2024 TRIP REPORT

HEMOVIGILANCE

EXTENDED VERSION

TRIP
Hemo- en biovigilantie

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The 2024 TRIP Hemovigilance report, extended version, is published under the responsibility of the TRIP (Transfusion and Transplantation Reactions in Patients) Foundation.
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FOREWORD

Once again, a new TRIP report is available on the data for 2024. Reading the report, yields a number of matters that are remarkable, at least for me as an internist haematologist/transfusion specialist working in a major academic medical centre. First of all, the extent of participation: all hospitals participated. To me, that is a really good message, because, although the extent of participation was already extremely good, a percentage of 100% is of course the best achievable!

It is also significant that the number of blood products distributed by Sanquin in 2024 shows a stable trend when we look at the issuance of platelet concentrates. There is, however, also a reduction in the issuance of red blood cell concentrate, a trend that was previously noted. If we have become 'more economical' in transfusions, then that is quite evident. We are on the right road when we look at the data, because it is and remains important to have a correct indication for transfusions.

I find another significant point to be the imputability of transfusion reactions. Most of them may have possibly been affected by imputability – that is logical – after all things are not always 'black and white' when looking at the possible causes. However, it would be nice if there were an even clearer distinction possible as to whether a reaction is transfusion-related or not. Of course, I do not have the solution either, but it gives us food for thought.

The section on 'Events in the transfusion chain' is also interesting. There are slightly fewer reports in the category 'Incorrect blood product administered' compared to last year, but significantly more 'Other events'. It is always good to read: what are (and continue to be) the risks in the transfusion chain? What can be improved on this aspect?

The report also mentions research into 'Respiratory transfusion reactions', a collaboration between Amsterdam UMC and TRIP. We are quite curious about the results.

Of course, we are very grateful to the people who have made this report possible, namely the highly enthusiastic input by the hemovigilance staff members and officers. The important role played by the Hemovigilance Advisory Committee, and of course the TRIP staff members!

Lastly, I would like to draw your attention to the death of the TRIP Foundation's patroness, Eveline Six – Baroness Van Voorst tot Voorst, professor Emeritus in Clinical Chemistry on 15 August 2024. At the time, she played an important role in the founding of TRIP. Please refer to the TRIP website for an 'in memoriam'.

Dr Peter te Boekhorst, Internist Haematologist/Transfusion Specialist
President of the TRIP Foundation

1 MAIN 2024 FINDINGS

1.1 Hemovigilance in 2024

In 2024, TRIP received a total of 1,236 reports before the closing date of this annual report. This includes 1,114 reports of transfusion reactions and 144 reports of events (incidents), with 22 reports describing a combination of an event and a reaction. As in other years, there is a high participation in hemovigilance reporting by hospitals. Figures on use of blood products were received from all hospitals (79/79=100%). In 2024, transfusion reactions and/or events were reported by 71 hospitals (90%).

The number of reports should be seen in relation to the number of units distributed and transfused (Figures 1 and 2). A downward trend in the number of erythrocyte (red blood cell) units distributed has been seen over many years. After a period of stabilisation from 2017 to 2021, this decline is continuing/trending again. Since 2021, this report has used the number of units of SD plasma transfused (solvent/detergent treated plasma; Omniplasma® in the Netherlands) as reported by the hospitals, as TRIP does not have access to the number of SD plasma units distributed.

The total number of reported events in 2024 (144) is slightly higher than in 2023 (120). It is noteworthy that the number of reports in which an incorrect blood product was administered has decreased (2024: 25, 2023: 39). The number of reported near misses received from ten different hospitals (from five hospitals in 2023), rose to 26 (which was 17 in 2023). There were 82 other events reported (compared to 54 in 2023) of which 40 in the sub-category 'other'.

The number of reported transfusion reactions (excluding reports of new antibody formation) is 2.4 per 1,000 blood products, which is comparable to the average of previous years (with an average of 2.4 per 1,000 in 2019-2023). In 2024, there was a lower absolute number of reports of serious transfusion reactions than last year (131 in 2024 compared to 146 including late reports in 2023). The number of reported serious transfusion reactions with an imputability of definite, probable, or possible was 0.28 per 1,000 distributed blood products (2019-2023: an average of 0.25).

This year, respiratory reactions are also a major cause of transfusion-associated morbidity and mortality. Adequate diagnosis may be complex due to an overlap of symptoms between the various respiratory reactions and the potential for concomitant occurrence of TACO and TRALI. The question is whether there is a diagnostic continuum. In collaboration with TRIP, the Amsterdam UMC started a retrospective study into the respiratory transfusion reactions reported in the period 2019-2024, investigating whether there are patterns that support the existence of a clinical spectrum of respiratory transfusion reactions.

In 2024, an acute hemolytic transfusion reaction following the administration of an incorrect blood product (ABO-incompatible unit) was not reported to TRIP. This is the first time since 2013. No reports of transfusion-transmitted infections were received in 2024. There were a similar number of post-transfusion bacteremia reports as in 2023, of which two were serious reactions. The number of reports of bacterial contamination of blood product (these include both positive screening results at the blood bank and positive blood cultures obtained from (the remainder of) the administered unit in hospitals) is also comparable without resulting in serious reactions.

In conclusion, this twenty-second annual hemovigilance report shows a high degree of hospital involvement in hemovigilance. For the first time since 2015, there has been a 100% participation in reporting on blood product administration. This is a good starting point for application of the SoHO Regulation in 2027, which requires mandatory reporting of the number of units administered by all institutions using blood products for transfusion. The summary of the 2024 reports again shows that receiving a blood product in the Netherlands is safe.

