=1). These four types of errors were linked to 45 cases of transfusion-associated circulatory overload (TACO), 11 cases of febrile non-haemolytic reactions, 3 cases of minor allergic reactions, 2 cases of acute haemolytic reaction, 2 cases of delayed serologic reaction, 1 cases of incorrect dose administered, 1 case of IVIG headache, and 1 case of ABO incompatibility. Of the 2,669 errors that reached the patient, 29.7% (n=791) were related to the request for blood product pick-up (RP), 20.6% (n=548) to PR, and 19.2% (n=513) to UT. From 2012 to 2016, there was a decreasing trend in the annual rates of SC, SH, and ST errors that reached the patient.

The TESS data demonstrate that blood transfusions are safe in participating Canadian hospitals, as only 0.1% (n=67) of all errors reported to the TESS resulted in harm. No cases resulted in death. The TESS data also highlight potential areas for improvement. For example, most errors that escaped detection occurred during PR and UT processes. Thus, more system and process innovations, knowledge translations, attention, and awareness are required during these two processes to improve the safe delivery of blood to Canadians.

Data collected through the TESS can help facilitate the identification and evaluation of preventive measures designed to improve the transfusion process and patient safety.

Introduction

Blood transfusion is a very safe and effective treatment when performed according to hospital policies and procedures. Transfusion safety depends on a complex multistep process, beginning with the decision to order an appropriate blood component or fractionated plasma product. The process is then followed by sample collection, labeling, transportation, handling, storing, pre-transfusion testing, issuing and the transfusion of blood components and fractionated plasma products to the patient. Due to robust precautionary measures, the risk of an adverse reaction following transfusion is very low in developed countries, including Canada. However, errors may occur at each step of the multistep transfusion process and these errors can cause administrative delays in the transfusion procedure, product wastage, sample re-collection, unnecessary transfusions, adverse transfusion reactions, and death.[1] These errors have the potential to negatively impact patient safety and to increase costs of the healthcare system. Therefore, mitigating the risk of errors is a fundamental step in improving patient safety.

In 2005, the Transfusion Error Surveillance System (TESS) was initiated by the Public Health Agency of Canada (PHAC) as a sentinel pilot surveillance system with 11 hospitals [2, 3]. The objective was to monitor the incidence and trends of errors that can occur at any step in the transfusion chain. Currently, 15 hospitals across four provinces (Québec, British Columbia, Ontario, and Nova Scotia) participate in the TESS. The TESS data serve as a complement to data collected through the Transfusion Transmitted Injuries Surveillance System (TTISS), which monitors the incidence of adverse reactions following blood transfusion in Canada [4]. In addition, numerous other non-sentinel hospitals submit data to TESS for their own use of the data; their non-sentinel data are not reported here.

Participating hospitals provide anonymous data on a quarterly basis using a secure electronic web-based server maintained by the PHAC. In addition to data on errors, participating hospitals provide the number of blood components or fractionated plasma products received, requested, prepared, and issued, and the number of samples received and tests performed, which are used as denominator for calculating error rates. This allows for comparing error rates between sites and hospital locations/wards as well as across similar hospital sizes or transfusion practices.

The TESS allows hospitals to identify the points along the transfusion chain where errors most commonly occur, including those that are detected prior to the blood transfusion. Corrective action can be taken to minimize errors in those areas and prevent adverse reactions. Following the implementation of intervention measures, future TESS data may be used to evaluate the effectiveness of such measures. Findings may also provide comparable benchmarks for other hospitals in Canada and for international comparisons.

Methods

Details on the TESS's methods, including definitions, data collection, classification, categorization data management, data quality control, and analysis of errors, have already been described in previous reports [2, 3].

Definition of error:

Errors reported through the TESS are defined as unexpected and unplanned deviations from standard operating procedures or applicable laws and regulations, usually attributable to a human or system problem that could:

- Adversely affect the safety, efficacy or quality of blood components, and fractionated plasma products (plasma derivatives) as well as the safety of recipients, and/or;
- Result in inefficiencies or cost-ineffective care.

Errors are classified as near-miss events or actual events:

- Near-miss events are classified into two mutually exclusive categories, planned or unplanned discovery, based on whether the errors were detected by a standardized mechanism/process or by chance, respectively:
    - Planned discovery occurs when a near-miss event was detected by a standardized mechanism/process;
    - Unplanned discovery occurs when a near-miss event was detected by chance.
- Actual events refer to an error or deviation from standard procedures or policies that reached or caused impact to the patient. Actual events are classified into two mutually exclusive categories, based on whether or not they caused any harm to the patient:
    - **Harm**: The patient had an unintended or inadequate response to transfusion or suffered a negative impact or adverse transfusion reaction as a result of the error;
    - **No harm**: The patient did not have any known negative clinical consequences at the time of reporting as a result of the error.

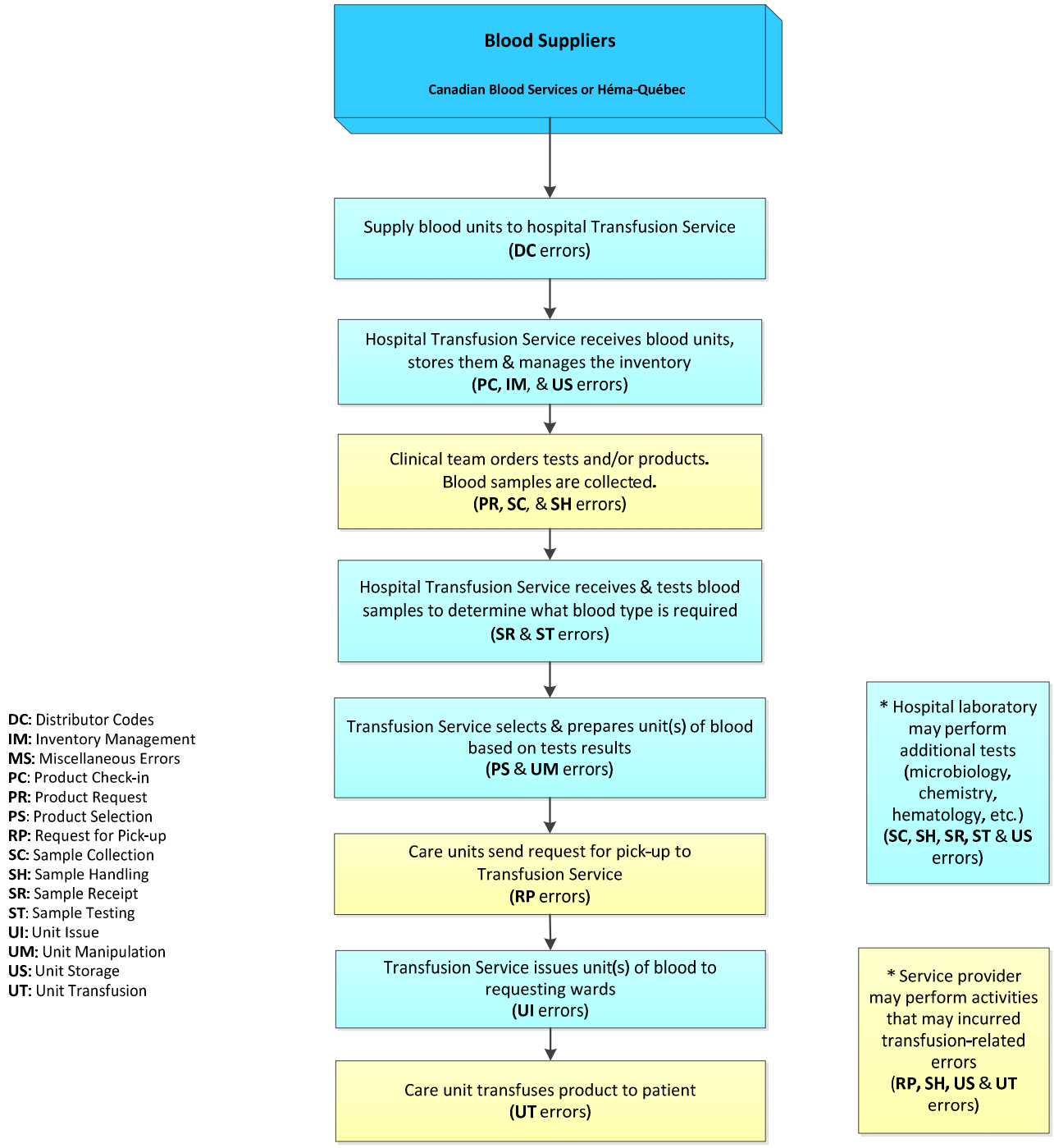
Error type and error coding:

Errors captured through TESS are also categorized according to their occurrence point in the transfusion chain. Figure 1 illustrates this multistep transfusion process where each type of error can occur**.** For instance, all errors described with distributor codes (DC) are errors that occur at the distributor/supplier level of blood components or fractionated plasma products, whereas unit transfusion (UT) errors occur at the time of transfusion in clinical settings. There are errors that occur only in the transfusion service or clinical settings (e.g., medical/surgical wards, operating rooms, emergency rooms, out-patient clinics and procedures [Out-patient clinics], intensive care units, and obstetrics). The transfusion service errors were divided into nine process types according to the point in the transfusion process, and clinical setting errors were divided into five types. Table 1 provides a summary of blood suppliers, transfusion services, and clinical settings.

A set of predefined standardized alpha-numeric codes that are used to classify each type of errors are described in detail in the TESS User's manual. Table 2 presents general error codes where the letters in the codes indicate the type of error. Errors are further sub-categorized into numeric values to differentiate specific errors within each type. A complete listing of the error codes is provided in Appendix 1.

To ensure the consistency of error coding across participating sites in the TESS, PHAC organises monthly error coding meetings to discuss complex cases for which error coding may be difficult. Baseline training for error coding is also offered to new sites prior to participating in the TESS.

Figure 1. Multistep transfusion process and type of errors that may occur at each step, TESS 2012-2016



* The transfusion chain demonstrates what transfusion services do throughout the transfusion cycle.

