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Haemovigilance Annual report 2018

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Haemovigilance
Annual report 2018

Evaluation of haemovigilance reports in 2018

Credits

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Haemovigilance Annual report 2018

1. Thank you!

The haemovigilance system relies on the commitment of and cooperation between professionals in hospitals and the blood transfusion service. This annual report documents the successful collaboration of numerous committed representatives from various professional groups.

It is only thanks to their constant dedication that the data presented here could be collated and corresponding findings derived for enhanced transfusion safety. We would particularly like to thank all haemovigilance officers at this point. It is their openness in communicating and willingness to respond to queries by undertaking additional investigations and searches on individual reports that have enabled this report to be produced.

In addition to numerous other tasks in the respective hospitals, they have always been committed to the development and introduction of transfusion guidelines and the permanent training in these guidelines, thereby creating the foundation for implementing those improvements in transfusion safety identified from the totality of the reports.

2. Editorial

For the protection of patients, Switzerland has adopted a range of reporting obligations in relation to Swissmedic as the Swiss authority for the authorisation and monitoring of therapeutic products. One of these reporting obligations concerns the use of labile blood products. The details are specified in the Therapeutic Products Act (TPA), the Therapeutic Products Ordinance (TPO) and the Medicinal Products Licensing Ordinance (MPLO).

These statutory obligations also include the duty of care and thus a quality management system that includes continuous improvement – learning from our mistakes is essential. The "no blame culture" helps ensure that as many potential or actual sources of error and risk as possible are identified and avoided in future. The knowledge obtained should be reported openly so that haemovigilance officers in other hospitals and institutions are also able to benefit. One of the contributions made by Swissmedic to patient safety is the issuing of the "Guidelines for quality assurance in transfusion practice" which were developed jointly with cantonal authorities and the responsible specialists and which define the respective transfusion-related standards.

However, the statutory reporting obligations in respect of transfusions remain unaffected and the reporting timelines still have to be observed. Haemovigilance officers play a crucial role in this process. To enable them to carry out their important work, hospital managements must provide them with adequate resources and opportunities for the in-house training of professionals and the in-house implementation of standards in transfusion practice.

In future, Swissmedic will increasingly be reviewing the reporting rates in haemovigilance. A welcome development is the steady rise in the reporting rates across Switzerland in recent years. However, distinct differences are apparent in reporting behaviour. Swissmedic will focus more closely on this aspect in future.

Thank you for your interest. We hope you find this report to be a stimulating read.

The Swissmedic Haemovigilance team

[1] For ease of readability, this document uses the masculine form to refer to persons of either gender.

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3. Introduction

Targeted haemotherapy means that patients are given the correct, safe and effective blood product on time. This requires all the individuals concerned to take their share of responsibility, starting with the blood donor, the blood transfusion services as producers of labile blood products, the transfusion laboratories in hospitals, the treating doctors and the authorities.

For recording all incidents and transfusion reactions that occur between donor selection and the administration of the blood to the patient, haemovigilance requires reliable reports. First and foremost, this concerns the treating doctor, who is responsible for identifying and then reporting transfusion reactions to the haemovigilance officer in his institution. The position of the haemovigilance officer is needed as a result of the provisions of the Therapeutic Products Act (TPA). Specifically, the TPA, which entered into force on 01.01.2002, requires anyone who is responsible for approving activities with blood and labile blood products, as well as institutions that administer blood products, to designate an individual who is responsible for haemovigilance and complying with the associated reporting obligations. These reports form the basis of this annual report, serving as the substantive foundation for the evaluations presented here and providing information about the nature and frequency of undesirable transfusion reactions. The analysis and evaluation provide an up-to-date overall picture of transfusion safety and the nature and magnitude of the risks expected during the transfusion of labile blood products in Switzerland.

In order to obtain a comprehensive overview of transfusion-associated incidents in Switzerland, the involvement of all institutions that administer blood components in haemovigilance is essential. This requires direct communication between all the agencies involved.

3.1 Haemovigilance

Haemovigilance involves the recording, reporting, analysis and evaluation of suspected adverse transfusion events. Corresponding measures are derived to improve the quality and safety of transfusions and thereby promote patient safety.

The system is based on the reporting of all incidents and transfusion reactions occurring in the course of the transfusion process, from the donor selection to the administration of blood products to the patient. The evaluation of haemovigilance reports provides a picture of the current transfusion-related risks, can pinpoint the cause of preventable transfusion incidents and reveal areas where corrective measures are necessary and possible.

According to Art. 58 of the Therapeutic Products Act (TPA), Swissmedic is responsible for haemovigilance. Institutions that are licensed to carry out activities with blood and labile blood products (e.g. blood transfusion services) must, as part of their reporting system, designate an individual who is responsible for haemovigilance and the reporting of adverse events arising during the manufacture and distribution of products (MPLO Art. 28, TPO Art. 61 and 65).

Institutions that use labile blood products (hospitals) are obliged to operate a quality system, based on the latest scientific and technical findings, for reporting unexpected or adverse events during a transfusion, and also to designate an individual responsible for fulfilling the reporting obligations (in accordance with Art. 65, para. 4 TPO).

3.2 Definitions for HV reports

Any adverse or unexpected event that might be connected with the administration of labile blood products is reported to Swissmedic.

3.2.1 Transfusion reaction (TR)

Immunologically-related transfusion reactions	Cardiovascular and metabolic problems	Infections
• Transfusion-associated acute lung injury (TRALI)* • Allergic TR • Alloimmunisation • Febrile, non-haemolytic TR (FNHTR)* • Haemolytic TR (HTR) acute and delayed • Post-transfusion purpura (PTP) • Transfusion-associated graft-versus-host disease (Ta-GvHD)	• Severe hypothermia (mass transfusion) • Hyperkalaemia • Hypotensive TR • Calcium deficiency • Circulatory overload (TACO) • Transfusion-associated dyspnoea (TAD)	• Bacterial • Parasitic • Prions • Viral

*non-immunological mechanisms underlying these transfusion reactions are also considered.

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3.2.2 Severity

Grade 1:	**Non-severe**
Grade 2:	**Severe** **Permanent damage or permanent risk. If the following symptoms or findings are present, a transfusion reaction should be classified at least as severe:** • **Alloimmunisations** • **Fever > 39° C and > 2° C increase** • **Dyspnoea / hypoxia (other than a very mild form), pulmonary oedema** • **Loss of consciousness, drop in blood pressure (other than a very mild form)** • **Suspected haemolytic transfusion reaction** • **Suspected bacterial contamination / infection as a result of the transfusion** • **Positive blood cultures in patient or blood product** • **Timely intervention is necessary to avoid permanent damage or a life-threatening course**
Grade 3:	**Life-threatening**
Grade 4:	**Death**

The severity of a transfusion reaction is evaluated independently of its possible connection with the transfusion (imputability). For example, suspected cases of bacterial contamination or other infections should be classified as severe – and should remain so – even if the imputability is classified as 'unlikely' in the final evaluation.

3.2.3 Imputability

(Causal connection between transfusion and reaction)

0: not evaluable:	
1: excluded/unlikely:	**The reaction is definitely/more likely to be due to other causes**
2: possible:	**The reaction can be explained both by the transfusion and by other causes**
3: probable:	**The reaction does not appear to be due to another cause**
4: definite:	**In all probability the reaction was caused by the transfusion**

3.2.4 Other transfusion-related events that must be reported

Transfusion errors (IBCT, incorrect blood component transfused)	Near Misses (discovered pretransfusion errors)	Incidents during manufacture that must be reported
• Mistakenly transfused blood product, regardless of whether the patient experienced an adverse effect • Blood products intended for another patient • Blood products that are not suitable for the patient (e.g. not irradiated)	• Deviation discovered before the transfusion has taken place • Discrepancies relating to patient identification, sample tubes or the prescribing of blood products	• Safety risks for blood donors: Incidents that pose a threat to the health of the blood donor. • Donor and donation mix-ups • Incorrect release, incorrect labels • Release of out-of-specification blood products • Defective materials or reagents. Incorrect testing • Suspected quality defects • Detection of a blood-borne infection in a blood donor

3.2.5 Severity

Grade 1: **Non-severe**
Grade 2: **Severe**
Grade 3: **Life-threatening**
Grade 4: (death) is not used for transfusion errors and near misses (if a transfusion error is fatal, the case is recorded as Grade 4 in the transfusion reaction database and as Grade 3 in the transfusion error database).