1.2 Recommendations

	Recommendations	Who?
1	Awareness in recognising transfusion reactions to ensure timely adherence to start the transfusion reaction protocol. Good communications between hospital departments and the laboratory.	Hemovigilance staff members and officers; connection to laboratory/department
2	Taking note of Regulation (EU) 2024/1938 on substances of human origin (including blood) and to identify the consequences for all concerned.	Executive Boards of hospitals and designated institutions, hemovigilance staff members and officers, Persons Responsible, TRIP

Explanatory note

1 In 2024, three events were reported of which the transfusion reaction was not reported to the lab, or was not reported in time and the transfusion reaction protocol was not started. These are the cases where the transfusion reaction was nonetheless observed and reported, and it is expected that reactions will not be recognised more often. In addition, two reports received did not contain sufficient data, such as a reporting category, seriousness or imputability, so no conclusion could be drawn. In order to provide sufficient data for a report, timely recognition and good communication are important. TRIP also recommends submitting the reports in good time so that any additional questions can be answered, e.g. in response to an event. TRIP provided clarity regarding the lead times of the reports in 2022 by means of a poster presentation during the NVB-TRIP symposium. Eighty-one percent of the reactions and/or events are reported to TRIP within three months, 77% of the reports are completed within three months of the event or reaction taking place.

2 Regulation (EU) 2024/1938 on substances of human origin (including blood) will immediately be applicable in all EU Member States in mid-2027. Additional information on this regulation can be found on a specially designed website of the Dutch Ministry of VWS. Additionally, TRIP will continue to provide its network with relevant data regarding hemovigilance in various ways.

1.3 Follow-up to previous years

1 Annual reporting to TRIP of some events analysed in more detail per institution, including near misses. This allows us to learn from each other and identify possible improvements for the future.
Development:
The number of near misses and other incidents reported is higher compared to last year. More attention for root-cause analysis is key to achieve improvements.

2 Focus on ensuring the correct patient identification when registering new patients, and a proper labelling of application forms and blood tubes. The other steps in the transfusion chain now undergo digital checks in many institutions.
Development:
The number of events as a consequence of identification errors is comparable to last year, some of which also involve work pressure and running several tasks simultaneously.

2 OVERVIEW OF 2024 HEMOVIGILANCE DATA

2.1 Overview of 2024 hemovigilance data in comparison with previous years

Of the 1,236 reports received by TRIP before the cut-off date for this report, 1,092 reports concerned transfusion reactions. A total of 122 events (incidents) were reported, with 22 reports describing a combination of an event and a transfusion reaction. All reported events are included in the tables, even if they were registered as a sub-category in combination with a reaction, and vice versa.

For several years, Sanquin Blood Supply Foundation has been preparing and supplying serum eye drops. This product is not a 'classic' blood component for transfusion, but is prepared as a 50% solution from small pools of male AB donor blood. Reports on this product are registered by TRIP and are important because of the need for intensive monitoring of these recently authorised products. In 2024, no reports on this product were received.

Reported data concerning the reports are shown in the following tables and figures:

* *Additional tables in online annex to this report*

Table 1 Reported events, 2020–2024

Event	2020	2021	2022	2023	2024	Number of reporting hospitals in 2024
Incorrect blood product transfused	44	26	28	39	25	19
Near miss	41	29	34	17	26	10
Other event	100	74	69	54	82	18
Calculated risk situation	8	8	1	5	6	6
Other categories of events[a]	10	8	2	5	5	5
Total	**203**	**145**	**134**	**120**	**144**	**32**

[a] *This includes look-back reports from the manufacturer, previous incorrect blood product transfused, and the reporting category or sub-category of bacterial contamination of blood product (5 in 2024; refer to Chapter 3.3).*

Table 2 Reported transfusion reactions, 2020-2024

Reaction	2020	2021	2022	2023	2024	Seriousness ≥ 2[a]	Number of reporting hospitals in 2024
Circulatory overload	112	102	100	119	100	43	40
TRALI	2	1	7	4	2	2	2
Transfusion-associated dyspnea	8	5	13	17	11	3	6
Acute hemolytic TR	16	9	9	18	8	7	7
Delayed hemolytic TR	6	5	6	10	9	1	7
New antibody formation	627	5	3	4	2	0	2
Allergic reaction	134	113	119	118	133	17	38
Non-hemolytic TR	304	303	299	292	251	21	58
Mild non-hemolytic febrile reaction	298	327	309	329	287	7	53
Post-transfusion bacteremia/sepsis	74	58	61	47	50	2	31
Other reactions	330	245	253	333	256	28	62
Other categories TR[b]	0	0	2	0	5	0	5
Total transfusion reactions (TR)	**1,911**	**1,173**	**1,181**	**1,291**	**1,114**	**131**	**70**
Total seriousness ≥ 2[a]	**141**	**122**	**115**	**146**	**131**		
Total reports including events	**2,082**	**1,300**	**1,296**	**1,394**	**1,236**		

[a] *Imputability of definite, probable, or possible*
[b] *Concerns reports of post-transfusion viral infection (2020-2024: 0), post-transfusion other infection (2022:1 and 2024:3), post-transfusion purpura (2022:1) and insufficient data available to evaluate the report (2024:2)*

Table 3 Number of reports per type of blood product in 2024

Type of blood product	Distributed in 2024	Transfused in 2024[a]	Number of blood products distributed		Reports per 1,000 blood products Number of reports	
			All	Serious[b]	All	Serious[b]
RBC concentrate	358,451	354,904	986	101	2.75	0.28
Platelet concentrate	55,949	53,074	144	19	2.57	0.34
Fresh frozen plasma	728	746	0			
SD plasma[c]		47,893	21	3	0.44[e]	0.06[e]
Serum eye drops	2,164	1,779	0			
COVID-19 convalescent plasma	170	163	1	0	5.88	
Combinations[d]			55	8		
Not linked blood product (events)			29			
Total	**417,462[f]**	**458,559**	**1,236**	**131**	**2.66[e]**	**0.28[e]**

[a] *Data received from 79/79 hospitals (100%)*
[b] *An imputability of definite, probable, or possible*
[c] *SD = solvent/detergent treated plasma; Omniplasma® in the Netherlands, only units transfused are reported.*
[d] *Combinations of labile blood products with SD plasma are also included*
[e] *Reports in relation to total units of red blood cell concentrate, platelet concentrate, fresh frozen plasma, COVID-19 convalescent plasma and SD plasma units transfused.*
[f] *Number of SD plasma units distributed is missing*