There are other activities that are not directly part of this transfusion chain, although they may affect it at any time. These activities are indicated in the margin of the chain.

** Miscellaneous Errors (MS) could be used in any location

Table 1. Summary of error codes that occur at blood suppliers, transfusion services or clinical settings.

Point in the Transfusion Process	Error Code	Type of Error
Blood Suppliers	**DC**	Distributor codes*
Transfusion Services	**DC**	Distributor codes
	PC	Product check-in
	IM	Inventory management
	US	Unit storage
	SR	Sample receipt
	ST	Sample testing
	PS	Production selection
	UM	Unit manipulation
	UI	Unit issue
	MS	Miscellaneous
Clinical Settings	**PR**	Product request
	SC	Sample collection
	SH	Sample handling
	RP	Request for pick-up
	UT	Unit transfusion
	MS	Miscellaneous

*Distributor code errors can also occur at blood supplier levels [including Canadian Blood Services (CBS) or Héma-Québec]. Distributor code errors can be divided into two parts according to their occurrence locations (e.g. blood suppliers and transfusion Services). Only partial data on DC errors were captured at blood supplier levels. For the calculation of the rate of DC errors at blood supplier levels, the denominator used was the total units of product received because of the non-availability of the total units of product distributed by blood suppliers.

Table 2. General error codes and corresponding denominator, TESS 2012-2016

Error Code	Type of Error	Description	Corresponding Denominator
DC	Distributor codes	• Errors occurring at the supplier level (including blood manufacturers, and blood suppliers)	Units of product received
PC	Product check-in	• Errors that relate to putting products into inventory from the blood centre, another site/campus or return from the clinical setting.	
US	Unit storage	• Errors related to storage of blood products/components within transfusion services	
IM	Inventory management	• Errors related to inventory management	
PR	Product request	• Errors related to placing an order/request for a product	Units of product requested
SC	Sample collection	• Errors that relate to collecting or labelling specimen tubes	Samples received
SH	Sample handling	• Events related to test ordering, sample collection and transportation that do not involve the sample itself. - Errors related to managing requisition - Sample transport errors, etc.	
SR	Sample receipt	• Errors related to receipt of samples in the transfusion service	
ST	Sample testing	• Testing errors	Tests performed
PS	Product selection	• Production selection errors	Units of product prepared
UM	Unit manipulation	• Processing errors (e.g., pooling, irradiation)	
RP	Request for pick-up	• Errors related to picking up blood products/ components for transfusion	Units of product issued
UI	Unit issued	• Events occurring during the issue of blood or blood product for transfusion. - Wrong product issued, - Product issued to wrong patient, etc.	
UT	Unit transfusion	• Events occurring outside of transfusion services involving the storage, selection and administration of a blood or blood product. - Wrong product administered, - Product administered to wrong patient, etc.	
MS	Miscellaneous	• Errors not related to any of those listed above (e.g., incomplete/ incorrect patient registration)	N/A

Potential severity of transfusion error:

The potential severity is a measure of the potential harm that the error may cause to the patient if it is not detected. High severity level is assigned to errors that have the potential to cause serious injury (including death), whereas low and medium severity levels are assigned to errors with the potential to cause no or minor/transient injury, respectively. The national TESS working group defined errors of high-potential severity, listed in Table 3.

Table 3. Pre-defined high (potential) severity of errors, TESS 2012-2016

Type of Error	Description	Error Code
Product request	• Order for wrong patient	PR 01
Sample collection	• Sample labelled with wrong patient identification	SC 01
	• Not labelled	SC 02
	• Wrong patient collected (not from intended patient)	SC 03
	• Label incomplete/illegible for key patient identifiers (e.g., name, identification, birthdate)	SC 07
	• Armband incorrect/not available	SC 10
Sample handling	• Paperwork and sample ID do not match	SH 02
Sample receipt	• Sample accepted in error	SR 01
Sample testing	• Sample labelled with incorrect accession label	ST 05
	• Sample/test tubes mixed up/mislabelled	ST 09
Request for pick-up	• Request for pick-up on wrong patient	RP 01
Unit issue	• Product issued to wrong patient	UI 04
	• LIS warning overridden (in error or outside standard operating procedure (SOP))	UI 06
	• Wrong type/dose of product issued to right patient	UI 19
Unit transfusion	• Administered product to wrong patient	UT 01
	• Administered wrong type/dose of product to patient	UT 02
Miscellaneous	• Patient registration incomplete/incorrect	MS 03

Data collection:

Hospital sizes were classified as the following: small transfusion volume, less than 2,000 units of red blood cells (RBCs) transfused per year; medium transfusion volume, 2,000 to 10,000 units of RBCs per year; and large transfusion volume, more than 10,000 units of RBCs per year. Data on errors were reported by 17 participating hospitals from four Canadian P/Ts in 2012. In 2014, three hospitals dropped out of the system. In 2015, a large transfusion volume hospital was reclassified as a medium transfusion volume hospital, and in 2016, a small transfusion volume hospital joined the surveillance system. As a result, from 2012 to 2016, the overall number of participating hospitals changed from 17 to 15: the number of large transfusion volume hospitals decreased from four to two, and both medium transfusion volumes and small transfusion volumes remained unchanged at five and eight, respectively.

Errors are detected using various methods, including ongoing systematic quality control (chart audit, record review, and real-time prospective transfusion audit), scheduled quality assurance, supervisory reports, and reporting by other authorized individuals. The reporting process begins with the individuals who discover the event, whether or not they are involved in the transfusion. Once an error is detected at a hospital, non-nominal data regarding the error are then collected by the site. The corresponding error type and code, as well as other pieces of information such as the date, time, and location of the error, the point in the transfusion chain at which the error occurred, the point in the transfusion chain at which the error was detected, the potential severity of the error, and its consequences to the patient, are captured using a reporting form. The data are validated and consolidated into a master file by the P/T coordinator. The data elements required for the TESS are then extracted and exported to PHAC as per the data sharing agreement between the P/T and PHAC. Data exports occur every 3 months. A user's manual for the TESS web application was developed to assist P/T with the data transfer.

Data analysis:

Data were submitted to PHAC either through the TESS electronic warehouse, web-based database, or by Microsoft Excel files. All raw data were retained in compliance with the Directive for the collection, use and dissemination of information relating to public health (PHAC. 2013 [unpublished document]). Microsoft Excel 2010 and SAS Enterprise Guide (SAS EG) v5.1 software were used for dataset combination, data cleaning, and analysis. Before the analysis and report preparation, all data were reviewed for errors, inconsistencies, and completeness. Follow-up validation was done with the reporting jurisdictions to resolve any concerns or data quality issues.

In this report, the term "rate" refers to the number of errors occurring in each year per 100,000 units of products received, requested, prepared, or issued, or per 100,000 samples received or tests performed, depending on the error type. Table 4 summarizes the number of units of blood components and fractionated plasma products received, requested, prepared, and issued before transfusion.

Table 4. Total units of blood components and fractionated plasma products received/requested /prepared/issued before transfusion for the hospitals participating in TESS 2012-2016

Denominator Data	2012	2013	2014	2015	2016	Total
Total number of samples received	144,586	132,391	104,850	98,494	110,580	590,901
Total number of tests performed	301,088	271,578	218,707	195,920	219,203	1,206,496
Total units of products received	202,618	189,354	154,229	144,669	156,657	847,527
· Blood components	110,202	98,536	77,978	70,955	76,423	434,094
· Fractionated plasma products	92,416	90,818	76,251	73,714	80,245	413,444
Total units of products requested	211,414	198,946	158,695	140,496	167,277	876,828
· Blood components	119,362	107,419	82,743	74,796	85,367	469,687
· Fractionated plasma products	92,052	91,527	75,952	65,700	81,910	407,141
Total units of products prepared	225,684	213,881	171,548	151,794	178,607	941,514
· Blood components	130,866	120,924	94,553	87,587	96,980	530,910
· Fractionated plasma products	94,818	92,957	76,995	73,329	81,710	419,809
Total units of products issued	210,290	198,046	158,034	140,008	166,714	873,092
· Blood components	118,287	106,613	82,126	77,149	84,927	469,102
· Fractionated plasma products	92,003	91,433	75,908	71,652	81,787	412,783

No statistical procedures were used for comparative analyses, nor were any statistical techniques applied to account for missing data. Data in tables with small cell sizes (n≤5) were not suppressed, since disclosure was not deemed to pose any risk of identifying individual cases. Errors were counted by the date of error occurrence.