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Table 1
Examples of severity classification of transfusion errors and Near Misses

Grade 1 (non-severe) Formal error with no potential for use by mistake	Grade 2 (severe) Formal error with potential for use by mistake or transfusion error involving a suboptimal product	Grade 3 Life-threatening Confusion occurring at some level in the transfusion chain
Examples: • Order form not initialled • Sample tubes not labelled correctly or order form incomplete • Minor discrepancy between tubes and order form • Deliberate Rhesus conversion in mass transfusions • Handling & storage with products discarded.	Examples: • Labels missing from sample tubes • Another patient's date of birth • Patient ID on sample tube differs from that on form • Transfusion error with unconfirmed allo-AB compatibility according to the SOP.	Examples: • Wrong blood in tube* (WBIT) • Discrepant BG determinations • Blood product orders for the wrong patient • Transfusion error ABO incompatible or ABO compatible only by chance * *Wrong Blood in Tube* means that the patient identification on the tube and order form does not match the patient whose blood is in the tube.

Donor reactions are reported to Swissmedic by the blood transfusion services. Severe reactions appear on the report form as individual case reports, the others are compiled into an annual summary in tabular form with no details of individual cases.

Quality defects and protective measures are usually reported to Swissmedic by the manufacturer. In most cases they involve infection markers, i.e. donors who have tested positive. However, quality defects and protective measures may also concern the users. Quality defects in a product are sometimes only detected in the hospital, and the hospitals are also actively involved in protective measures if products need to be traced (look-back).

4. Reports received

The evaluation of haemovigilance reports provides a picture of the current transfusion-related risks, can indicate the cause of preventable transfusion incidents and reveal areas where corrective measures are necessary and possible.

4.1 Overview

Table 2
Reports in 2018

Type	Number
Transfusion reactions	1 591
Transfusion errors / incorrect blood component transfused	45
Near misses (NM)	1 752
Donor reactions	31
Quality defects and protective measures	141
Total number of reports evaluated	**3 560**

Table 2 shows the number of reports involving labile blood products received in 2018. A total of 3,560 reports were received.

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Figure 1
HV reports by year

Events reported by year (2009 to 2018)

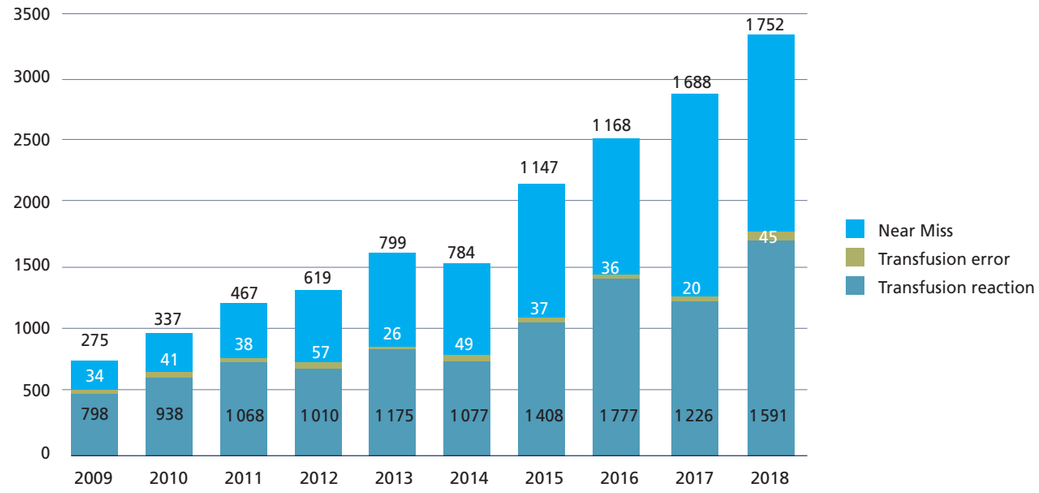


Figure 1 shows the number of HV reports received compared with previous years.

The increase in transfusion reactions in 2018 (n=1,591) compared to 2017 (n=1,226) is attributable to alloimmunisations. The near-miss reports have increased, with 1,752 reports in 2018 compared to 1,688 in 2017.

4.2. Number of transfusions and reporting rates

Table 3
Number of transfusions in Switzerland over the past 10 years

Blood components	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018[1]
pRBC	311 521	308 670	308 627	297 582	279 510	262 953	248 647	239 890	226 276	221 100
PC	29 600	29 900	33 068	34 265	34 750	35 328	36 439	38 374	37 490	38 947
FFP	70 300	61 500	50 063	49 832	44 083	38 183	33 658	33 310	29 303	30 552
Total	411 421	400 070	391 758	381 679	358 343	336 464	318 744	311 574	293 069	290 599

pRBC: packed red blood cells (Erythrozytenkonzentrat),
PC: platelet concentrates (Thrombozytenkonzentrat)
FFP: fresh frozen plasma (Frisch gefrorenes Plasma)
Data source: Blood Transfusion Service of the Swiss Red Cross.

Table 3 shows the number of transfusions given throughout Switzerland in the past 10 years. The figures are based on the number of blood components supplied as shown in the annual statistics of the Blood Transfusion Service of the Swiss Red Cross (1). These show a declining trend.

The reporting rate can be calculated from the number of transfusions.

Figure 2
Reporting rate, all reports

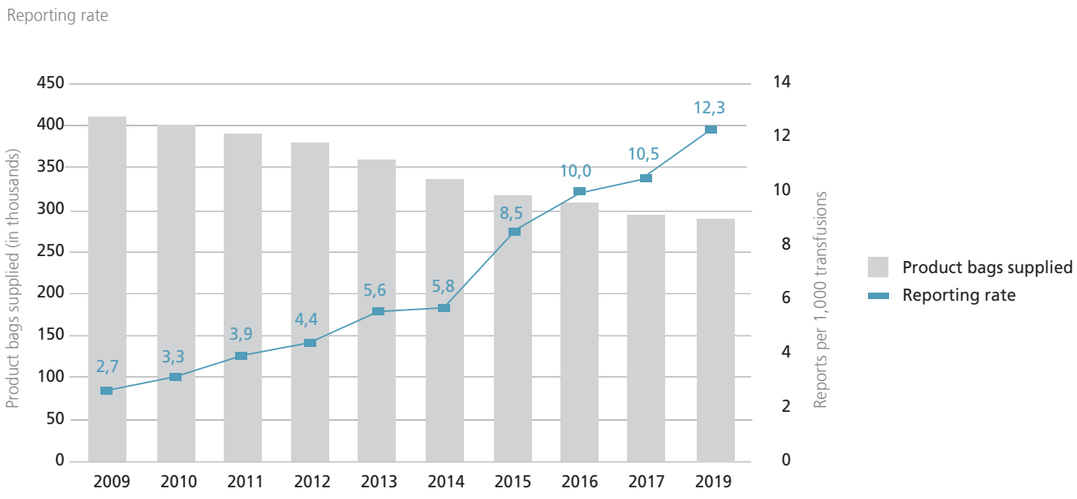


Figure 2 shows the overall reporting rate. The reporting rate is calculated from the total number of reports (n=3,560 for 2018) per 1,000 transfusions (product bags supplied). The reporting rate rose again in 2018: 12.3 reports per 1,000 transfusions in 2018 versus 10.5 in 2017.

4.3 Transfusion reactions

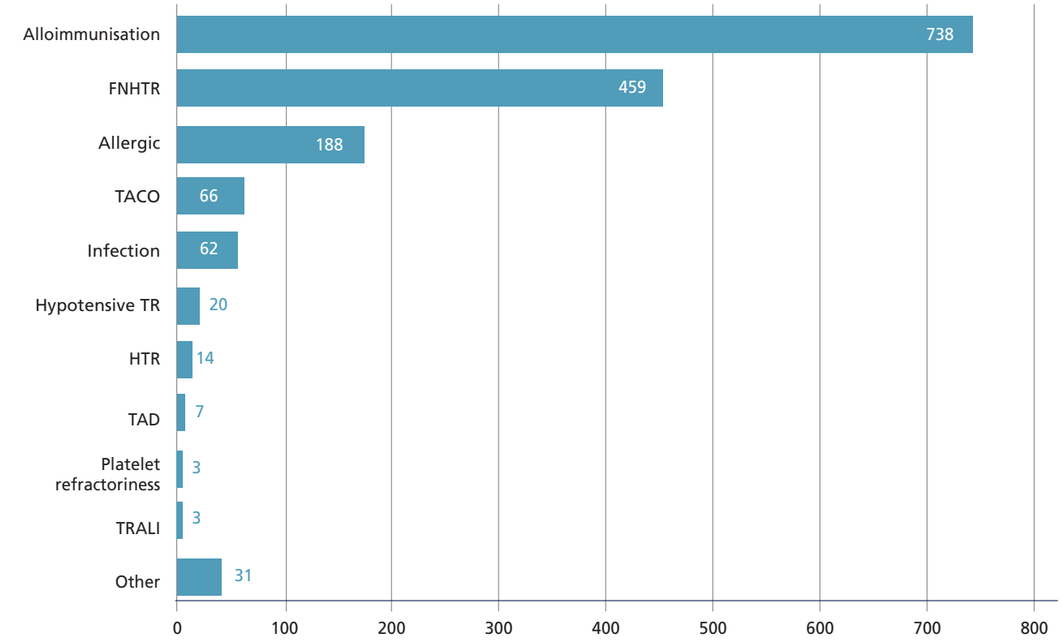
Transfusion reactions: All reported cases are recorded in the transfusion reaction database.
Each case is classified by:

- Category (allergic reaction, haemolytic reaction etc.)
- Severity 1-4 (see above for definitions)
- Imputability 0-4 (see above for definitions)

Overview

Figure 3
TR reported in 2018 by category

Transfusion reactions according to category



1,591 transfusion reactions were reported in 2018. This chart takes all levels of severity and imputability into account. As in previous years, the reactions most frequently observed were alloimmunisations, FNHTR and allergic TR. These account for approx. 87% of all reported transfusion reactions.

Table 4
Décès en 2018

	Imputability				Total
	1	**2**	**3**	**4**	
TACO	0	0	2	0	**2**
FNHTR	1	0	0	0	**1**
TRALI	0	2	0	0	**2**
Allergic	0	1	0	0	**1**
Other	1	1	0	0	**2**
Total	**2**	**4**	**2**	**0**	**8**

Imputability 1: excluded/unlikely, 2: possible, 3: probable, 4: certain.

Table 4: Reported deaths in 2018 by diagnosis and imputability. A total of eight deaths were reported in 2018. Since two of these had low imputability, a causal relationship with the transfusion is classed as unlikely. Imputability was considered possible in four cases. The dependence between the transfusion and the death cannot be clearly excluded in these cases. In two other cases, a causal relationship between the transfusion and the death is classed as probable.

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Imputability	Description
excluded/ unlikely	• Multimorbid female patient, hospitalised for bilateral aspiration pneumonia. The patient was already hypoxic and tachypnoeic before the transfusion. After approx. 100ml of the pRBC transfusion, the hypoxia deteriorated and was followed by a rise in temperature. The transfusion was stopped. No evidence of cardiac overload. The clinical picture did not improve and the patient remained hypoxic and tachypnoeic, most likely due to her underlying illness. The patient died two days later. • Orthopaedic procedure in a female patient with metastatic malignant melanoma and terminal renal failure requiring dialysis. Since bleeding occurred during the operation, the patient was transfused postoperatively. Approx. 6 hours after transfusion and a complicated stay in intensive care, her general condition progressively deteriorated, with subsequent liver failure and death.
possible	• Patient with MDS receiving supportive therapy. Multi-transfused with development of iron overload (last measured level > 2000mcg/l), with deliberate omission of iron chelation therapy. After receiving a pRBC transfusion, the patient complained of feeling acutely unwell, and subsequently lost consciousness and died. The underlying causes were an acute circulatory collapse and arrhythmia. A connection between the transfusion-related iron overload and the cardiac arrest could not be ruled out. • Heart surgery was followed by several transfusions of different blood products. The patient became highly unstable, and was given vasoactive agents and transferred to intensive care, where he was stabilised. During a pRBC transfusion on the fourth postoperative day there was a sudden and sustained drop in blood pressure, with complete cardiovascular arrest and PEA. Mechanical and medical CPR proved unsuccessful. Possibilities considered in the differential diagnosis included anaphylactic shock in connection with the transfusion, and this could not be ruled out. • Polymorbid patient, received several ECs before and during surgery. During intubation, aspiration followed by persistent hypotension despite vasoactive therapy. X-ray image shows an ARDS, stabilization was not possible. Exitus lethalis on the same day.
probably	• Gastrointestinal bleeding on oral anticoagulants with resulting anaemia and known LV dysfunction, hypertensive heart disease, chronic renal insufficiency and COPD. The patient was given intravenous volume replacement with and two units of pRBC. Both were transfused over one hour, with a break of two hours between each unit of pRBC. Shortly after the transfusion of the second unit, tachypnoea and a drop in SpO2 occurred. With rattling respiration and a GCS of 3, the patient died within a few minutes. • Palliative treatment for metastatic prostate cancer in a patient who had suffered a myocardial infarction one month previously. In response to the transfusion of 1 unit of pRBC and 1 of PC, the patient became dyspnoeic and showed a substantial drop in oxygen saturation. On clinical examination, rales were audible over the whole lung. Clinical improvement with furosemide and oxygen, after which it was decided to transfuse another unit of pRBC. During this transfusion there was a further episode of acute dyspnoea and substantial drop in saturation, and rales could again be heard over the whole lung. The decision was taken to make the patient as comfortable as possible, and he subsequently died on the same day.

One case concerning a TRALI is not described in this connection, since the investigations were still ongoing when this annual report was being prepared.

Imputability

Number of transfusion reactions in 2018 by diagnosis and imputability

Table 5
Imputability

	Imputability				Total
	1	**2**	**3**	**4**	
Alloimmunisation	0	1	465	272	**738**
FNHTR	100	267	79	12	**458***
Allergic TR	2	40	107	39	**188**
TACO	1	23	31	11	**66**
Infection	57	5	0	0	**62**
Hypotensive TR	0	7	9	4	**20**
HTR	1	4	4	5	**14**
TAD	0	5	2	0	**7**
TRALI	0	2	0	1	**3**
Platelet refractoriness	0	0	2	1	**3**
Other	7	17	5	2	**31**
Total	**168**	**371**	**704**	**347**	**1 590**

Imputability 1: excluded/unlikely, 2: possible, 3: probable, 4: certain.

*Plus one transfusion reaction for which the imputability could not be evaluated.

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Severity

Only those transfusion reactions with an imputability of 2, 3 or 4 (possible, probable or certain) are presented here.

Table 6
Severity

	Severity				Total
	1	**2**	**3**	**4**	
Alloimmunisation	0	738	0	0	**738**
FNHTR	333	25	0	0	**358**
Allergic TR	140	36	9	1	**186**
TACO	18	30	15	2	**65**
Hypotensive TR	2	16	2	0	**20**
HTR	2	8	3	0	**13**
TAD	2	5	0	0	**7**
Infection	0	5	0	0	**5**
TRALI	0	0	1	2	**3**
Platelet refractoriness	0	3	0	0	**3**
Other	21	1	1	1	**24**
Total	**518**	**867**	**31**	**6**	**1 422**

Severity 1: non-severe, 2: severe/permanent damage, 3: life-threatening, 4: death.

A total of six deaths and 31 life-threatening transfusion reactions with an imputability of 2, 3 or 4 were reported in 2018. The cause in almost half (46 %) of the life-threatening reports was found to be TACO.

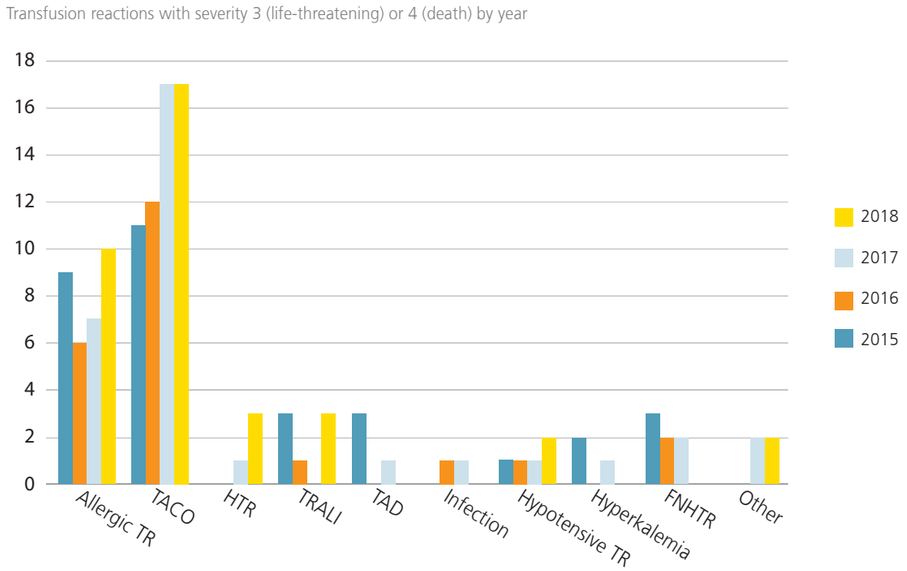
Life-threatening or fatal (severities 3 and 4) transfusion reactions

Table 7
Life-threatening or fatal TR (severities 3 and 4)

	possible	probable	definite	Total
TACO	5	7	5	**17**
Allergic TR	5	4	1	**10**
TRALI	2	0	1	**3**
HTR	0	1	2	**3**
Hypotensive TR	0	2	0	**2**
Other	2	0	0	**2**
Total	**14**	**14**	**9**	**37**

By way of comparison:
in 2017, 33 transfusion reactions with an imputability of 2, 3 or 4 (including 20 with an imputability of 3 or 4) were reported to Swissmedic, compared to 37 in 2018 (including 23 with an imputability of 3 or 4).