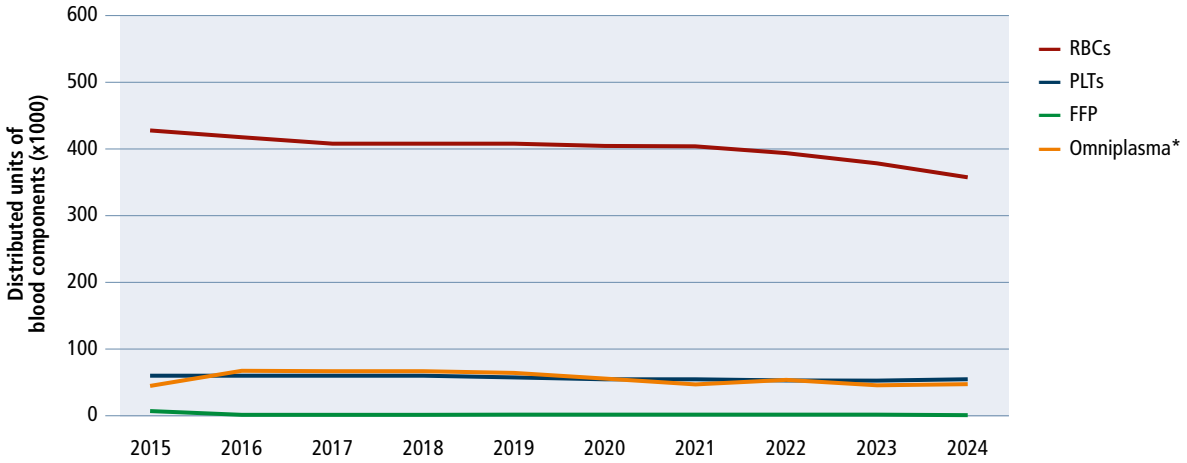

Figure 1 Distributed units of blood products, 2015-2024

* For SD plasma (Omniplasma®), the units transfused are reported in 2015 because of the roll-out phase; the units transfused in 2021-2024 are reported due to the lack of data on distribution.

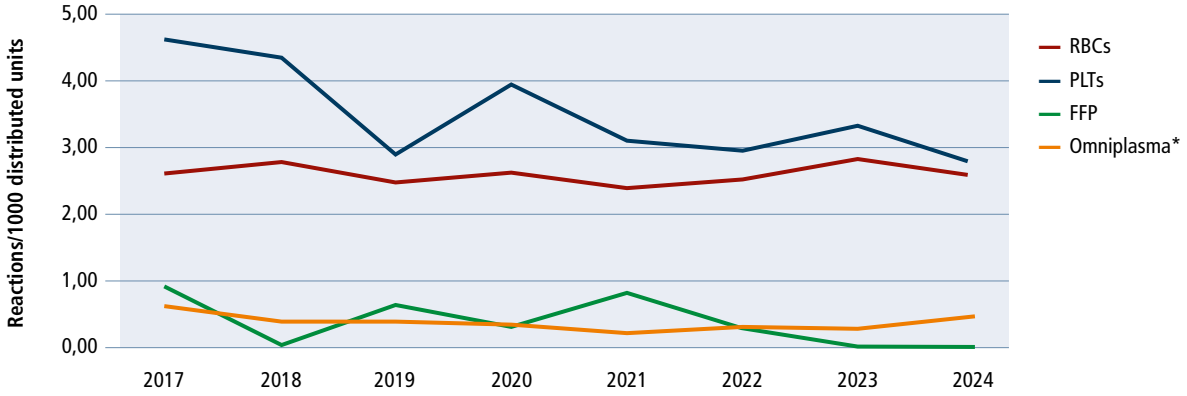

Figure 2 Transfusion reactions per type of blood product, 2017-2024

* *For SD plasma (Omniplasma®), only units actually transfused are reported as from 2021*
The graph shows transfusion reactions (all imputabilities) with the exception of new antibodies, in which reactions associated with more than one type of blood product are attributed proportionally to the respective types (i.e. a reaction in a patient who received both platelets and red blood cells is counted as: 0.5 reaction for platelets and 0.5 reaction for red blood cells, etc.). This method of analysing was introduced since reporting year 2017.

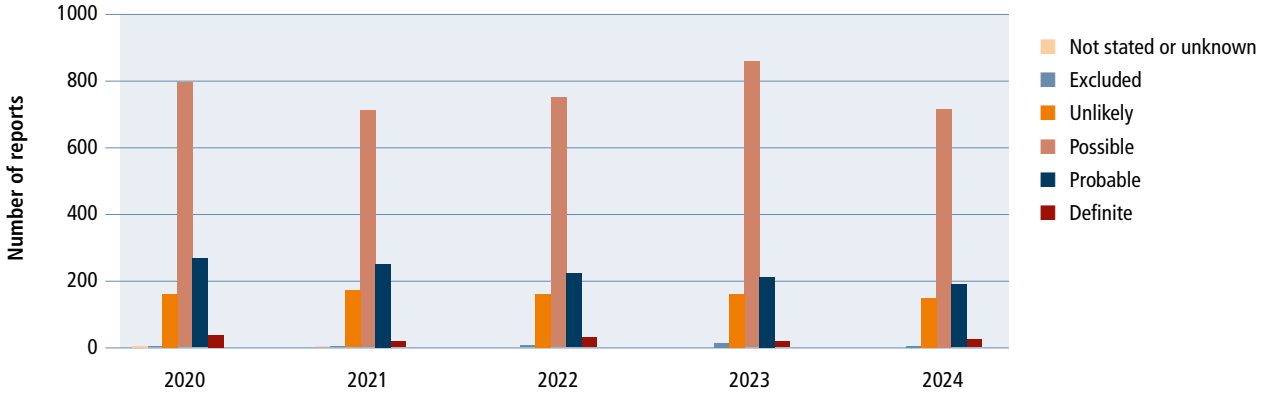

Figure 3 Imputability of transfusion reactions, 2020-2024

Included are all transfusion reactions with the exception of new antibody formation.