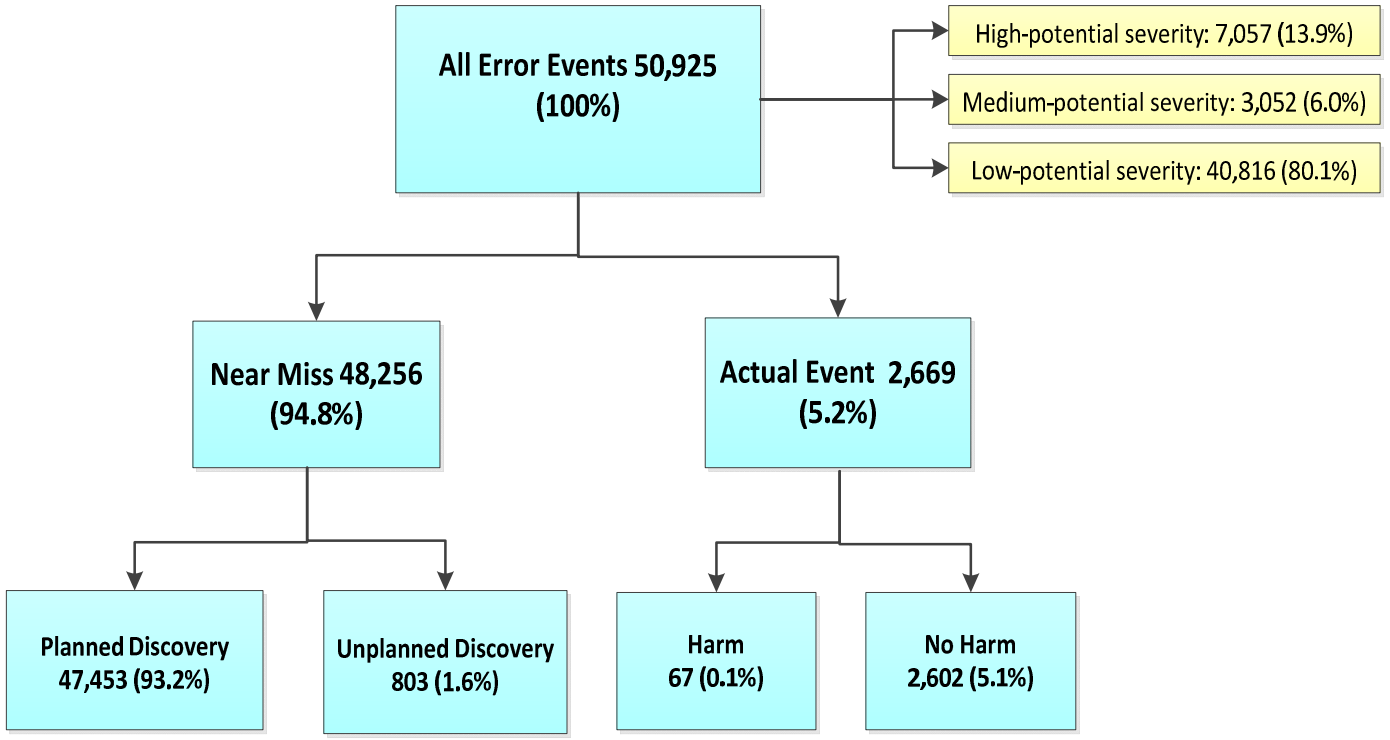
Results

The results are organized into four sections:

1. Overview of errors
2. Errors that did not reach the patient (near-miss events)
3. Errors that reached the patient (actual events)
4. Potential severity of errors

Section 1. Overall errors, TESS 2012-2016

Figure 2. Error flowchart, overall counts for 2012-2016



From 2012 to 2016, a total of 50,925 errors were reported (Figure 2). Approximately 94.8% (n=48,256) of all errors were near-miss events while only 5.2% (n=2,669) were actual events. Of all 50,925 error events, 0.1% (n=67) resulted in harm. Of the 48,256 near-miss events, approximately 98.3% (n=47,453) were detected by a planned discovery and 1.7% (n=803) by an unplanned discovery. Based on its potential severity, these 50,925 errors are classified into three categories: high (n=7,057; 13.9%), medium (n=3,052; 6.0%), or low (n=40,816; 80.1%).

a) Errors reported by hospitals of various transfusion volumes

Table 5. Summary report of errors by hospitals of various transfusion volumes, TESS 2012-2016

Hospital Type	2012			2013			2014			2015			2016			Total	
	N*	Freq.	%	N	Freq.	%	N	Freq.	%	N	Freq.	%	N	Freq.	%	Freq.	%
Small (< 2,000 RBC units /year)	8	356	2.9	8	459	4.0	7	302	3.5	7	274	3.1	8	482	5.0	1,873	3.7
Medium (2,000 -10,000 RBC units /year)	5	1,821	15.0	5	1,539	13.3	4	1,527	17.5	5	2,879	32.4	5	2,859	29.8	10,625	20.9
Large (> 10,000 RBC units /year)	4	9,969	82.1	4	9,567	82.7	3	6,916	79.1	2	5,722	64.5	2	6,253	65.2	38,427	75.5
Total	17	12,146	100	17	11,565	100	14	8,745	100	14	8,875	100	15	9,594	100	50,925	100

*Number of participating hospitals.

Table 5 summarizes the counts of errors by year and hospitals of various transfusion volumes. Of the 50,925 errors reported by participating hospitals between 2012 and 2016, hospitals of large transfusion volumes accounted for over 75% (n=38,427) and medium and small transfusion volumes accounted for 20.9% (n=10,625) and 3.7% (n=1,873), respectively.

b) Summary report of errors by type and hospital of various transfusion volumes

Table 6. Summary report of counts and rate of errors by hospitals of various transfusion volumes, TESS 2012 – 2016

Type of Error	Small (<2,000 RBC units/year)			Medium (2,000 -10,000 RBC units/year)			Large (>10,000 RBC units /year)			Total		
	Freq.	%	Rate per 100,000	Freq.	%	Rate per 100,000	Freq.	%	Rate per 100,000	Freq.	%	Rate per 100,000
SC	243	13.0	665.3	2,735	25.7	1,510.3	14,507	37.8	3,886.2	17,485	34.3	2,959.0
SH	192	10.3	525.7	1,068	10.1	589.8	4,461	11.6	1,195.0	5,721	11.2	968.2
SR	173	9.2	473.7	166	1.6	91.7	1,492	3.9	399.7	1,831	3.6	309.9
ST	110	5.9	339.8	796	7.5	198.8	1,681	4.4	217.2	2,587	5.1	214.4
DC	49	2.6	165.3	689	6.5	235.3	616	1.6	117.3	1,354	2.7	159.8
IM	24	1.3	80.9	131	1.2	44.7	345	0.9	65.7	500	1.0	59.0
PC	49	2.6	165.3	397	3.7	135.6	635	1.7	120.9	1,081	2.1	127.5
US	673	35.9	2,270.0	97	0.9	33.1	2,770	7.2	527.5	3,540	7.0	417.7
PR	56	3.0	223.4	832	7.8	269.8	1,782	4.6	327.9	2,670	5.2	304.5
PS	3	0.2	20.7	58	0.5	17.5	72	0.2	12.1	133	0.3	14.1
UM	35	1.9	241.9	181	1.7	54.6	509	1.3	85.4	725	1.4	77.0
RP	20	1.1	92.0	539	5.1	174.8	1,148	3.0	211.5	1,707	3.4	195.5
UI	39	2.1	179.3	488	4.6	158.2	2,284	5.9	420.7	2,811	5.5	322.0
UT	173	9.2	795.5	2,046	19.3	663.4	4,821	12.5	888.0	7,040	13.8	806.3
MS*	34	1.8	NA	402	3.8	NA	1,304	3.4	NA	1,740	3.4	NA
Total	1,873	100	NA	10,625	100	NA	38,427	100	NA	50,925	100	NA

*Rate of MS errors could not be calculated because the appropriate denominator data were not available.

Overall, the three most common errors were related to SC (34.3%, n=17,458), UT (13.8%, n=7,040), and SH (11.2%, n=5,721) (Table 6). The corresponding rates for SC, SH and UT were 2,959, 968.2, and 806.3 per 100,000; however, this number varied depending on the hospital's transfusion volume. Among small transfusion volume hospitals, the three most commonly reported errors were US (35.9%), SC (13%), and SH (10.3%) and among large transfusion volume hospitals, these were SC (37.8%), UT (12.5%), and SH (11.6%). From 2012 to 2016, the annual rate of US errors in hospitals with small transfusion volumes was more than four times higher compared to that in hospitals with large transfusion volumes. The rate of SC errors was more than five times higher in hospitals with large transfusion volumes compared to hospitals with small transfusion volumes.

c) Errors by type and year

Table 7. Summary report of errors by type and year, TESS 2012-2016

Type of Error	2012		2013		2014		2015		2016	
	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000
SC	4,191	2,898.6	3,998	3,019.8	3,173	3,026.2	3,095	3,142.3	3,028	2,817.5
SH	1,122	776.0	1,354	1,022.7	1,044	995.7	886	899.5	1,315	1,223.6
SR	444	307.1	428	323.3	390	372.0	272	276.2	296	275.4
ST	634	210.6	538	198.1	512	234.1	557	284.3	347	158.3
DC	440	217.2	323	170.6	183	118.7	239	165.2	169	107.9
IM	115	56.8	86	45.4	81	52.5	94	65.0	124	79.2
PC	281	138.7	228	120.4	174	112.8	214	147.9	184	117.5
US	772	381.0	917	484.3	602	390.3	773	534.3	476	303.8
PR	759	359.0	562	282.5	565	356.0	357	239.1	427	255.3
PS	40	17.7	29	13.6	22	12.8	20	12.4	22	12.3
UM	207	91.7	143	66.9	123	71.7	132	82.0	120	67.2
RP	365	173.6	486	245.4	316	200.0	276	185.5	264	158.4
UI	583	277.2	662	334.3	551	348.7	396	266.1	619	371.3
UT	1,928	916.8	1,467	740.7	672	425.2	1,197	804.4	1,776	1,065.3
MS*	265	NA	344	NA	337	NA	367	NA	427	NA
Total	12,146	NA	11,565	NA	8,745	NA	8,875	NA	9,594	NA

*Rate of MS errors could not be calculated because the appropriate denominator data were not available.