Figure 4
Life-threatening or fatal TR



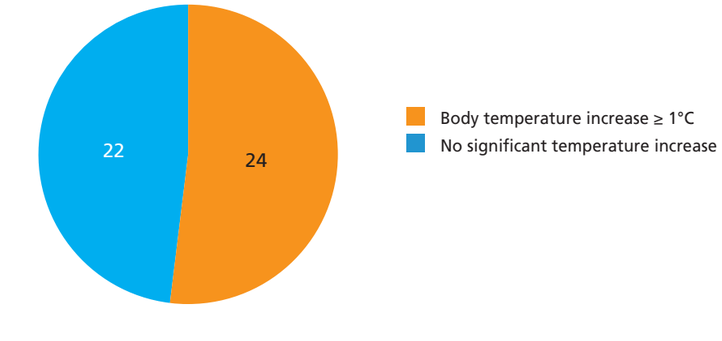
TACO (n=17 in 2018) and allergic TR (n=10 in 2018) remain the most frequent causes in life-threatening or fatal transfusion reactions.

TACO and fever

A total of 66 TACO cases were reported in 2018. In 46 (69.7%) of these 66 TACO cases, the rise in temperature was observed before and after the transfusion reaction. An increase in temperature of ≥ 1°C was documented in 22 (47.8%) of these 46 cases. These results confirm the observations of current publications and lead to the conclusion that the rise in temperature cannot be used as a criterion in the differential diagnosis of TRALI/TACO. (2)

Figure 5
Change in body temperature in TACO cases

Body temperature changes in TACO cases

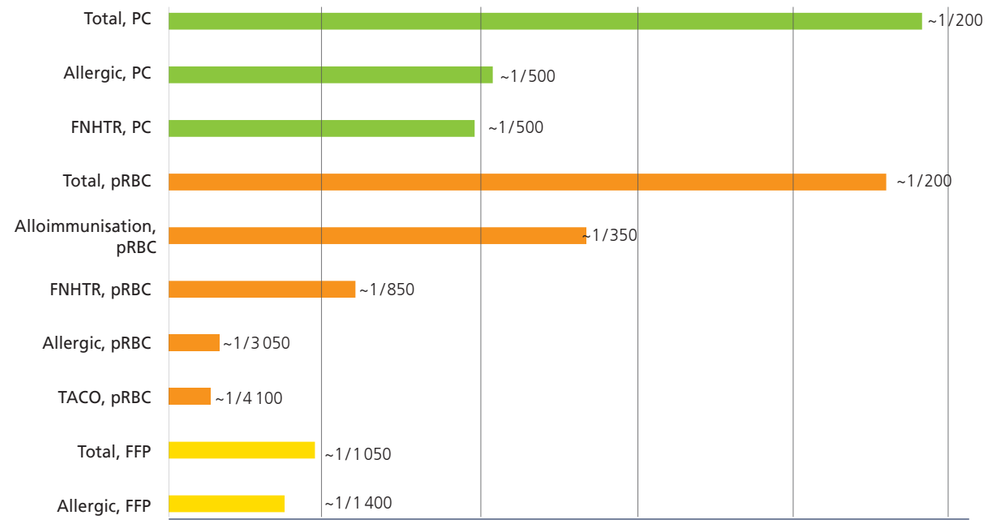


Product-specific risks

Reporting rates in 2018 per product, imputability of 2, 3 or 4 – all severities.

Figure 6
Reporting rate by component

Reporting rate according to reaction and blood component

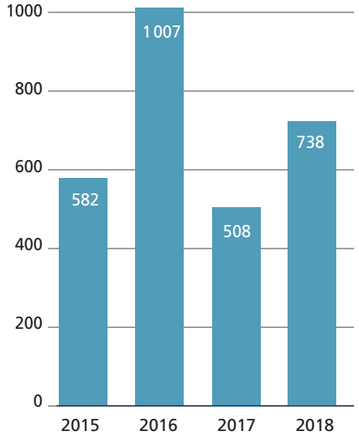


pRBC: packed red blood cells
PC: platelet concentrates
FFP: fresh frozen plasma

Figure 6 shows a comparison of the product-specific reporting rates. Platelet concentrates (PC) showed the highest reporting rate, with approx. 1 transfusion reaction per 200 supplied PC bags. The most frequent reactions observed in 2018 for PC were allergic reactions (approx. 1/500) and FNHTR (likewise approx. 1/500). While allergic reaction was also the commonest reaction seen with fresh frozen plasma (FFP), it occurred less frequently than with PC (approx. 1/1,400). The reporting rate for packed red blood cells (pRBC) was approx. 1/200; the reactions that occurred most frequently were Alloimmunisations (approx. 1/350) and FNHTR (approx. 1/850). In contrast to PC and FFP, allergic reactions were much rarer with pRBC (approx. 1/3,050).

Alloimmunisations

Figure 7
Alloimmunisation reports by year



The increase in Alloimmunisations in 2018 is partly due to the inclusion of Alloimmunisation cases from 2017 that were submitted late. The same applies to 2018 cases that were not submitted on time. These will be recorded for 2019.

Table 8
Alloimmunisation reports by BG system

Name	ISBT #	%
Rh (RH)	004	46.0
Kell (KEL)	006	18.8
MNS (MNS)	002	9.6
Kidd (JK)	009	7.6
Duffy (FY)	008	5.2
Lutheran (LU)	005	5.1
Lewis (LE)	007	4.7
Diego (DI)	010	1.0
Other		2.0
Total		100.0

Figure 8
Alloimmunisations by BG system%

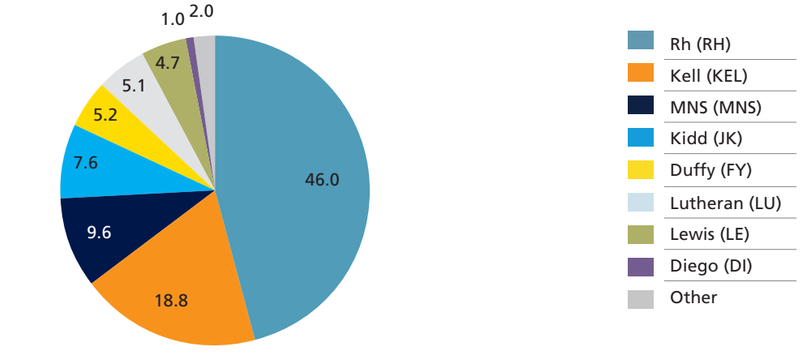
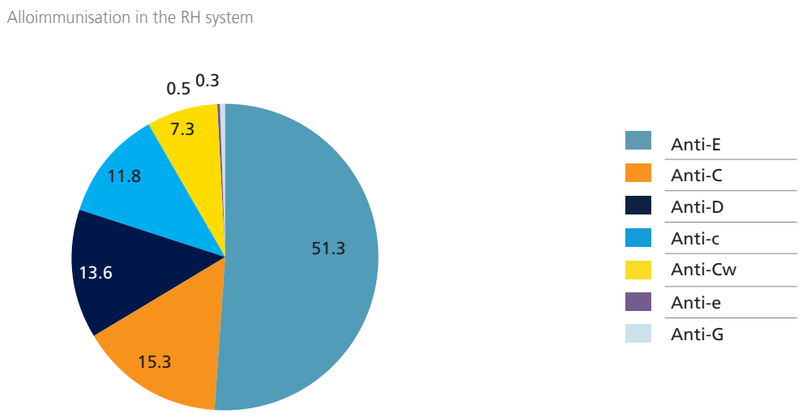


Figure 9
Alloimmunisations in the Rh system



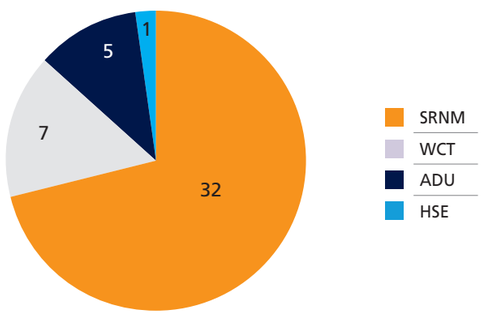
For the Rh system, 204 Anti-E, 61 Anti-C, 54 Anti-D, 47 Anti-c, 29 Anti-Cw, 2 Anti-e and 1 Anti-G cases were reported.