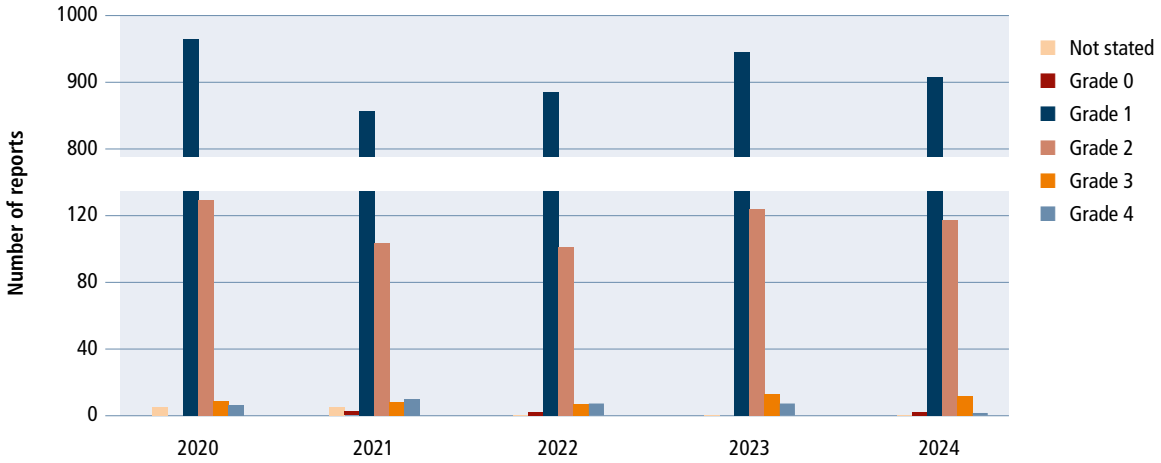

Figure 4 Seriousness of transfusion reactions (imputability of definite, probable, or possible), 2020-2024

Included are all transfusion reactions with the exception of new antibody formation.

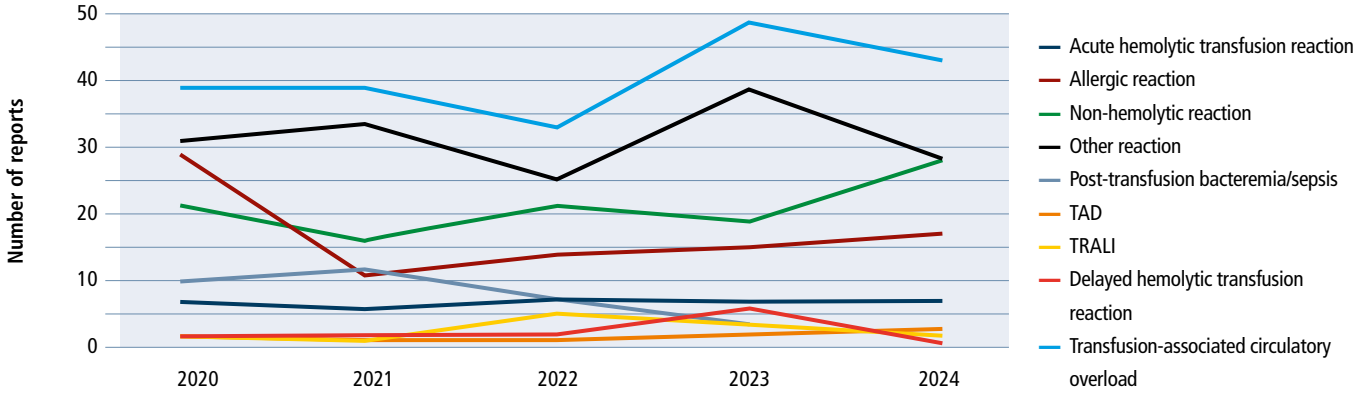

Figure 5 Serious transfusion reactions (imputability of definite, probable, or possible), 2020-2024

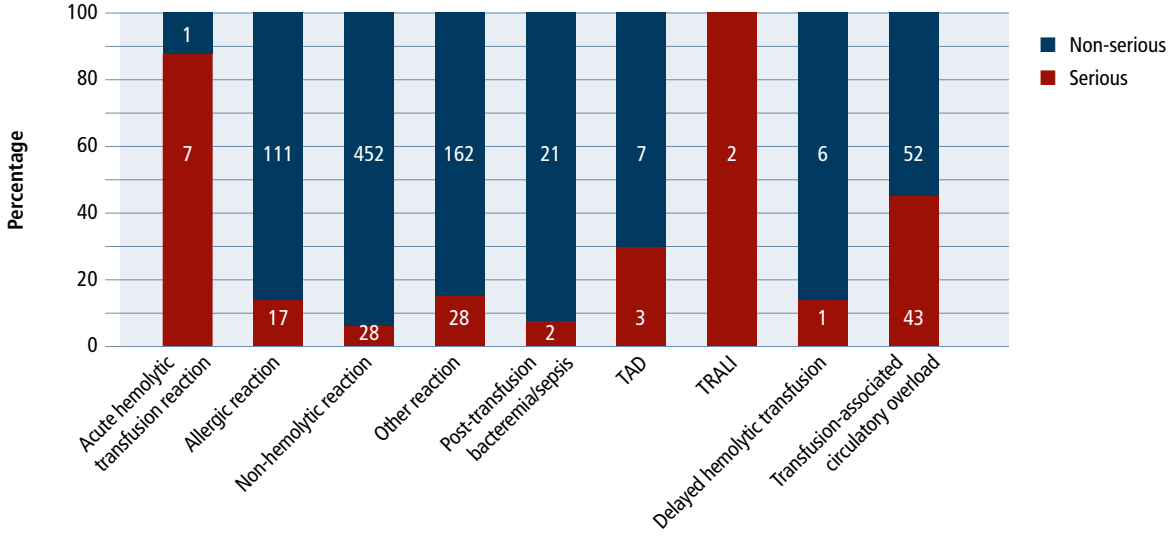

Figure 6 Ratio of serious and non-serious transfusion reactions (imputability of definite, probable, or possible) per reporting category in 2024