In Table 7, the annual rates of errors for SC, SH, SR, and ST remained relatively stable from 2012 to 2016. An overall upward trend in UI errors was observed from 277.2 per 100,000 in 2012 to 371.3 per 100,000 in 2016.

d) Three most frequent events that were attributable to each type of error

Table 8. Counts, proportions and rates of the three most frequent events that were associated with each type of error, TESS 2012 – 2016

Description	Error Code	Freq.	Percent	Rate per 100,000
Sample collection errors				
Sample collected unnecessarily	SC 08	8,847	50.6	1,497.2
Sample haemolysed	SC 06	3,181	18.2	538.3
Label incomplete/illegible for non-key patient identifiers	SC 12	2,070	11.8	350.3
Sample handling errors				
No phlebotomist / witness identification	SH 05	2,452	42.9	415.0
Patient information (other than ID) missing / incorrect on requisition	SH 07	1,258	22.0	212.9
Sample arrives without requisition	SH 01	424	7.4	71.8
Sample receive errors				
Sample incorrectly accessioned (test / product)	SR 04	765	41.8	129.5
Historical review incorrect / not done	SR 02	472	25.8	79.9
Demographic review / entry incorrect / not done	SR 03	386	21.1	65.3
Sample testing errors				
Data entry incorrect	ST 06	983	38.0	81.5
Data entry incomplete / not done	ST 04	644	24.9	53.4
Final check not done / incorrect	ST 20	204	7.9	16.9
Distributor code errors				
Packaging	DC 04	682	50.4	80.5
Transport	DC 05	202	14.9	23.8
Order incompletely / incorrectly filled	DC 08	184	13.6	21.7
Inventory management errors				
Product status not / incorrectly updated in computer-internal only (available / discard)	IM 02	338	67.6	39.9
Product ordered incorrectly / not submitted to supplier	IM 04	91	18.2	10.7
Inventory audit not done / incorrect	IM 01	37	7.4	4.4
Product check-in errors				
Data entry incomplete / not performed/incorrect	PC 01	951	88.0	112.2
Inappropriate return to inventory	PC 05	44	4.1	5.2
Unit confirmation not done / incorrect	PC 06	35	3.2	4.1

Unit storage errors				
Inappropriate monitoring of storage device	US 03	3233	91.3	381.5
Expired product in stock	US 02	145	4.1	17.1
Unit storage error of unspecified nature	US 99	93	2.6	11.0
Product / test request errors				
Inappropriate order of a blood product	PR 06	944	35.4	107.7
Order not done / incorrect / incomplete	PR 04	502	18.8	57.3
Order incorrectly entered (online order entry)	PR 02	244	9.1	27.8
Product selection errors				
Incorrect type / product / unit / dose selected	PS 01	104	78.2	11.0
Special needs not checked	PS 07	19	14.3	2.0
Product selection errors of unspecified nature	PS 99	7	5.3	0.7
Unit manipulation errors				
Data entry incomplete / incorrect	UM 01	223	30.8	23.7
Special processing not done / incorrectly done	UM 09	200	27.6	21.2
Unit Manipulation errors of unspecified nature	UM 99	131	18.1	13.9
Request for pick-up errors				
Request for pick-up incomplete	RP 06	506	29.6	58.0
Request for pick-up of unspecified nature	RP 99	361	21.2	41.3
Request for pick-up on wrong patient	RP 01	266	15.6	30.5
Unit issue errors				
Receipt verification not done (pneumatic tube issue)	UI 21	1,735	61.7	198.7
Data entry incomplete / incorrect	UI 01	609	21.7	69.8
Not checking/incorrect checking of unit and/or patient information)	UI 09	147	5.2	16.8
Unit transfusion errors				
Incorrect storage of product on floor	UT 04	1,763	25.0	201.9
Documentation not returned	UT 24	1,572	22.3	180.0
Documentation not complete / incorrect	UT 23	1,371	19.5	157.0

In Table 8, the DC errors were largely attributable to packaging (50.3%, n=682), transport (14.9%, n=202), and order incompletely or incorrectly filled (13.6%, n=184). The three most frequent SC errors were sample collected unnecessarily (50.6%, n=8,847), sample haemolysed (18.2%, n=3,181), and label incomplete/illegible for non-key patient identifiers (11.8%, n=2,070), for which the corresponding rates were 1,497.2, 538.3, and 350.3 per 100,000. The

three most frequent SH errors included no phlebotomist/witness identification (42.9%, n=2,452), patient information missing/incorrect on requisition (22.0%, n=1,258), and sample arrives without requisition (7.4%, n=424).

The relative effectiveness of each clinical setting or transfusion service in the transfusion chain was assessed by comparing the proportion of errors originating from and detected by each setting/unit/service (Table 9). Of the 50,775 errors, approximately 68.5% (n=34,775) and 28.9% (n=14,681) occurred in clinical settings and in the transfusion service, respectively. The highest proportions of errors that occurred in clinical settings were medical/surgical wards (19.8%, n=10,043) and emergency rooms (16.3%, n=8,298). Of the 34,775 errors that occurred in clinical settings, approximately 94.2% (n=32,773) were detected by the transfusion service and 5.6% (n=1,947) by clinical settings. Of the 14,691 errors that occurred in the transfusion service, 97.3% (n=14,277) were discovered by the transfusion service and only 2.7% (n=395) by clinical settings.

e) Localisation of errors

Table 9. Errors by locations of error occurrence and error discovery

Location of error discovery*	Location of Error Occurrence										
	Emergency rooms, Freq. (%)**	Intensive care units, Freq. (%)	Medical /surgical wards, Freq. (%)	Obstetrics, Freq. (%)	Operating rooms, Freq. (%)	Out-patient clinics, Freq. (%)	Laboratory services, Freq. (%)	Supplier/ Service provider, Freq. (%)	Transfusion services, Freq. (%)	Blood supplier, Freq. (%)	Total, Freq. (%)
Emergency rooms	220 (2.7)	1 (0.0)	1 (0.0)	0 (0.0)	0	2 (0.0)	0 (0.0)	3 (1.0)	28 (0.2)	5 (0.6)	260 (0.5)
Intensive care units	4 (0.0)	569 (10.8)	4 (0.0)	1 (0.0)	5 (0.2)	3 (0.1)	1 (0.5)	4 (1.3)	76 (0.5)	8 (1.0)	675 (1.3)
Medical /surgical wards	24 (0.3)	4 (0.1)	460 (4.6)	0 (0.0)	0 (0.0)	5 (0.1)	0 (0.0)	6 (2.0)	74 (0.5)	14 (1.7)	587 (1.2)
Obstetrics	0 (0.0)	1 (0.0)	0 (0.0)	28 (1.4)	1 (0.0)	0 (0.1)	0 (0.0)	0 (0.0)	8 (0.1)	0 (0.0)	38 (0.1)
Operating rooms	4 (0.0)	1 (0.0)	8 (0.1)	0 (0.0)	322 (9.7)	10 (0.2)	1 (0.5)	7 (2.3)	62 (0.4)	6 (0.7)	421 (0.8)
Out-patient clinics	5 (0.1)	1 (0.0)	2 (0.0)	0 (0.0)	0 (0.0)	261 (4.5)	3 (1.6)	7 (2.3)	120 (0.8)	3 (0.4)	402 (0.8)
Lab services	9 (0.1)	5 (0.1)	13 (0.1)	0 (0.0)	7 (0.2)	7 (0.1)	8 (4.3)	1 (0.3)	2 (0.0)	0 (0.0)	53 (0.1)
Blood supplier	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.1)	2 (0.7)	27 (0.2)	10 (1.2)	41 (0.1)
Supplier/ Service provider	3(0.0)	2 (0.0)	4 (0.0)	0 (0.0)	3 (0.1)	1 (0.0)	0 (0.0)	3 (1.0)	7 (0.0)	0 (0.0)	23 (0.0)
Transfusion services	8,029 (96.8)	4,695 (88.9)	9,551 (95.1)	1,989 (98.5)	2,975 (89.8)	5,534 (95.0)	172 (92.0)	268 (89.0)	14,277 (97.2)	785 (94.5)	48,275 (95.1)
Total	8,298 (100)	5,279 (100)	10,043 (100)	2,019 (100)	3,313 (100)	5,823 (100)	187 (100)	268 (100)	14,681 (100)	831 (100)	50,775 (100)

*Information on the location of error discovery was not available for 150 cases.

**Due to rounding, percentages may not always appear to add up to 100%.

Table 10. Counts and rate of errors that occurred in clinical settings by location of error occurrence, TESS 2012–2016*

Type of Error	Location of Error											
	Emergency rooms		Intensive care units		Medical /surgical wards		Obstetrics		Operating rooms		Out-patient clinics	
	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000
SC	5,013	4,450.7	1,629	5,516.2	4,863	4,357.1	1,117	2,573.0	911	5066.2	2,259	1,073.9
SH	1,173	1,041.4	731	2,475.4	1,323	1,185.4	427	983.6	305	1696.1	1,327	630.8
PR	442	710.5	513	392.1	755	476.8	268	3,760.9	188	149.0	273	87.1
RP	288	467.2	501	383.6	555	353.8	88	1,248.9	89	70.5	114	36.5
UT	527	854.8	1,295	991.5	776	494.7	86	1,220.6	1,262	999.9	1,136	363.4

*Both the frequency and the rate reported by three hospitals for the period of 2012-2013 were excluded from the analysis because appropriate denominator data were not available.

In Table 10, the two locations with the highest rates of SC errors were intensive care units and operating rooms, with 5,516.2 and 5,066.2 per 100,000, respectively. SH errors also had the highest rates in intensive care units and operating rooms. Obstetrics had the highest rates of PR, UT, and RP errors.

f) Errors that did not reach (near-miss events) and reached the patient (actual events) by type

Table 11. Counts, percentages, and rates of errors that did not reach and reached the patient by type, TESS 2012-2016

Type of Error	Actual Events			Near-Miss Events		
	Freq.	%	Rate per 100,000	Freq.	%	Rate per 100,000
SC	44	0.3	7.4	17,441	99.7	2,951.6
SH	126	2.2	21.3	5,595	97.8	946.9
SR	102	5.6	17.3	1,728	94.4	292.4
ST	100	3.9	8.3	2,488	96.1	206.2
DC	69	5.1	8.1	1,285	94.9	151.6
IM	34	6.8	4.0	466	93.2	55.0
PC	20	1.9	2.4	1,061	98.1	125.2
US	2	0.1	0.2	3,538	99.9	417.4
PR	548	20.5	62.5	2,122	79.5	242.0
PS	45	33.8	4.8	88	66.2	9.3
UM	57	7.9	6.1	668	92.1	70.9
RP	791	46.3	90.6	916	53.7	104.9
UI	144	5.1	16.5	2,667	94.9	305.5
UT	513	7.3	58.8	6,527	92.7	747.6
MS*	74	4.3	NA	1,666	95.7	NA
Total	2,669	5.2	NA	48,256	94.8	NA

*Rate of MS errors could not be calculated because the appropriate denominator data were not available.