Alloimmunisations accounted for the bulk of the transfusion reactions with severity 2. Allo-antibody formation signifies a permanent disadvantage for the affected patients, since a limited choice of compatible blood components will be available for any future transfusions. During pregnancy these antibodies can lead to haemolytic disease of the newborn (HDN).

4.4 IBCT

Transfusion errors are analysed according to their classification and localisation of the deviation in the transfusion chain. A total of 45 transfusion errors were reported to Swissmedic in 2018.

Figure 10
IBCT
Transfusion errors classification



SRNM: Specific requirements not met
WCT: Wrong component transfused
ADU: Avoidable, Delayed or Under-/Over-transfusion
According to SHOT definition. (3)

Subclassification of transfusion errors

Table 9
Subclassification of IBCT

Transfusion errors classification[2]		n		n
IBCT (Incorrect blood components transfused)	WCT (Wrong component transfused)	7	ABO-incompatible	2
			ABO-compatible by chance	4
			Wrong product	1
	SRNM (Specific requirements not met)	32	Non-irradiated	1
			Failure to use phenotyped blood	25*
			Failure to follow SOP	6
HSE (Handling and storage errors)		1	Other	1
ADU (Avoidable, Delayed or Under-/ Over-transfusion)		5	Overtransfusion	5
Total		45		45

ransfusion errors were classified according to SHOT definitions (3).

*Of these 25 cases, 14 were deliberate decisions (e.g. Rhesus conversion in mass transfusions) that are permitted by the SOPs.

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Localisation of the error

Table 10
Localisation IBCT

Transfusion errors classification		Clinical	Laboratory	Total
IBCT (Incorrect blood components transfused)	SRNM (Specific requirements not met)	24	8	32
	WCT (Wrong component transfused)	5	2	7
HSE (Handling and storage errors)		1	0	1
ADU (Avoidable, Delayed or Under-/ Over-transfusion)		5	0	5
Total		35	10	45

The analysis of localisation shows that more errors occur during ordering and administration than during preparation in the laboratory. Laboratory IT systems (LIS) support the measures for minimising the number of errors in the laboratory.

4.5 Near Miss reports

The quality assurance systems in the individual hospitals and blood transfusion services have continued to develop and improve this year. The increase in near-miss reports from 1,688 events (reporting rate of 5.8) in 2017 to 1,752 reports (reporting rate of 6.0) in 2018 reflects an increased willingness to approach critical events openly.

It is a question of accepting that errors happen and that they can be identified and rectified only by discovering and dealing with the causes, thereby preventing the same errors occurring repeatedly. Corresponding training is needed to ensure that the open approach to deviations in the daily routine is implemented successfully.

This training must involve all the relevant professional groups, take place in all areas / hospitals where blood products are transfused and cover the whole transfusion chain. This task requires considerable time, resources and, above all, continuity – particularly in areas where there are frequent staff changes.

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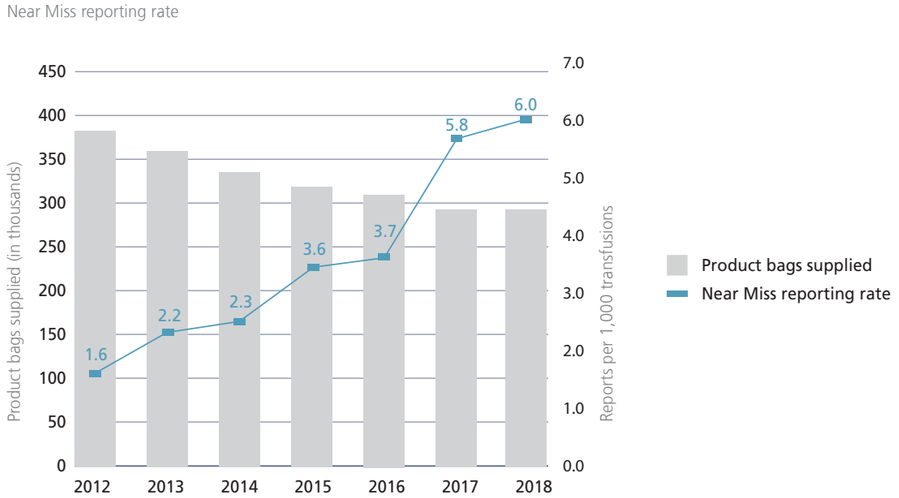
Figure 11
Near Miss reporting rate by year



4.5.1 Near Mmiss by severity and localisation

Near Miss events are analysed according to their severity and localisation of the deviation in the transfusion chain. The severity of near-miss events is determined according to the possible consequences that could have arisen if the event had not been detected. Therefore, every sample mix-up should be considered as a life-threatening scenario because it could potentially lead to an ABO-incompatible transfusion.

Table 11
Severity

Severity	n
Non-severe	688
Severe	721
Life-threatening	343
Total	**1752**

Figure 12
Near Miss severity

Near Miss reports according to severity

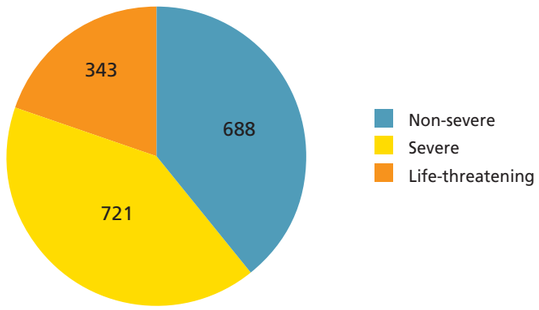
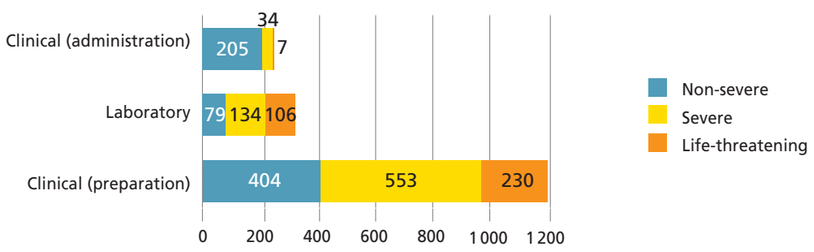


Figure 13
Near Miss severity and localisation

Near Miss according to severity and localisation



The origin of most NM events arose during preparation, with 1,187 cases, followed by 319 events in the laboratory and 246 cases at the time of administration.

The seven serious cases during administration included incorrect labelling of the packed red blood cell units and discovery of the mistake during the check before transfusion at the patient's bed, or the collection of blood products for the wrong patient, which was likewise noticed at the patient's bed. In these cases, the 4-eyes principle was able to prevent the administration of the wrong transfusion.