Table 4 Seriousness 4 reports in 2024

Reporting category in report	Sub-category in report	Blood product	Gender, age group (years)	Imputability	Symptomatology
Circulatory overload		Red blood cells and SD plasma	Male, 40-50 y	Possible	End-stage liver disease and bleeding for which transfusion, subsequent to transfusion is unapproachable and saturation decrease, initial recovery after diuretics and stem bleeding, later respiratory deterioration, next day palliative care and death.
Circulatory overload		Red blood cells	Female, 80-90 y	Possible	Severe COPD and femoral fracture with low postoperative Hb for which transfusion, end of transfusion in resuscitation setting due to ventricular tachycardia and cardiac arrest, next day congestive heart failure for which dehydrated, day later extubation, palliative care and death.
Circulatory overload		SD plasma	Male, 50-60 y	Unlikely	Severely ill patient with auto-immune vasculitis, sudden deterioration after plasmapheresis with hypotension and chest pain, chest X-ray showed signs of fluid overload, two days after apheresis refractory shock with multi-organ failure and death.
Other reactions		Red blood cells	Female, 80-90 y	Unlikely	Within a few hours of admission via A&E and transfusion due to anaemia in work diagnosis sepsis a picture of progressive multi-organ failure despite maximum support, death after discontinuation of treatment.
Other reactions		Red blood cells	Male, 80-90 y	Unlikely	Suspected myelofibrosis and acute deterioration in several weeks with anaemia for which transfusion, after 2nd unit hypertension, tachycardia and fever, after antibiotics there was some stabilisation and segmental pulmonary embolism in imaging, death within 24 hours after transfusion as a result of ongoing shock with multi-organ failure in inflammatory reaction or sepsis without any clear focus.
Other reactions	Other event	Red blood cells	Female, 60-70 y	Unlikely	Metastasis and pneumosepsis involving increasing oxygen demand. Transfusion may possibly have been given based on diluted sample with incorrect low Hb, no acute deterioration based on transfusion reaction, due to underlying condition palliative care agreed, died the same day.

Table 5 Seriousness 4 reports (imputability of definite, probable, or possible), 2015-2024

Reaction	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
Acute hemolytic TR	2						1				3
Other reactions	1	1	1	2			2	1	1		9
Post-transfusion bacteremia/sepsis							1		1		2
TRALI	2	1	1	1	1			1	1		8
Delayed hemolytic TR							1				1
Circulatory overload	2	3	6	2	2	6	5	5	5	2	38
Total	**7**	**5**	**8**	**5**	**3**	**6**	**10**	**7**	**8**	**2**	**61**

2.2 Late reports

After the cut-off date for submitting reports for the 2023 reporting year, 18 late reports were still received from that year and, in addition, one report from 2020 was completed (Table 6). The late reports came from five hospitals. These late reports have been incorporated into the figures and tables in this report for the respective reporting year. Among the late reports, there were four serious reactions with a seriousness of 2 or higher; this concerned a delayed hemolytic transfusion reaction (seriousness 2, imputability of probable) circulatory overload twice (seriousness 2 and 4, both with an imputability of possible) and once an allergic reaction (seriousness 2, with an imputability of possible). The report with seriousness 4 concerned a patient who, based on the underlying condition, received transfusion in palliative setting. In accordance with the mandatory procedure, these four serious reactions have been added to the report to the European Commission for 2024, refer to Chapter 2.3.

Table 6 Late reports from 2023 in the 2024 report (N = 18)

Reporting category	Seriousness		
	1	2	4
Allergic reaction		1	
Mild non-hemolytic febrile reaction	1		
Non-hemolytic transfusion reaction	8		
Other reactions	2		
Transfusion-associated dyspnea	1		
Delayed hemolytic transfusion reaction		1	
Circulatory overload	2	1	1

Late report of delayed hemolytic transfusion reaction (DHTR) case

Signs or symptoms of hemolysis occurring from 24 hours to a maximum of 28 days after transfusion, such as: unexplained drop in haemoglobin, dark urine, fever/chills.

One late report related to a report of delayed hemolytic transfusion reaction with seriousness 2 and an imputability of probable, and in the sub-category new antibody formation. The patient, 70-80 y, with a recent history of aortic aneurysm, renal insufficiency and hepatic cirrhosis, received several units over three days due to chronic anaemia. Within one week of the transfusion episode, the patient developed symptoms of dark urine, abdominal pain and general malaise. The patient was admitted and a transfusion reaction is considered. Patient appears to have developed an anti-E, anti-c and anti-K, which could possibly lead to hemolysis. The hemolysis parameters confirm the hemolysis and two of the units administered are positive for the corresponding antigens E, c and K.

2.3 Overview of mandatory reports to the European Commission

TRIP compiles an overview for the European Commission of mandatory reports of serious reactions and events in the transfusion chain yearly. The 'Common Approach' prepared by the European Commission together with member states, provides the following guidance:

— Reactions with an imputability of definite, probable, or possible are reported; late reports from the previous year should be included.
— Reactions that occurred after transfusion of an incorrect blood product or other event are taken into account in the relevant category.
— Hemolytic reactions are subdivided into immunological (ABO), immunological (non-ABO) and non-immunological (e.g. infusion in combination with hypotonic fluid).
— Reactions to SD plasma only are not counted due to the legally different route.
— On the form, reports are subdivided according to type of blood product transfused.

The febrile reactions listed in the table were assessed as serious due to (prolongation of) hospitalisation (Table 7).

Table 7 Number and imputability of reports of seriousness 2 or higher in 2024, or late reports from 2023, in accordance with EU overview

Seriousness	2 or 3			4	
Imputability	Definite	Probable	Possible	Possible	Total
Hemolytic transfusion reaction (ABO)					0
Hemolytic transfusion reaction (immunological, non-ABO)	4	2			6
Hemolytic transfusion reaction (non-immunological)		2	1		3
Allergic reaction	1	8	7		16
Febrile reaction	1	10	17		28
Other reactions	1	10	18		29
TAD			3		3
TRALI	2				2
Circulatory overload	3	18	21	3	45
Total	**12**	**50**	**67**	**3**	**132**

2.4 Application of COVID-19 convalescent plasma (CCP) and reports

Plasma collected from patients who have recovered from a SARS coronavirus type 2 infection, SARS-CoV-2, and whose levels of antibodies are sufficiently high against this virus, may potentially be effective in the treatment of some patients with COVID-19. Studies on this effectiveness have been carried out and published both in the Netherlands and internationally. In 2024, CCP was transfused less often than in previous years. A total of 170 units were distributed (512 in 2023) and 163 units were reported as applied (448 in 2023).