The three highest percentages of actual events were RP (46.3%), PS (33.8%), and PR (20.5%) errors with corresponding cumulative rates of 90.6, 4.8, and 62.5 per 100,000, respectively. The three highest percentages of near-miss events were US (99.9%), SC (99.7%), and PC (98.1%) errors, with corresponding cumulative rates of 417.4, 2,951.6, and 125.2 per 100,000, respectively (Table 11).

g) Errors by type and potential severity

Table 12. Counts and proportions of errors by type and potential severity, TESS 2012–2016

Type of Error	High Potential Severity			Medium Potential Severity			Low Potential Severity		
	Freq.	%	Rate per 100,000	Freq.	%	Rate per 100,000	Freq.	%	Rate per 100,000
SC	2,840	16.2	480.6	129	0.7	21.8	14,516	83.0	2,456.6
SH	1,724	30.1	291.8	247	4.3	41.8	3,750	65.5	634.6
SR	184	10.1	31.1	222	12.1	37.6	1,424	77.8	241.0
ST	166	6.4	13.8	456	17.6	37.8	1,966	76.0	163.0
DC	149	11.0	17.6	82	6.1	9.7	1,123	82.9	132.5
IM	6	1.2	0.7	43	8.6	5.1	451	90.2	53.2
PC	11	1.0	1.3	48	4.4	5.7	1,022	94.5	120.6
US	7	0.2	0.8	19	0.5	2.2	3,514	99.3	414.6
PR	988	37.0	112.7	755	28.3	86.1	927	34.7	105.7
PS	21	15.8	2.2	61	45.9	6.5	51	38.3	5.4
UM	33	4.6	3.5	98	13.5	10.4	594	81.9	63.1
RP	306	17.9	35.0	123	7.2	14.1	1,278	74.9	146.4
UI	168	6.0	19.2	133	4.7	15.2	2,510	89.3	287.5
UT	178	2.5	20.4	514	7.3	58.9	6,348	90.2	727.1
MS*	276	15.9	NA	122	7.0	NA	1,342	77.1	NA
Total	7,057	13.9	NA	3,052	6.0	NA	40,816	80.1	NA

*Rate of MS errors could not be calculated because the appropriate denominator data were not available.

Of all the 50,925 errors reported between 2012 and 2016, 7,057 (13.9%) were considered to be high-potential severity/risk, 3,052 (6%) medium-potential severity, and 40,816 (80.1%) low-potential severity. The percentages of high-severity cases varied across different types of errors. A large percentage of high-potential severity errors were related to PR (37%), SH (30.1%), RP (17.9%), and SC (16.2%) (Table 12).

h) Errors by type and occurrence time

Table 13. Counts and percentage of errors by 4 hour range for the event occurrence time*,**,***

Type of Error	Time of Day											
	00:00 - 04:00		04:00 - 08:00		08:00 - 12:00		12:00 - 16:00		16:00 - 20:00		20:00 - 24:00	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
SC	1,132	6.5	2,098	12.0	5,010	28.7	4,094	23.4	2,741	15.7	2,409	13.8
SH	352	6.2	585	10.2	1,642	28.7	1,579	27.6	890	15.6	673	11.8
SR	145	7.9	138	7.5	458	25.0	600	32.8	321	17.5	168	9.2
ST	150	5.8	260	10.0	620	24.0	784	30.3	461	17.8	313	12.1
DC	82	6.1	79	5.8	515	38.0	353	26.1	200	14.8	125	9.2
IM	94	18.8	52	10.4	134	26.8	117	23.4	51	10.2	52	10.4
PC	22	2.0	40	3.7	476	44.0	360	33.3	112	10.4	71	6.6
US	574	16.2	425	12.0	1,074	30.3	702	19.8	352	9.9	413	11.7
PR	281	10.5	336	12.6	773	29.0	666	24.9	377	14.1	237	8.9
PS	7	5.3	8	6.0	31	23.3	42	31.6	27	20.3	18	13.5
UM	59	8.1	67	9.2	192	26.5	220	30.3	115	15.9	72	9.9
RP	137	8.0	128	7.5	429	25.1	450	26.4	336	19.7	227	13.3
UI	157	5.6	188	6.7	966	34.4	850	30.2	412	14.7	238	8.5
UT	403	5.7	602	8.6	2,640	37.5	1,642	23.3	949	13.5	804	11.4
MS	149	8.6	211	12.1	434	24.9	601	34.5	139	8.0	206	11.8
Total	3,744	7.4	5,217	10.2	15,394	30.2	13,060	25.6	7,483	14.7	6,026	11.8

*Information on the event occurrence time was not available for one case.

**Rate could not be calculated because the appropriate denominator data were not available.

***The limitation of just counting the number of errors is that it does not allow people to make fair comparisons of the frequency of errors occurred in different time periods, since they do not take into account the corresponding denominator (ie, transfusion volumes). When measuring frequency, proportions and rates are very helpful for comparing groups, because they relate the number of errors to transfusion volumes in which these errors occur.

The majority of events (55.8%) occurred from 8:00 AM to 4:00 PM. A large number of IM and US errors occurred from 0:00 AM to 4:00 AM (Table 13).

Section 2. Errors that did not reach the patient (near-miss events)

Table 14. Counts and annual rates of errors that did not reach the patient by type and year, TESS 2012-2016

Type of Error	2012		2013		2014		2015		2016	
	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000
SC	4,175	2,887.6	3,991	3,014.6	3,161	3,014.8	3,090	3,137.2	3,024	2,734.7
SH	1,071	740.7	1,324	1,000.1	1,018	970.9	876	889.4	1,306	1,181.0
SR	418	289.1	407	307.4	373	355.7	252	255.9	278	251.4
ST	598	198.6	517	190.4	494	225.9	541	276.1	338	154.2
DC	424	209.3	302	159.5	172	111.5	224	154.8	163	104.0
IM	108	53.3	82	43.3	77	49.9	91	62.9	108	68.9
PC	278	137.2	226	119.4	172	111.5	205	141.7	180	114.9
US	770	380.0	917	484.3	602	390.3	773	534.3	476	303.8
PR	630	298.0	433	217.6	437	275.4	276	196.4	346	206.8
PS	26	11.5	16	7.5	17	9.9	15	9.9	14	7.8
UM	195	86.4	128	59.8	111	64.7	122	80.4	112	62.7
RP	224	106.5	239	120.7	162	102.5	152	108.6	139	83.4
UI	558	265.3	622	314.1	536	339.2	362	258.6	589	353.3
UT	1,867	887.8	1,410	712.0	608	384.7	969	692.1	1,673	1,003.5
MS*	248	NA	331	NA	320	NA	355	NA	412	NA
Total	11,590	NA	10,945	NA	8,260	NA	8,303	NA	9,158	NA

*Rate of MS errors could not be calculated because the appropriate denominator data were not available.

A downward trend in the annual rate per 100,000 of DC errors that did not reach the patient was observed from 209.3 in 2012 to 104 in 2016. Annual rates of SC, SH, SR, and ST errors that did not reach the patient remained relatively stable (Table 14).

Table 15. Counts and rates of near-miss events that were detected through a planned discovery by type and year, TESS 2012-2016

Type of Error	2012		2013		2014		2015		2016	
	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000
SC	4,152	2,871.6	3,978	3,004.7	3,147	3,001.4	3,077	3,124.0	3,018	2,729.2
SH	1,063	735.2	1,317	994.8	1,012	965.2	869	882.3	1,302	1,177.4
SR	408	282.2	389	293.8	367	350.0	242	245.7	274	247.8
ST	560	186.0	484	178.2	466	213.1	514	262.4	330	150.5
DC	417	205.8	296	156.3	168	108.9	223	154.1	159	101.5
IM	102	50.3	76	40.1	74	48.0	88	60.8	108	68.9
PC	269	132.8	222	117.2	167	108.3	203	140.3	178	113.6
US	764	377.1	916	483.8	600	389.0	773	534.3	476	303.8
PR	606	286.6	415	208.6	425	267.8	254	180.8	335	200.3
PS	23	10.2	13	6.1	11	6.4	13	8.6	12	6.7
UM	190	84.2	123	57.5	107	62.4	121	79.7	110	61.6
RP	215	102.2	231	116.6	157	99.3	145	103.6	135	81.0
UI	541	257.3	611	308.5	530	335.4	351	250.7	583	349.7
UT	1,825	867.8	1,375	694.3	566	358.2	930	664.2	1,646	987.3
MS*	232	NA	312	NA	308	NA	350	NA	404	NA
Total	11,367	NA	10,758	NA	8,105	NA	8,153	NA	9,070	NA

*Rate of MS errors could not be calculated because the appropriate denominator data were not available.

Of the 48,256 near-miss events, discovery was planned for 47,453 errors (98.3%), and discovery was unplanned for 803 (1.7%). There was a downward trend in the annual rate of DC errors that did not reach the patient and that were detected through a planned discovery, from 205.8 to 101.5 per 100,000 between 2012 and 2016 (Table 15).

Table 16. Counts and rates of errors that did not reach the patient that were detected through an unplanned discovery by type and year, TESS 2012-2016

Type of Error	2012		2013		2014		2015		2016	
	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000
SC	23	15.9	13	9.8	14	13.4	13	13.2	6	5.4
SH	8	5.5	7	5.3	6	5.7	7	7.1	4	3.6
SR	10	6.9	18	13.6	6	5.7	10	10.2	4	3.6
ST	38	12.6	33	12.2	28	12.8	27	13.8	8	3.6
DC	7	3.5	6	3.2	4	2.6	1	0.7	4	2.6
IM	6	3.0	6	3.2	3	1.9	3	2.1	0	0.0
PC	9	4.4	4	2.1	5	3.2	2	1.4	2	1.3
US	6	3.0	1	0.5	2	1.3	0	0.0	0	0.0
PR	24	11.4	18	9.0	12	7.6	22	15.7	11	6.6
PS	3	1.3	3	1.4	6	3.5	2	1.3	2	1.1
UM	5	2.2	5	2.3	4	2.3	1	0.7	2	1.1
RP	9	4.3	8	4.0	5	3.2	7	5.0	4	2.4
UI	17	8.1	11	5.6	6	3.8	11	7.9	6	3.6
UT	42	20.0	35	17.7	42	26.6	39	27.9	27	16.2
MS*	16	NA	19	NA	12	NA	5	NA	8	NA
Total	223	NA	187	NA	155	NA	150	NA	88	NA

*Rate of MS errors could not be calculated because the appropriate denominator data were not available.