4.5.2 Discovery

Table 12
Near Miss discovery

		Discovery of the deviation		
		Ward/Op	Laboratory	**Total**
Stage at which the deviation occured	Clinical (preparation)	32	1 155	**1 187**
	Laboratory	21	298	**319**
	Clinical (administration)	9	237	**246**
Total		**62**	**1 690**	**1 752**

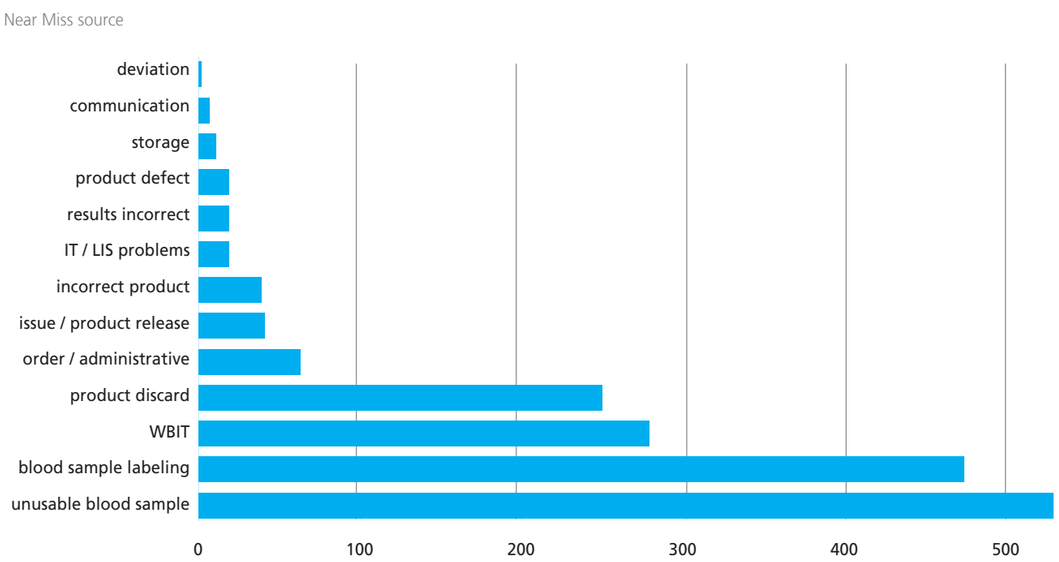
Table 12 shows the localisation of the deviation (rows) and the localisation of the discovery of the deviation (columns). Most of the deviations were discovered in the laboratory.

68% of all near-miss events happened during sampling before transfusion. This includes all deviations that prevent a sample from being unambiguously assigned to the patient receiving the transfusion (patient mix-ups, sample mix-ups, sample/order labelling errors, etc.). 65% of these cases were noticed during the incoming inspection of the samples in the laboratory. Examples include: Sample label missing or incomplete, details of the wrong patient on the sample, discrepancy between labelling on the sample and order, etc.

The incoming inspection of samples in the laboratory is an important safety precaution for preventing transfusion errors. But this is not enough on its own, as indicated by 279 cases of WBIT (16%) which passed unnoticed during the incoming inspection. Only in light of a blood group discrepancy between the actual assay and a previous result was it realised that a mix-up had occurred during the blood sample collection. But the existence of a previous result was needed for its discovery. Without a previous determination of the blood group such a mix-up would remain undiscovered, and a possible consequence would be an ABO-incompatible transfusion.

4.5.3 Near Miss incidents according to cause

Figure 14
Near Miss according to cause



The main causes of NM events were inappropriate blood sample collection, defective / poor labelling of samples and patient mix-ups. Sample and patient mix-ups and labelling errors followed the same pattern:

The sample tubes were labelled in advance and then – due to the failure to check the patient's identity – blood was collected from the wrong patient, or else the unlabelled sample tubes were filled and subsequently (at the nurses' station) labelled with the details of another patient. It is essential therefore that both the blood collection for T&S and the correct patient identification are carried out strictly according to procedure (active identification of the patient, sample labelling at the patient's bed).

Experience has shown that this must be taught and repeatedly emphasised so that the nurses carrying out these tasks are aware of and constantly alerted to the importance of repeated checks – particularly on the patient's identity – in avoiding mix-ups.

In areas with frequently changing staff, regular training and awareness-raising sessions are essential! The serious transfusion errors usually occur as a result of mix-ups. Confirming and checking identity is therefore essential at every stage of the transfusion preparation and administration process!

4.6 Donor reactions

4.6.1 Overview

In 2018, Swissmedic received a total of 31 reports.

Table 13
Donor reactions (summarised briefly in quantitative terms)

Severity	Local symptoms	Vasovagal reactions	Other	Total
Non-severe	0	8	0	8
Severe	3	3	0	6
Life-threatening	1	15	1	17
Death	0	0	0	0
Total	**4**	**26**	**1**	**31**

Overall, "vasovagal reactions", with 15 cases, were the most common donor reactions in grade 3 (no grade 4 reports were received in 2018). A large proportion of the cases were classified as grade 3 because the donor had to be referred to a hospital.

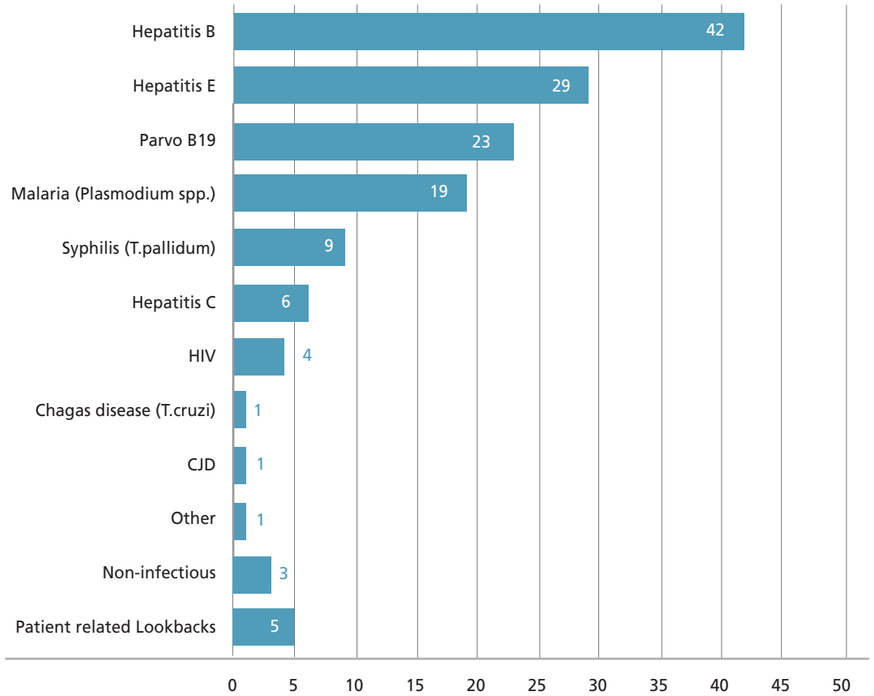
4.7 Quality defects and protective measures

Manufacturers (including blood stores) are required to report the protective measures adopted when quality defects are identified. This includes situations in which donors test positive for infection markers. The individual case reports are entered in the Swissmedic database and evaluated both globally and pathogen-specifically.

4.7.1 Overview

In 2018, a total of 141 reports were received concerning protective measures for positive infection markers and quality defects.

Figure 15
Quality defects and protective measures



Two donors had each tested positive for two infection markers at the same time (both with HBV and *Plasmodium spp.*). The non-infectious category generally involved quality deviations or technical problems.

The "Other" category involved a suspected transmission of Lyme disease (it was discovered retrospectively that the donor was suffering from this disease). However, transmission to the recipient of the blood product was ruled out.

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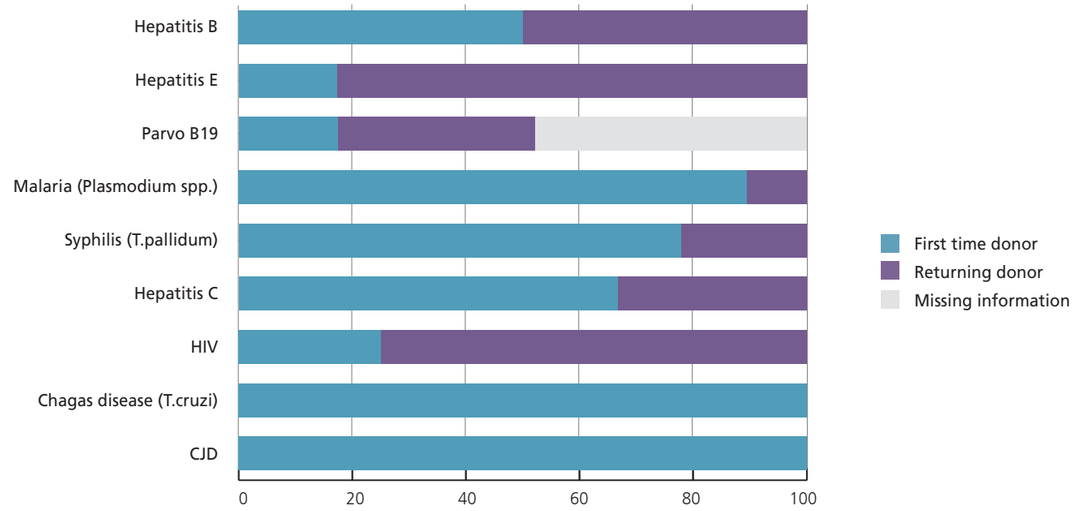
4.7.2 Infection markers and donor status

Figure 16
Infection markers and donor status



4.8. Patient-specific Look-Back procedures

Table 14
Look-Back procedures in 2018

Infectious marker	Number of cases	Excluded	Not excluded	Still under investigation on 31.12.2018
HBV	1	1	0	0
HEV	3	2	0	1
HIV	1	1	0	0

Out of a total of 5 Look-Back procedures, 4 (1 HBV, 2 HEV, 1 HIV) showed a negative result (the patients had not acquired the infection by the transfused blood products, but by some other route), 1 HEV case is still being processed (figures from the annual statistics of the Blood Transfusion Service of the Swiss Red Cross).