In 2024, one reaction associated with CCP transfusion was reported (2023: 5 reactions). This concerned a non-serious allergic reaction with generalised itching and redness, seriousness 1 and imputability of probable. There was no adverse reaction to a subsequent transfusion with CCP and prior preventive medication.

3 EXPLANATORY NOTE TO THE REPORTING CATEGORIES

3.1 Events in the transfusion chain

Incorrect blood product transfused

All cases in which the patient was given a blood product that did not comply with all the requirements of a suitable product for the relevant patient, or that was intended for another patient.

25 reports, this is fewer than last year (39 reports)
Reports were submitted by 19 different hospitals (24%), range 1-4 reports per hospital

- Of the five reports in which there was a risk that ABO-incompatible blood was transfused (ABO risk), three events concerned an identification error, a mix-up of blood bags, patients or patient data. In all three reports, there was no consequence because, by chance, the patient had the same blood type or only the RhD was different. The other two cases concerned an error in the selection of SD plasma, O instead of AB. In one of the patients, lab values indicated that there was some hemolysis. It cannot be ruled out that this was caused by the anti-A in SD plasma O. There were no further clinical signs or symptoms. The other patient soon died as a result of trauma sustained in an accident. It was estimated by the physician of the Transfusion Medicine Unit that only when four (or more) units of SD plasma O are transfused is there enough anti-A to cause a hemolytic transfusion reaction.
- Two reports of an incorrect blood product transfused concerns a patient with previously found irregular antibodies, an irrab risk. No data was found in the TRIX system but it appeared that anti-E had previously be found in the patient. Also, a patient with an Rh variant and anti-D/anti-Jk(b). In both cases, there was no consequence for the patient.
- Eight times, the preventive policy to avoid the formation of irregular antibodies was not followed.. This has led to anti-D formation for one patient (female < 45 y). In five cases, it was overlooked that the patient had MDS and this was not taken into account in the selection of the blood product. For one MDS patient, a new antibody formation, anti-E, was identified.
- There was one report of a risk of overtransfusion; rather than the requested 11 ml platelet concentrate, a product of 27 ml was ordered and also administered to the baby patient (4 months old, no adverse effects).

TRIP risk classification

As in previous years, TRIP assessed all reports in the category incorrect blood product transfused, to estimate the highest potential risk which a patient would be exposed to as a result of transfusion of the incorrect blood product. The risk classification used by TRIP is described on the website (www.tripnet.nl: hemovigilance/forms under explanatory note).

In 2024 too, *irrab prevention* represented the largest risk group (this was 8 compared to 11 in 2023). This risk group has not acted in accordance with applicable hospital standards and regulations for the prevention of irregular antibody formation in a particular target group.

In the irrab group, fewer reports (2) were received (8 were received in 2023). For the recipient, there is a risk of a transfusion using an irregular antibody-incompatible unit, due to pre-existing irregular antibodies in the patient.

A total of seven reports have been classified in the Miscellaneous category; two reports concern an incorrect blood product transfused with a risk of transfusion-associated graft-versus-host reaction (TA-GvHD), where one patient had inadvertently not received an irradiated RBC unit (to prevent TA-GvHD). Four reports concern the transfusion of blood products that had not been tested for Parvovirus B19 in patients who did meet the criteria for testing. No adverse effects have been observed in the patients involved. Furthermore, the report with a risk of overtransfusion, see inset.

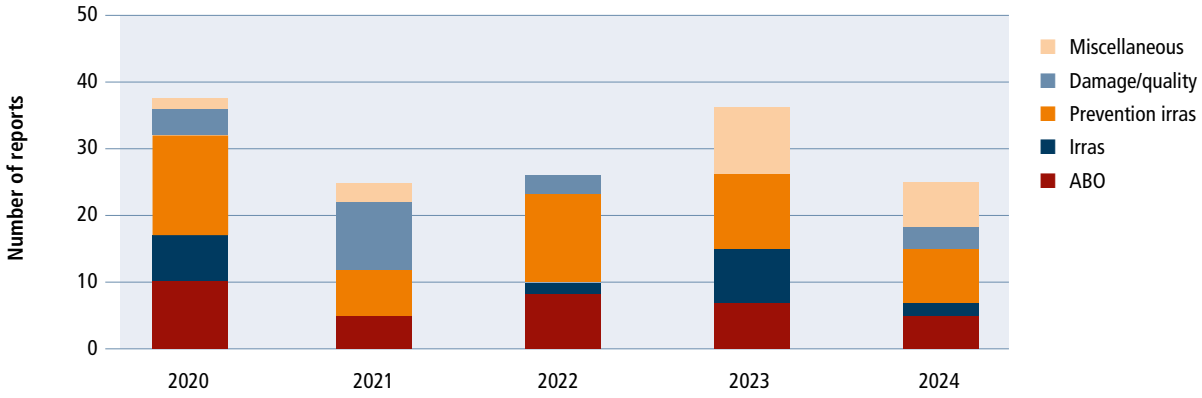

Figure 7 Incorrect blood product transfused 2020-2024: subdivided according to risk group

ABO = *Risk of exposure to an ABO-incompatible unit*
Irrab = *Risk of exposure to an irregular antibody-incompatible unit*
Irrab prevention = *Risk of alloimmunisation due to non-compliance with preventive matching criteria*
Damage = *Risk of (potentially) reduced quality of a blood product due to damage*
Miscellaneous = *Parvovirus B19 risk, overtransfusion risk, TA-GvHD risk, other*

Case studies (in Dutch) in the category incorrect blood product transfused can be found at www.tripnet.nl in the Report of the Month section (*Melding van de Maand 2025-1: Een verkeerde aanname* [Report of the Month 2025-1: an incorrect assumption])

Near miss (NM)

Any mistake/error that, if undetected, could have led to an incorrect type of blood group, or supply, or transfusion of an incorrect blood product, and which was detected prior to transfusion.

In all, 26 reports were received from ten different hospitals (13% last year from only five different hospitals), range 1-10 reports per hospital.
In 22 reports, there is a potential ABO risk. For one report the risk of transfusing a blood product of which the quality could no longer be guaranteed (left outside the refrigerator for too long), and for one report the patient's transfusion recommendation was not entered fully into the lab system, which allowed the incorrect product to be selected (*irrab* risk).
One report concerned a diluted blood sample, the measured Hb level was only 1.6 mmol/l. This sample could have led to a false negative screening.
One report showed a discrepancy between Kell phenotyping in the lab at week 12 and the Sanquin results at week 27 of the pregnancy. The test at the lab was performed incorrectly and was false negative.