A downward trend in the annual rates of PC and SC errors that did not reach the patient and that were detected through an unplanned discovery was observed between 2012 and 2016 (Table 16).

Table 17. Counts and rates of errors that did not reach the patients by type and hospital of various transfusion volumes, TESS 2012-2016

Type of Error	Small (<2,000 RBC units/year)		Medium (2,000 -10,000 RBC units/year)		Large (>10,000 RBC units /year)	
	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000
SC	243	665.3	2,705	1,493.8	14,493	3,882.5
SH	185	506.5	1,054	582.0	4,356	1,166.9
SR	170	465.5	136	75.1	1,422	380.9
ST	108	333.6	739	184.6	1,641	212.1
DC	43	145.0	642	219.3	600	114.3
IM	20	67.5	120	41.0	326	62.1
PC	46	155.2	383	130.8	632	120.4
US	673	2,270.0	96	32.8	2,769	527.3
PR	46	183.5	760	246.5	1,316	242.2
PS	3	20.7	42	12.7	43	7.2
UM	35	241.9	161	48.6	472	79.2
RP	10	46.0	459	148.8	447	82.3
UI	36	165.5	405	131.3	2,226	410.0
UT	158	726.5	1,821	590.4	4,548	837.7
MS*	33	NA	352	NA	1,281	NA
Total	1,809	NA	9,875	NA	36,572	NA

*Rates of MS errors could not be calculated because the appropriate denominator data were not available.

The rates of SC and SH errors were higher in hospitals of large transfusion volumes than those of small transfusion volumes. However, the rate of US errors was four times higher in hospitals of small transfusion volumes than those of large transfusion volumes (Table 17).

Section 3. Errors that reached the patient (actual events)

Table 18. Counts and rates of errors that reached the patient by type and year, TESS 2012-2016

Type of Error	2012		2013		2014		2015		2016	
	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000
SC	16	11.1	7	5.3	12	11.4	5	5.1	4	3.6
SH	51	35.3	30	22.7	26	24.8	10	10.2	9	8.1
SR	26	18.0	21	15.9	17	16.2	20	20.3	18	16.3
ST	36	12.0	21	7.7	18	8.2	16	8.2	9	4.1
DC	16	7.9	21	11.1	11	7.1	15	10.4	6	3.8
IM	7	3.5	4	2.1	4	2.6	3	2.1	16	10.2
PC	3	1.5	2	1.1	2	1.3	9	6.2	4	2.6
US	2	1.0	0	0.0	0	0.0	0	0.0	0	0.0
PR	129	61.0	129	64.8	128	80.7	81	57.7	81	48.4
PS	14	6.2	13	6.1	5	2.9	5	3.3	8	4.5
UM	12	5.3	15	7.0	12	7.0	10	6.6	8	4.5
RP	141	67.1	247	124.7	154	97.4	124	88.6	125	75.0
UI	25	11.9	40	20.2	15	9.5	34	24.3	30	18.0
UT	61	29.0	57	28.8	64	40.5	228	162.8	103	61.8
MS*	17	NA	13	NA	17	NA	12	NA	15	NA
Total	556	NA	620	NA	485	NA	572	NA	436	NA

*Rate of MS errors could not be calculated because the appropriate denominator data were not available.

The counts and annual rates of errors that reached the patient are presented in Table 18. The annual rates of SC errors that reached the patient diminished over twofold from 11.1 to 3.6 per 100,000 from 2012 to 2016. There was a downward trend in the annual rates of SH errors that reached the patient, from 35.3 to 8.1 per 100,000 between 2012 and 2016. The annual rates of ST errors that reached the patient decreased over three times from 12 to 4.1 per 100,000 from 2012 to 2016.

As presented in Table 19, the cumulative rate of PR errors that reached the patient was more than two times higher in hospitals with large transfusion volumes than those with small transfusion volumes. The cumulative rate of DC errors that reached the patient was more than seven times higher in hospitals with small transfusion volumes than those with large transfusion volumes.

Table 19. Counts and rates of errors that reached the patient (actual events) by type and hospital transfusion volumes, TESS 2012-2016

Type of Error	Small (<2,000 RBC units/year)		Medium (2,000-10,000 RBC units/year)		Large (>10,000 RBC units/year)	
	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000
SC	0	0.0	30	16.6	14	3.8
SH	7	19.2	14	7.7	105	28.1
SR	3	8.2	30	16.6	70	18.8
ST	2	6.2	57	14.2	40	5.2
DC	6	20.2	47	16.1	16	3.0
IM	4	13.5	11	3.8	19	3.6
PC	3	10.1	14	4.8	3	0.6
US	0	0.0	1	0.3	1	0.2
PR	10	39.9	72	23.4	466	85.8
PS	0	0.0	16	4.8	29	4.9
UM	0	0.0	20	6.0	37	6.2
RP	10	46.0	80	25.9	701	129.1
UI	3	13.8	83	26.9	58	10.7
UT	15	69.0	225	72.9	273	50.3
MS*	1	NA	50	NA	23	NA
Total	64	NA	750	NA	1,855	NA

*Rate of MS errors could not be calculated because the appropriate denominator data were not available.

Table 20. Counts and proportion of outcomes of errors that reached the patient by type, TESS 2012–2016

Type of Error	Procedure Delayed Cancelled		Transfusion Delayed		Adverse Reaction		Product Transfused-No Reaction		Incorrect Dose Administered		Lost Traceability		Total	%
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%		
SC	1	2.3	37	84.1	0	0.0	6	13.6	0	0.0	0	0.0	44	100
SH	3	2.4	103	81.7	0	0.0	20	15.9	0	0.0	0	0.0	126	100
SR	2	2.0	42	41.2	0	0.0	57	55.9	1	1.0	0	0.0	102	100
ST	6	6.0	56	56.0	1	1.0	37	37.0	0	0.0	0	0.0	100	100
DC	1	1.4	62	89.9	0	0.0	5	7.2	1	1.4	0	0.0	69	100
IM	0	0.0	13	38.2	0	0.0	3	8.8	0	0.0	18	52.9	34	100
PC	0	0.0	20	100.0	0	0.0	0	0.0	0	0.0	0	0.0	20	100
US	0	0.0	1	50.0	0	0.0	1	50.0	0	0.0	0	0.0	2	100
PR	9	1.6	380	69.3	49	8.9	101	18.4	9	1.6	0	0.0	548	100
PS	0	0.0	20	44.4	1	2.2	22	48.9	2	4.4	0	0.0	45	100
UM	2	3.5	35	61.4	0	0.0	15	26.3	4	7.0	1	1.8	57	100
RP	2	0.3	785	99.2	0	0.0	2	0.3	2	0.3	0	0.0	791	100
UI	0	0.0	72	50.0	0	0.0	60	41.7	6	4.2	6	4.2	144	100
UT	1	0.2	61	11.9	15	2.9	140	27.3	25	4.9	271	52.8	513	100
MS	4	5.4	62	83.8	0	0.0	6	8.1	2	2.7	0	0.0	74	100
Total	31	1.2	1,749	65.5	66	2.5	475	17.8	52	1.9	296	11.1	2,669	100

Of the 2,669 errors that reached the patient, 2.5% (n=66) resulted in adverse reaction; 65.5% (n=1,749) were attributable to transfusion delay; 17.8% (n=475) of errors that did not result in an adverse reaction were discovered after the product had been transfused; and 11.1% (n=296) were associated with lost traceability (Table 20).

Table 21. Counts of cases with harm caused by errors, TESS 2012-2016

Event definition	Event code	ABO incompati-bility	TACO	Other*	Acute haemotic transfusion reaction	Delayed haemolytic transfusion reaction	Febrile non-haemolytic reaction	IVIG Headache	Minor allergic reaction	Incorrect dose administered	Total (%)
Order not done / incorrect / incomplete	PR 04	0	7	0	0	0	0	0	0	0	7 (10.4)
Inappropriate order of a blood product	PR 06	0	9	0	0	1	9	0	2	0	21 (31.3)
Product request error of unspecified nature	PR 99	0	21	0	0	0	0	0	0	0	21 (31.3)
Incorrect type / product / unit / dose selected	PS 01	0	0	0	1	0	0	0	0	1	2 (3.0)
Sample testing error of unspecified nature	ST 99	0	0	0	0	1	0	0	0	0	1 (1.5)
Administered product to wrong patient	UT 01	1	0	1	0	0	0	0	0	0	2 (3.0)
Administered wrong type / dose of product to patient	UT 02	0	0	0	1	0	0	0	0	0	1 (1.5)
Appropriate monitoring of patient not done	UT 11	0	2	0	0	0	0	0	0	0	2 (3.0)
Guidelines for infusion time not followed	UT 25	0	6	0	0	0	0	0	1	0	7 (10.4)
Transfusion reaction protocol not followed	UT 26	0	0	0	0	0	2	1	0	0	3 (4.5)
Total (%)		1 (1.5)	45 (67.2)	1 (1.5)	2 (3.0)	2 (3.0)	11 (16.4)	1 (1.5)	3 (4.5)	1 (1.5)	67 (100)

*Unspecified adverse reaction

Approximately 2.5% (n=67) of the errors that reached the patient resulted in harm (Table 21). The most common cases of harm were TACO (45 cases, 67.2%), febrile non-haemolytic reactions (FNHR) (11 cases, 16.4%), minor allergic reactions (3 cases, 4.5%), acute haemolytic transfusion reaction (AHTR) (2 cases, 3%), and delayed haemolytic transfusion reaction (DHTR) (2 cases, 3%). Errors that led to TACO were related to PR [product order not done or incorrect (PR 04), inappropriate order of a blood product (PR 06), other unspecified PR error (PR 99)], and UT [not following guidelines for infusion time (UT 25) and appropriate monitoring of patient not done (UT 11)]. Those that resulted in febrile non-haemolytic and minor allergic reactions were due to PR [inappropriate order of blood product (PR 06)] and UT [not following transfusion reaction protocol (UT 26) and not following guidelines for infusion time (UT 25)]. Other harmful events that resulted from errors included a case of ABO incompatibility due to administered wrong type / dose of product to patient (UT 01) and a case of IVIG-related headache caused by not following transfusion reaction protocol (UT 26).