5. Findings and prevention

Based on the analysis of the haemovigilance reports received in 2018, we currently recommend the following as the most important measure for increasing transfusion safety: the targeted determination of, and compliance with, transfusion rates in all patients, and the close clinical monitoring of patients who are at increased risk of TACO. Based on the current data, the magnitude of the transfusion risks can be estimated and suitable measures to reduce these risks can be identified.

5.1 TACO prevention

IlTACO can be prevented by identifying at-risk patients and implementing preventive measures. The increase in serious cases of TACO in recent years prompted Swissmedic to issue a TACO checklist. This checklist consists of two parts: The first part addresses the risk factors and the second part the preventive measures.

The risk factors considered are taken from the literature (4) (5) (6) (7) (8) (9) and included:
- LV dysfunction
- Heart failure
- Patient taking diuretics
- Chronic kidney disease
- Previous TACO reaction
- Positive fluid balance
- Acute kidney injury
- Elevated blood pressure
- Elevated proBNP
- Recent emergency surgery

The proposed preventive measure is primarily designed to ensure strict checking of the indication and timing. If the indication is correct and the patient needs to be transfused immediately, preventive measures must be taken:
- Clinical, individual evaluation of the prophylactic administration of diuretics. (10)
- Adaptation of the infusion rate (5) (max. 1ml/kg/h)
- Close monitoring, as certain vital parameters change very rapidly in at-risk patients. (11)
- Prescribe only one blood product at a time, and reassess the patient and anaemia before ordering another unit. (5) (7)

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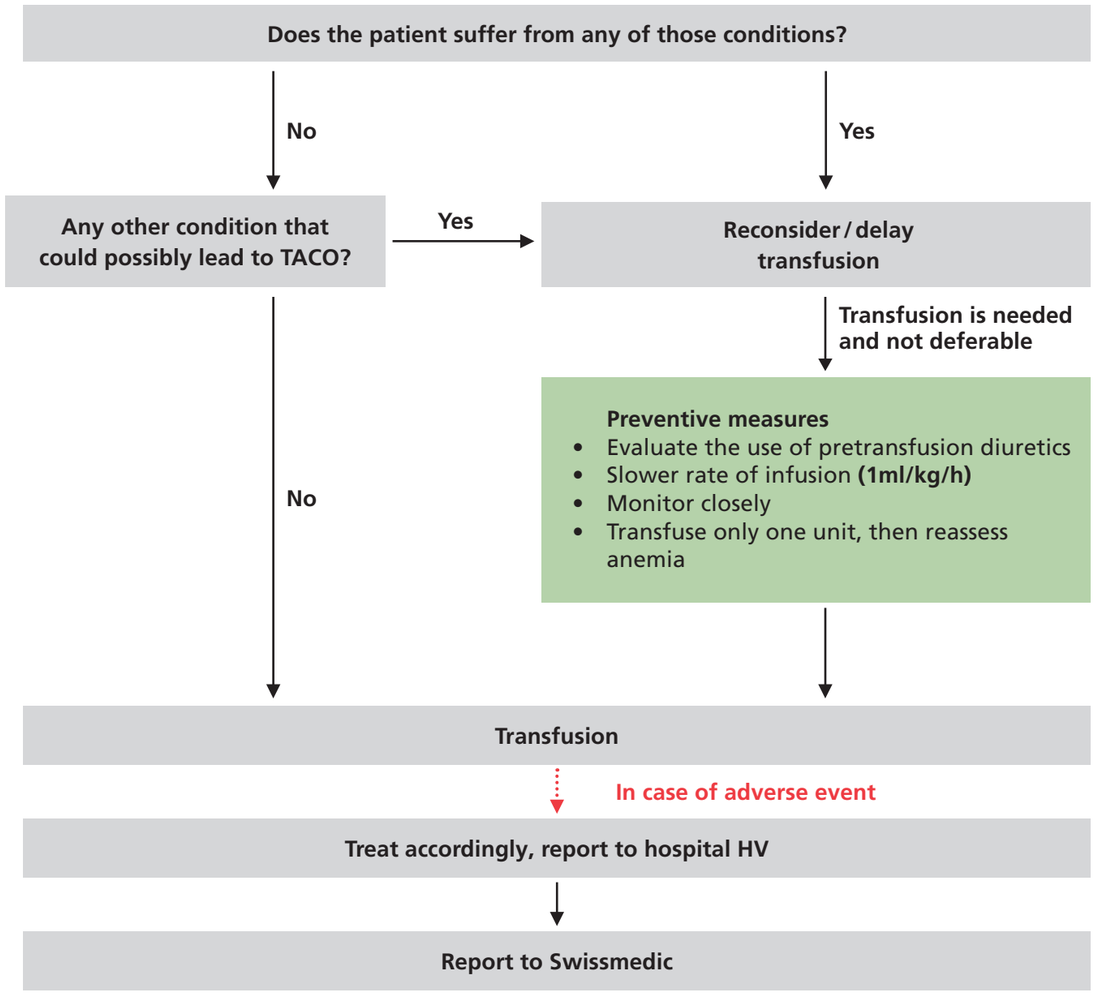
5.2 TACO Checklist

Consider the following risk factors for TACO

1 Patient's history
- LV Dysfunction
- Heart failure
- Patient is on regular diuretic
- Chronic kidney disease
- Known previous TACO

2 Current condition
- Positive fluid balance
- Acute kidney injury
- Elevated blood pressure
- Elevated proBNP
- Underwent emergency surgery



6. Findings from our working visits

The management of the clinical transfusion process is part of haemovigilance and pursues the following aims:

- Provide patients, when needed, with suitable blood components as quickly as possible
- Offer patients and doctors maximum safety
- Minimise expired products and waste

The transfusion triggers should be based on the latest scientific evidence, specified in the internal guidelines of hospitals and practice and followed. They should take account of current findings, such as alternatives to transfusion or as part of patient blood management (PBM) and seek to minimise the consumption of labile blood products (12).

After the patient's risk of bleeding and the potential need for a transfusion have been reviewed, it is important to order a type and screen (T&S) before a transfusion. One of the most important risks for surgical patients is an error when sending a T&S sample before operation!

6.1 Type and Screen (T&S)

Case report: Female patient with known antibody (IgG type) admitted to hospital for a birth. No T&S implemented. Since complications occurred during the birth, the patient had to be taken to the operating theatre for a caesarean section. A T&S sample was taken and sent to the blood transfusion service. Delays and communication errors occurred between the theatre, laboratory and blood transfusion service. Time passed and questions (when will the product arrive?) could not be followed up. During this time the patient's general condition steadily deteriorated. It was decided to administer "universal blood". The transfused units were administered without crossmatching (no tolerability sample with known AB).

If a patient is to undergo elective surgery in which blood loss requiring transfusion is expected or a planned red blood cell transfusion is needed, a type and screen must be ordered beforehand. A transfusion probability of 5 % or above is sufficient for ordering a unit of pRBC (13) (14).

In hospitals, the T&S decision can be based on the maximum surgical blood order schedule (MSBOS). MSBOS, which was first described in the 1970s, is a list of recommended preoperative blood orders for various types of surgical procedures (15). Numerous changes have since occurred in the surgical procedures and blood management, including the introduction of laparoscopic and robotic techniques, intraoperative autologous blood recovery, haemostatic methods and a general improvement in surgical techniques. The blood order lists, for example, constantly have to be revised by the hospital transfusion committee. In transfusion medicine, MSBOS helps in identifying those surgical cases that might require blood and those that do not.

Avoidable delays in ordering a necessary transfusion should be viewed as process errors (16). Such delays are particularly critical and problematic when patients are taken to the operating theatre before the T&S is concluded. If an unforeseen surgical blood loss then occurs, it is important for the blood to arrive in theatre on time. The time between the ordering and receipt of the blood product can be measured. This time, also known as turnaround time (TAT), is an important quality indicator in the hospital (17). Both the procedure in emergency

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or crisis situations and the indication for specific blood products (irradiated blood products, Rhesus/Kell phenotype-compatible blood products, etc.) are regulated in internal guidelines.