- In 22 reports, there was one identification error with an ABO risk.
- 18 near misses were detected in good time because of a blood-group discrepancy, one because of an incorrect Hb result. In one report, maternal blood was sent instead of that from the baby and in one report the wrong patient had been selected (one of twins). The initials were not checked, which was revealed by the results of the NIPT prenatal screening test.
- 22 near misses were detected in good time by the laboratory, four ion the ward.
- There was an irrab risk in two reports.
- In one report, a product had been kept out of refrigeration for too long, > 4 hours, holding a risk of administering a blood product of which the quality can no longer be guaranteed.

Table 8 Reason for detection of 'Near miss'

Where did it happen*	N	Where was it detected	N	How was it detected	N
Assessment prior to transfusion request	23	Scheduled check	18	Blood group discrepancy	17
				Abnormal Hb level	1
		Alertness of ward staff	3	Timely discovery of incorrect identification	3
		Laboratory	2	Discrepancy compared to previous NIPT results	1
				Discrepancy in result of Rhesus-c determination by lab week 12 versus week 27 by Sanquin	1
Request	1	Scheduled check	1	Blood group discrepancy	1
Processing request	1	Laboratory	1	Technician alertness when entering request	1
Issuance	1	Ward	1	Blood product found on patient admission	1

** Position in the transfusion chain. Where in the transfusion chain did the incident occur? Refer to TRIP website*

Causes of identification errors:

- Incorrect sticker on tube due to labelling the tubes at a different time/different location (8×)
- Incomplete verification of patient's name/date of birth (5×)
- Unfortunately, cause is no longer traceable (9×), in some hospitals the laboratory does not have access to the VIM report.

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

In all, 82 reports were submitted by 18 different hospitals (23%), range 1-14 reports per hospital. This is a considerable increase compared to 2023 (54 reports).

- 12 reports in which a reaction has also been observed. In three cases, the event concerned not initiating the transfusion reaction protocol.
- Nine reports described 3× other reactions, 2× NHTR, 2× TACO (see inset with case), 2× allergic reactions. Due to a blood sampling error, a low Hb had been measured (3.6 mmol/l) and the patient unnecessarily received two RBC units leading to an NHTR. The patient died, imputability of unlikely.
- 56 units were lost or partially lost, in particular due to subcutaneous infusion or due to IV failure.

Classification by type of error
As in previous years, categorisation into 'other events' is again based on the type of error and whether the product was lost or partially lost. As reported above, 56 events resulted in the loss or partial loss of the blood product. These are categorised as 'lost' when the blood bag could not be returned to stock or could not be fully transfused because of an event.

The largest group of other events are classified according to the nature of the event: other (40). In this category, there were 23 cases where the unit was not properly connected and appeared to be infused subcutaneously, despite the protocol checks (after 10 minutes). This is also the most common cause for units being lost. A number of RBC units (5) had to be destroyed because they had been outside a controlled refrigerator on the ward for too long. In three reports, the unit had accidentally been punctured and a blood product had been spiked prematurely three times causing it to be lost.

A number of reports involved the incorrect administration of RBCs due to an incorrect Hb/TC level measurement (8×). The underlying causes varied, errors in blood sample collection (clot, or diluted), or measurement error. There are four reports in which an error was made when setting the infusion rate, in three cases this resulted in the patient's transfusion reaction.

Other events with reactions; 1× other reaction + 2× TACO

- Instead of three RBC units in which each RBC unit had to be administered in three hours, the three units were not administered given to the patient in nine hours, but consecutively within three hours. On administering the 3rd RBC unit, blood pressure increased (> 20 mmHg), no respiratory symptoms. Treatment using captopril was started, patient recovered completely. This reaction was classified as other reaction, seriousness 1.
- In a patient with severe congestive heart failure, decompensated liver cirrhosis and renal dysfunction, four RBC units were administered instead of two, on handover (very busy) it has not been explicit that two units had already been administered to the patient. Patient suffered dyspnea, bloated face; circulatory overload (TACO, seriousness 1). Aside from clemastine and dexamethasone, the patient was additionally administered furosemide and recovered completely.
- In a patient who has pre-terminal renal insufficiency, diabetes, hypertension, and is oxygen-dependent, saturation decreases to 86% and dyspnea occurs. Patient already has furosemide patch-pump administration, dosage increase and additional oxygen are insufficient. Patient taken to ICU for emergency dialysis, after which patient recovered completely. This reaction (TACO seriousness 3) may have been caused by the pump rate being set too high.