Those two cases of AHTR occurred in the year 2012 and 2015, respectively. The first case was related to the incorrect product selected. Two units of group O incompatible apheresis plasma were selected and transferred to an urgent patient of unknown blood group. Laboratory work was initiated, however, the test results were not available prior to transfusion due to the urgency of the situation. As per follow-up laboratory tests, the patient was group B positive and showed evidence of hemolysis after the transfusion, which resolved within a few days of the event. The second case was an issue regarding an administered wrong dose to patient combined with a computerized provider order entry (CPOE) error. The physician ordered more IVIG than required, which caused a 4^{th} dose of IVIG to a Group A patient and resulted in severe hemolysis after the administration. No further information on the patient was provided.

Section 4. Potential severity of errors

Table 22. Counts and rates of errors of high-potential severity by type and year, TESS 2012–2016

Type of Error	2012		2013		2014		2015		2016	
	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000
SC	500	345.8	613	463.0	617	588.5	587	596.0	523	473.0
SH	324	224.1	386	291.6	393	374.8	317	321.8	304	274.9
SR	44	30.4	38	28.7	41	39.1	28	28.4	33	29.8
ST	50	16.6	41	15.1	26	11.9	28	14.3	21	9.6
DC	37	18.3	36	19.0	18	11.7	39	27.0	19	12.1
IM	1	0.5	1	0.5	1	0.6	0	0.0	3	1.9
PC	1	0.5	5	2.6	1	0.6	4	2.8	0	0.0
US	1	0.5	1	0.5	4	2.6	0	0.0	1	0.6
PR	233	110.2	203	102.0	188	118.5	162	115.3	202	120.8
PS	7	3.1	3	1.4	6	3.5	3	2.0	2	1.1
UM	11	4.9	10	4.7	2	1.2	7	4.6	3	1.7
RP	67	31.9	83	41.9	59	37.3	43	30.7	54	32.4
UI	38	18.1	46	23.2	23	14.6	33	23.6	28	16.8
UT	17	8.1	42	21.2	36	22.8	35	25.0	48	28.8
MS*	61	NA	62	NA	94	NA	29	NA	30	NA
Total (%)	1,392 (19.7)	NA	1,570 (22.2)	NA	1,509 (21.4)	NA	1,315 (18.6)	NA	1,271 (18.0)	NA

*Rate of MS errors could not be calculated because the appropriate denominator data were not available.

High-potential severity UT errors increased threefold from 8.1 to 28.8 per 100,000 from 2012 to 2016. Downward trends in the annual rates of ST errors were observed from 16.6 to 9.6 per 100,000 from 2012 to 2016. Both high-potential severity SC and SH were relatively stable over time (Table 22).

Table 23. Counts and rates of high-potential severity that occurred in clinical settings by location of occurrence, TESS 2012–2016*

Type of Error	Location of Error Occurrence											
	Emergency rooms		Intensive care units		Medical /surgical wards		Obstetrics		Operating rooms		Out-patient clinics	
	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000
SC	647	574.4	383	1,296.9	763	683.6	370	852.3	143	795.2	478	227.2
SH	461	409.3	186	629.8	415	371.8	122	281.0	111	617.3	383	182.1
PR	192	308.6	251	191.8	376	237.5	27	378.9	42	33.3	95	30.3
RP	51	82.7	100	76.6	79	50.4	8	113.5	23	18.2	13	4.2
UT	23	37.3	28	21.4	49	31.2	2	28.4	45	35.7	22	7.0

*Both the frequency and the rate reported by three hospitals for the period 2012-2013 were excluded from the analysis because appropriate denominator data were not available.

High-potential severity SC errors occurred most frequently in intensive care units (1,296.9 per 100,000). The two locations with the highest rate of high-potential severity SH errors were intensive care units and operating rooms, with 629.3 and 617.3 per 100,000, respectively. High-potential severity PR and RP errors occurred most frequently in obstetrics with rates of 378.9 and 113.5 per 100,000, respectively. The two locations with the highest rate of high-potential severity UT errors were the emergency rooms and operating rooms, with 37.3 and 35.7 per 100,000, respectively (Table 23).

Table 24. Counts and rates of errors of medium-potential severity by type and year, TESS 2012–2016

Type of Error	2012		2013		2014		2015		2016	
	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000
SC	41	28.4	33	24.9	31	29.6	14	14.2	10	9.0
SH	52	36.0	80	60.4	47	44.8	32	32.5	36	32.6
SR	58	40.1	59	44.6	48	45.8	33	33.5	25	22.6
ST	127	42.2	116	42.7	90	41.2	79	40.3	43	19.6
DC	17	8.4	21	11.1	13	8.4	14	9.7	17	10.9
IM	10	4.9	8	4.2	11	7.1	9	6.2	5	3.2
PC	11	5.4	12	6.3	8	5.2	9	6.2	8	5.1
US	9	4.4	4	2.1	2	1.3	1	0.7	3	1.9
PR	275	130.1	144	72.4	190	119.7	81	57.7	65	38.9
PS	19	8.4	16	7.5	6	3.5	10	6.6	10	5.6
UM	29	12.8	28	13.1	21	12.2	11	7.2	9	5.0
RP	37	17.6	36	18.2	18	11.4	20	14.3	12	7.2
UI	36	17.1	32	16.2	26	16.5	21	15.0	18	10.8
UT	153	72.8	207	104.5	55	34.8	58	41.4	41	24.6
MS*	19	NA	37	NA	30	NA	14	NA	22	NA
Total	893	NA	833	NA	596	NA	406	NA	324	NA

*Rate of MS errors could not be calculated because the appropriate denominator data were not available.

The total reported errors of medium-potential severity decreased from 2012 to 2016, with the highest frequency of errors (n=893) reported in 2012 and the lowest frequency of errors (n=324) reported in 2016. Downward trends in the annual rates of ST, UM, and UI errors of medium-potential severity were also observed. The annual rates of DC and PC errors of medium-potential severity remained relatively stable. The rates of SR, ST, UI, and RP remained stable up until 2015 and then decreased in 2016. Of the 3,052 errors reported from 2012-2016, a high frequency of medium-potential severity errors were related to PR, UT, and ST. Overall, PR had the highest annual error rate in 2012 and 2014-2016, whereas UT errors had the highest annual rate in 2013.

Table 25. Counts and rates of errors of low-potential severity by type and year, TESS 2012–2016

Type of Error	2012		2013		2014		2015		2016	
	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000	Freq.	Rate per 100,000
SC	3,650	2,524.4	3,352	2,531.9	2,525	2,408.2	2,494	2,532.1	2,495	2,256.3
SH	746	516.0	888	670.7	604	576.1	537	545.2	975	881.7
SR	343	237.2	331	250.0	301	287.1	211	214.2	238	215.2
ST	456	151.5	381	140.3	396	181.1	450	229.7	283	129.1
DC	386	190.5	266	140.5	152	98.6	186	128.6	133	84.9
IM	104	51.3	77	40.7	69	44.7	85	58.8	116	74.0
PC	269	132.8	211	111.4	165	107.0	201	138.9	176	112.3
US	762	376.1	912	481.6	596	386.4	772	533.6	472	301.3
PR	251	118.7	215	108.1	187	117.8	114	81.1	160	95.6
PS	14	6.2	10	4.7	10	5.8	7	4.6	10	5.6
UM	167	74.0	105	49.1	100	58.3	114	75.1	108	60.5
RP	261	124.1	367	185.3	239	151.2	213	152.1	198	118.8
UI	509	242.0	584	294.9	502	317.7	342	244.3	573	343.7
UT	1,758	836.0	1,218	615.0	581	367.6	1,104	788.5	1,687	1,011.9
MS*	185	NA	245	NA	213	NA	324	NA	375	NA
Total	9,861	NA	9,162	NA	6,640	NA	7,154	NA	7,999	NA

*Rate of MS errors could not be calculated because the appropriate denominator data were not available.

Of the 40,816 low-potential severity errors that were reported from 2012 to 2016, the highest frequency of total errors was reported in 2012 (n=9,861) and the lowest frequency of total errors was reported in 2014 (n=6,640). The error rates for SC, SR, ST, PC, PR, PS, UM, and UI remained relatively stable from 2012 to 2016. Overall, SC errors had the highest low-potential severity error rate and PS errors had the lowest error rate in each year throughout the five-year period. Overall, the highest rate was SC errors in 2012, with 2,524.4 per 100,000 and the lowest rate was PS errors in 2015, with 4.6 per 100,000.

Table 26. Counts and proportions of errors by potential severity and hospitals of transfusion volumes, TESS 2012-2016

Potential Severity	Small (<2,000 RBC units/year)		Medium (2,000 -10,000 RBC units/year)		Large (>10,000 RBC units /year)	
	Freq.	%	Freq.	%	Freq.	%
High	125	6.7	2,139	20.1	4,793	12.5
Medium	69	3.7	892	8.4	2,091	5.4
Low	1,679	89.6	7,594	71.5	31,543	82.1
Total	1,873	100	10,625	100	38,427	100

There was a variation in the percentage of reported high-potential severity errors between the hospital sites. The percentage of high-potential severity errors was higher in hospitals of large and medium transfusion volumes than in those of small transfusion volumes (Table 26).

Discussion

The near-misses are not truly indicative of organizational weakness; instead, they may demonstrate that predetermined plans and corrective actions are performed before transfusion. The planned discovery of near-misses can help evaluate current detection and intervention procedures for identifying and mitigating events. Additionally, reporting the unplanned discovery of near-misses can help to identify where mechanisms to detect errors before transfusion may be lacking. As actual events indicate a weakness in the blood transfusion system, appropriate measures may be taken to prevent the continuation of such events. Data presented in this report will help identify critical points in the transfusion chain to develop preventative measures for future improvement.