The transfusion of uncrossmatched packed red blood cells with a known antibody as a result of process errors is extremely dangerous.

Without exception, a type and screen (blood group, Rhesus factor and antibody screening) must be carried out before any procedure requiring a transfusion.

6.2 Reporting Alloimmunisations

Allo-antibody formation signifies a permanent disadvantage for the affected patients, since a limited choice of compatible blood components will be available for any future transfusions. Allo-antibodies (Allo-AB) may be formed during transfusions or pregnancy and are directed against antigens that the affected person does not have. Most of these antibodies could lead to (usually) delayed haemolytic reactions in the recipient in the course of a subsequent transfusion. If the recipient becomes pregnant, there is also the risk of some of these antibodies triggering haemolysis in the foetus or new-born child.

It is not always possible to differentiate between a new immunisation and the stimulation of an antibody that is already present but not detectable in the pretransfusion analysis. Alloimmunisations caused by a transfusion must be reported. However, since it is not always possible to decide, in women, whether the allo-AB was formed as a result of a previous pregnancy or a previous transfusion, the newly discovered cases of alloimmunisation has to be reported. The Imputability will be evaluated accordingly. Only through the widest possible recording of alloimmunisations and their analysis by antibody type and patient will it be possible to produce useful recommendations for avoiding this transfusion reaction. We would encourage all immunhaematology laboratories that carry out pretransfusion analyses to record these alloimmunisations after transfusions and report them to Swissmedic.

- The forwarding of relevant immunhaematology findings between hospitals could help avoid HTRs due to disregarded allo-AB that are no longer detectable (regional / national networking of data systems).
- Reporting all newly occurring alloimmunisations as a basis for any preventive measures.

6.3 Haemovigilance reporting route

The reporting route primarily concerns the treating doctor, who is responsible for identifying and then reporting transfusion reactions to the haemovigilance officer in his institution. The position of the haemovigilance officer has become necessary as a result of the provisions of the Therapeutic Products Act (TPA). The TPA requires anyone who is responsible for approving activities with blood and labile blood products, as well as institutions that administer blood products, to designate an individual who is responsible for haemovigilance and complying with the associated reporting obligations.

When the clinical and laboratory-specific investigation of the transfusion reaction is concluded, the haemovigilance officer reports this, using the specially designated official report form, to Swissmedic and the blood transfusion service that supplied the blood product. This is particularly useful if a quality defect associated with the transfused blood product is suspected, so that the manufacturer can act immediately and, if necessary, block further blood products.

After reviewing the product details, the blood transfusion centre then forwards the report of the transfusion reaction to the Haemovigilance department at Swissmedic. The Swissmedic Haemovigilance department only requires anonymised details of the incident and does not even require the name of the doctor directly involved. However, haemovigilance officers have to be identified so that they can to respond to any queries about the incident for a better understanding of the causes

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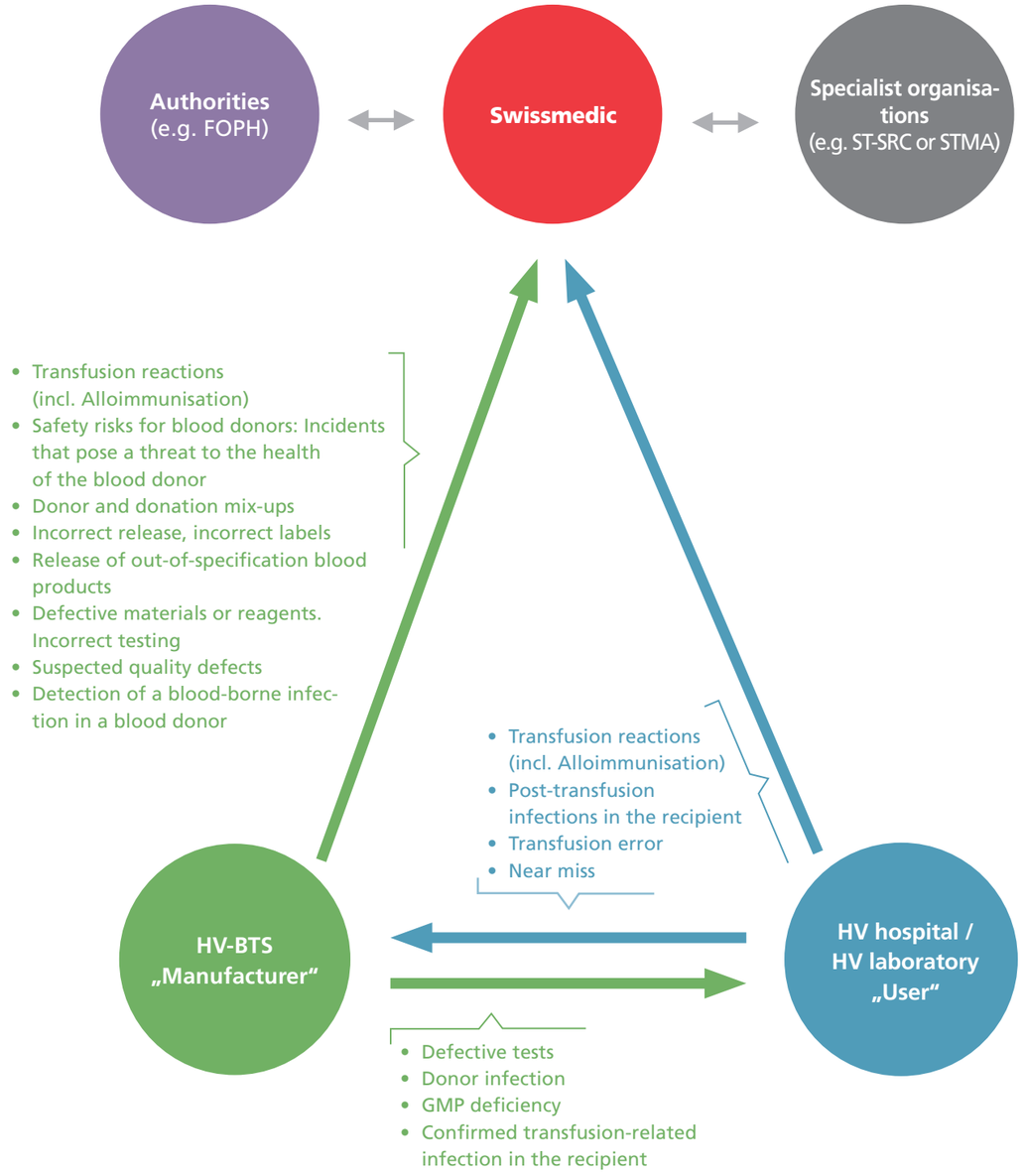
Figure 17
Haemovigilance reporting routes



Abbreviations

°C	degrees Celsius
ABO	ABO blood group system
ADU	avoidable, delayed or under/overtransfusion
AB	antibodies
BG	blood group
BD/BTO	blood donation/blood transfusion organisation
CH	Switzerland
CPR	cardiopulmonary resuscitation
CV	cardiovascular
e.g.	for example
FFP	fresh frozen plasma
FNHTR	febrile non-haemolytic transfusion reaction
GCS	Glasgow Coma Scale
HBV	hepatitis B virus
HCV	hepatitis C virus
HDN	haemolytic disease of the newborn
HEV	hepatitis E virus
HIV	human immunodeficiency virus
HTR	haemolytic transfusion reaction
HV	haemovigilance
HVO	haemovigilance officer
IBCT	incorrect blood component transfused
LIS	laboratory information system
mcg/l	micrograms/litre
ml	millilitre
NM	near miss
O2	oxygen
OAC	oral anticoagulants
PBM	patient blood management
PC	platelet concentrate (PCa: apheresis-derived; PCb: whole blood-derived)
PEA	pulseless electrical activity
pRBC	packed red blood cells
PTP	post-transfusion purpura
Rh	rhesus
SOP	standard operating procedure
SRC	Swiss Red Cross
SRNM	specific requirements not met
T. cruzi	Trypanosoma cruzi (causative agent in Chagas disease)
TACO	transfusion-associated circulatory overload
TAD	transfusion-associated dyspnoea
TR	Transfusion reaction
TRALI	transfusion-related acute lung injury
T&S	type and screen (to define blood group and detect irregular antibodies)
WBIT	wrong blood in tube
WCT	wrong component transfused

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