Although near-misses are discovered and corrected before the transfusion, they are still defined as errors in TESS. These events can still have consequences on the healthcare system and can indirectly impact patients. For example, among the 17,485 SC errors reported by participating hospitals, over 68% of cases were haemolysed samples or were associated with samples that were collected unnecessarily. In addition, intensive care units and operating rooms were identified as clinical areas where SC errors occurred commonly. These errors often resulted in delays in the issuing of blood (due to time needed to correct events before blood product issue), non-productive workload, iatrogenic anemia for infants (due to additional blood loss for samples that cannot be tested), and delayed procedures that were waiting for redrawing sample.

The TESS provides valuable information on errors regardless of their level of severity. The data can be used to identify issues that risk the patient's safety (e.g., an incident with or without an adverse reaction) and quality issues such as deviations from standard operating procedures (SOPs).

Annual rates of SC errors that indicate to have the potential to cause an ABO-incompatible transfusion remained relatively high and stable from 2012-2016. Despite such a high rate of SC errors, the transfusion service team and clinical health care workers were able to detect the majority of SC errors according to the SOP before an incompatible transfusion could occur because more than 95% of these SC errors were detected by a planned recovery mechanism. Furthermore, there is a decreasing trend in the rate of SC errors that reached the patient from 2012-2016. These results demonstrate that the TESS working group has shown that it is possible to improve some error tracking within clinical and transfusion areas even when there are safety SOPs in place. Future work will target interventions to increase timely error tracking in the clinical settings, particularly those related to sample collection and transfusion documentation. Further analysis is required to understand trends in errors and the impact of intervention measures, with the aim of improving transfusion process, patient safety, and mitigating error-related healthcare costs.

Data Limitations

The trends observed from 2012 to 2016 should be interpreted with caution since the composition of hospitals participating in TESS changed over time and for some errors, the corresponding rates are based on low numbers which are more prone to fluctuation over time. Furthermore, the true incidence of bedside transfusion errors in TESS may be underestimated because surveillance data rely on reporting of clinically relevant events or on indirect methods. Improved error detection capabilities, data cleaning and validation,

shortened reporting delay, and changes in reporting practices at the jurisdictional level can contribute to changes in observed trends. Once the data for the summary report has been validated, adjustments made to individual P/T data will be updated in that year's national data. As a result of comparing dynamic databases, small discrepancies between PHAC and provincial or territorial numbers are expected.

Summary

Overall, SC, UT, and SH errors remain the most frequent errors. Transfusion services, medical/surgical wards, and emergency rooms are the locations where most errors occur. Although the total number of errors recorded remains substantially high (n=50,925), only 5.2% (n=2,669) of errors reached the patient, demonstrating that near-misses are much more frequent than actual events. Among the 2,669 actual events that reached the patient, only 2.5% (n=67) resulted in harm to the patient. As clinical settings were less effective in reporting errors, it may be appropriate to audit, review, and update the current transfusion error reporting procedures in these settings. Particular attention may be given to procedures targeting errors related to PR, RP, and UT, as these errors collectively represented the majority of the errors that reached the patient. Enhancing error reporting in both transfusion services and clinical settings will help identify problematic areas for improving transfusion safety. Continued participation in error identification and report efforts through the TESS is a key piece of the ongoing efforts to improve the safety of transfusions in Canada.

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Appendix

Appendix 1. Types of errors and corresponding descriptions

Error Code	Description of Event
Errors related to Distributor Codes (DC)	
DC 00	Not specified
DC 01	Collection issues
DC 02	Processing/Testing issues
DC 03	Labelling incorrect
DC 04	Incorrect packaging of product for transport
DC 05	Transport delayed / sent to wrong location
DC 06	Look-back / Trace-back issues
DC 07	Recall process not / incorrectly followed
DC 08	Order incompletely / incorrectly filled
DC 99	Other
Errors related to Product Check-in (PC)	
PC 00	Not specified
PC 01	Data entry incomplete/not performed/incorrect
PC 05	Inappropriate return to inventory
PC 06	Unit confirmation not done / incorrect
PC 07	Administrative check not done / incorrect
PC 99	Other
Errors related to Inventory Management (IM)	
IM 00	Not specified
IM 01	Inventory audit not done / incorrect
IM 02	Product status not / incorrectly updated in computer-internal only (available / discard)
IM 03	Supplier recall / look back / trace back not addressed appropriately
IM 04	Product ordered incorrectly / not submitted to supplier
IM 99	Other
Errors related to Unit Storage (US)	
US 00	Not specified
US 01	Incorrect storage of product in transfusion service
US 02	Expired product in stock
US 03	Inappropriate monitoring of storage device
US 04	Unit stored on incorrect shelf (Group / Autologous / Reserved)
US 99	Other
Errors related to Product Request (PR)	
PR 00	Not specified
PR 01	Order for wrong patient
PR 02	Order incorrectly entered (online order entry)
PR 03	Special needs not indicated (e.g. auto, CMV negative)
PR 04	Order not done / incorrect / incomplete

PR 06	Inappropriate order of a blood product (includes duplicate orders)
PR 07	Wrong product ordered (type)
PR 99	Other
Errors related to Sample Collection (SC)	
SC 00	Not specified
SC 01	Sample labelled with wrong patient identification
SC 02	Not Labelled
SC 03	Wrong patient collected (not from intended patient)
SC 04	Collected in wrong tube type
SC 05	Sample NSQ (Non-sufficient quantity)
SC 06	Sample haemolysed
SC 07	Label incomplete /illegible for key patient identifiers (name, identification, birthdate)
SC 08	Sample collected unnecessarily
SC 09	Requisition arrives without samples
SC 10	Armband incorrect / not available
SC 12	Label incomplete / illegible for non-key patient identifiers
SC 99	Other
Errors related to Sample Handling (SH)	
SH 00	Not specified
SH 01	Sample arrives without requisition
SH 02	Paperwork and sample ID do not match
SH 03	Patient ID incomplete/illegible on requisition
SH 04	No patient ID on requisition
SH 05	No phlebotomist / witness identification
SH 06	Sample arrives with incorrect type of requisition
SH 07	Patient information (other than ID) missing / incorrect on requisition
SH 10	Sample transport issues
SH 11	Incorrect test ordered / requested
SH 12	Test not ordered / requested
SH 99	Other
Errors related to Sample Receipt (SR)	
SR 00	Not specified
SR 01	Sample accepted in error
SR 02	Historical review incomplete or inadequate / not done
SR 03	Demographic review / entry incorrect / not done
SR 04	Sample incorrectly accessioned (test / product)
SR 99	Other
Errors related to Sample Testing (ST)	
ST 00	Not specified
ST 02	Appropriate sample check(s) not done / incorrect
ST 03	Computer warning overridden
ST 04	Data entry incomplete / not done
ST 05	Sample labelled with incorrect accession label
ST 06	Data entry incorrect
ST 09	Sample / test tubes mixed up / mislabelled

ST 12	Testing not done (ordered / confirmatory)
ST 13	Incorrect testing method chosen
ST 14	Testing performed incorrectly (did not follow SOP)
ST 15	Test result misinterpreted
ST 16	Inappropriate reagents used for testing
ST 19	Additional testing not performed
ST 20	Final check not done / incorrect
ST 21	Administrative check not done / incorrect (after the fact, record review, audit)
ST 22	Sample storage incorrect / inappropriate
ST 98	Quality control related (only to be used as 2nd event code)
ST 99	Other

Errors related to Request for Pick-up (RP)	
RP 00	Not specified
RP 01	Request for pick-up on wrong patient
RP 02	Incorrect type / dose of product requested for pick-up
RP 03	Product requested prior to obtaining consent
RP 04	Product requested for pick-up, patient not ready / unavailable
RP 05	Product requested for pick-up IV not ready
RP 06	Request for pick-up incomplete (no Pt. Id, MRN / or product indicated)
RP 10	Product transport issues (internal)
RP 99	Other

Errors related to Product Selection (PS)	
PS 00	Not specified
PS 01	Incorrect type / product / unit / dose selected
PS 07	Special needs not checked
PS 09	Special needs misinterpreted
PS 99	Other

Errors related to Unit Manipulation (UM)	
UM 00	Not specified
UM 01	Data entry incomplete / incorrect
UM 04	Final check not done / incorrect
UM 05	Labelling incorrect
UM 09	Special processing not done / incorrectly done
UM 10	Administrative check not done / incorrect
UM 99	Other

Errors related to Unit Issue (UI)	
UI 00	Not specified
UI 01	Data entry incomplete / incorrect
UI 04	Product issued to wrong patient
UI 06	LIS warning overridden (in error or outside SOP)
UI 09	Not checking/incorrect checking of unit and/or patient information)
UI 11	Product delivered to the incorrect location by the Transfusion Service (physical delivery)
UI 19	Wrong type / dose of product issued to right patient
UI 21	Receipt verification not done (pneumatic tube issue)
UI 22	Issue approval not obtained / documented

UI 99	Other
[redacted]	
Errors related to Unit Transfusion (UT)	
UT 00	Not specified
UT 01	Administered product to wrong patient
UT 02	Administered wrong type / dose of product to patient
UT 04	Incorrect storage of product on floor
UT 05	Bedside check not done / incorrect (unit / patient info)
UT 06	Administered product with incompatible IV fluid
UT 08	Wrong unit / product chosen from satellite refrigerator
UT 11	Appropriate monitoring of patient not done
UT 12	Floor/clinic did not check for existing units in their area
UT 13	Labelling incorrect
UT 22	Order / consent check not done / incorrect
UT 23	Documentation not complete / incorrect
UT 24	Documentation not returned
UT 25	Guidelines for product infusion not followed
UT 26	Transfusion reaction protocol not followed
UT 27	Monitoring of satellite fridge not done / incorrect
UT 28	Inappropriate preparation of product
UT 29	Product storage tracking incorrect / not done
UT 99	Other
[redacted]	
Miscellaneous Errors (MS)	
MS 00	Not specified
MS 03	Patient registration incomplete / incorrect
MS 04	Equipment / computer failure
MS 05	Equipment QC not done / documented
MS 06	Reagent/material event
MS 07	Patient incurred event
MS 99	Other