Table 9 Reports of other events in 2024, subdivided according to type of error

Type of error	N	Lost or partially lost	N	Description	N
Clerical error	1	No	2	No registration of administration in EHR	1
				1st RBC unit for patient A in EHR, 2nd RBC unit incorrectly registered for patient B.	1
Assessment error	7	Yes	4	Hb determination after 3rd RBC unit instead of after 4. Not cancelled in time, 4th RBC unit was lost	1
				Not reported that RBC unit was no longer needed, RBC unit already spiked, was lost	1
				RBC unit already spiked before vital signs were measured, patient has fever, was lost	1
				RBC unit no longer administered at ward, was no longer needed but not returned to lab	1
		No	3	Venflon broken, reconnected to the same RBC unit, not allowed according to protocol	1
				Blood transfusion protocol not started, cause unclear	1
				Blood transfusion protocol not started, A&E physician assistant considered this unnecessary	1
Storage error	5	Yes	5	Unit out of refrigeration for too long	2
				Unit dropped when unpacking cool box, broken	1
				Unit not stored properly pending lab	1
				Unit not removed from transport case	1
Blood sample collection error	6	No	6	Transfusion based on Hb determination in infusion arm, blood gas, diluted sample	5
				Blood sample not swirled properly, clot. Not observed by technician either	1
Communications error	6	Yes	3	RBC unit ordered by ward but not taken out of pneumatic tube post system, returned to lab next day, destroyed. Order not communicated within the ward	1
				4× RBC units ordered, 3rd RBC unit subcutaneous infusion, transfusion protocol not started, NHTR, seriousness 2, patient recovered completely	1
				Patient still appeared to receive IVIG and platelet concentrate had already been spiked	1
		No	3	5 platelet concentrate administered without interim check of yield	
				Intention was probably 5-donor concentrate	1
				Platelet concentrate administered too early, time of surgery was much later	1
				Patient received 4 RBC units instead of 2 RBC units, consequence TACO seriousness 2	1
Identification error	1	No	1	Courier arrives at A&E (A1 order) and gives the RBC unit directly to the nurse.	
				Delivery may only be to the laboratory	1
Lab procedure error	2	No	2	Platelets level below 30. Tube found to contain clot	2
Technical error	1	Yes	1	After infusion of 20 cc RBC leakage, it appeared not to be spiked properly	1
Administration error	12	Yes	4	Checks of infusion or infusion pump not performed or not properly performed (IV not properly connected, transfusion not started, subcutaneous infusion)	1
				Infusion for both RBC units dislodged by restless patient, NHTR, seriousness 1	3
		No	8	Glucose bag 5% administered to patient in combination with RBC, hemolysis risk. Glucose disconnected and, after flushing transfusion continued	1
				Transfusion via PICC line simultaneously with antibiotics. Disconnected and enabled infusion via a new IV	1
				On checking, it showed that the RBC unit had not been fully transfused after 7.5 hours	1
				The 10 minute checks were not performed when transferring patient to the ward	1
				3 RBC units transfused over 3 hours instead of 3 hours per unit which was ordered. This caused other reaction, seriousness 1, patient recovered completely	1
				Infusion rate set too high, no consequence for patient	1
				Infusion rate set too high for patient with circulatory overload and renal insufficiency, TACO, seriousness 3, imputability of possible, patient recovered completely	1
				Platelet concentrate infused too slowly prior to surgery, bleeding, another platelet concentrate infused which caused an allergic reaction seriousness 1, patient recovered completely	1
Other	40	Yes	35	Venflon/infusion system malfunctioned after > 10 minutes	10
				Checks on infusion (system) performed, but infused subcutaneously (at later stage)	23
				RBC unit punctured when spiking (leak)	2
			4	Venflon malfunctioned due to restless patient	4
		no	1	Diluted sample, error in Hb level measured resulting in unnecessarily transfusing	1

Calculated risk situation

A situation where the clinician knowingly decides to proceed with transfusion in the presence of an increased risk or anticipated side effect of the transfusion as described in the literature and where the intended benefit from transfusion is deemed to justify the risk of harm and its possible seriousness.

Six reports have been received from six different hospitals.

- Five reports involved emergency situations. In these cases, pre-existing antibodies in the patient could not be taken into account. Twice it concerned pre-existing antibodies in a patient who had been transfused with uncrossmatched units. Three times it concerned a situation where it was not possible to select a suitable product urgently (without antibodies present).
- In one of the five situations there was also an other reaction, seriousness 1, patient recovered completely, no antibody formation.
- In one report, the transfusion was continued after puncturing the bag (after repair) because the patient has very specific antibodies.

Conclusion on events in the transfusion chain

The total number of events with 144 is higher than in 2023 (120), 12 concerned a reaction in combination with an event. In 2024, 25 reports were classified as incorrect blood product transfused, far fewer than in 2023 (39 reports). It is noteworthy that more near misses were reported (26 compared to 17 last year) by more hospitals, although the number is still small (10, compared to 5 last year). For some of the reports the causes are missing, which is important to be able to learn from them.

Also notable, are the reports in which the transfusion reaction protocol had not been started, so attention for recognising symptoms of reactions as well as training, continues to be necessary. In two cases, circulatory overload had occurred due to the transfusion being too fast or too much.

3.2 Non-infectious transfusion complications

Respiratory transfusion reactions

Circulatory overload, Transfusion Associated Circulatory Overload (TACO)

Respiratory problems during or within 12 hours after blood transfusion, manifesting as at least one pulmonary component (criterion A or B). In all, at least 3 of the criteria below must be met. Refer also to notes 1 to 6 on www.tripnet.nl.

A New or worsening respiratory problems
B Indications of new or worsening pulmonary edema based on:
   — Physical examination, and/or
   — Chest X-ray or other imaging of the chest
C Findings suggestive of relevant changes in the cardiovascular system
D Findings suggestive of relevant changes in the fluid balance
E Biomarker result(s) consistent with TACO cases in 2024

TACO cases 2024

- In 2024, 100 cases of TACO were reported by 40 hospitals (51%), with a range of 1 to 7 reports per hospital.
- TACO was registered twice as a sub-category of another type of transfusion reaction.
- 95 (95%) of the reports of circulatory overload have an imputability of definite, probable, or possible.

Definite, probable, possible TACO (Table 10):

- 43 TACO cases (45%) are classified as serious. This represents 33% of the total number of serious transfusion reactions with an imputability of definite, probable, or possible. TACO is the transfusion reaction with the highest number of serious events recorded.
- Ten times, TACO was reported as a sub-category of another type of transfusion reaction, due to additional findings that were inconsistent with TACO.
- TACO has occurred twice following an event of overtransfusion, whereas in one case the infusion rate was set too high and in the other case, more units were transfused than prescribed (see Chapter 3.1). TACO occurred twice in combination with an event unrelated to the reaction.
- Figure 8 shows the number of TACO reports per 1,000 distributed blood products over the period 2020-2024.

Table 10 Overview of TACO reports in 2024 with an imputability of definite, probable, or possible

	TACO N = 95
Gender (%)	
Female	54 (57%)
Male	41 (43%)
Age (years)	76 (68–85)
Time interval between start of transfusion and occurrence of transfusion reaction (hrs:min)	2:55 (1:16 – 4:34)
Seriousness of transfusion reaction (%)	
Seriousness 1	52 (55%)
Seriousness 2	34 (36%)
Seriousness 3	7 (7%)
Seriousness 4	2 (2%)
Imputability (%)	
Definite	6 (6%)
Probable	37 (39%)
Possible	52 (55%)

Values are expressed as numbers (%) or medians (IQR)

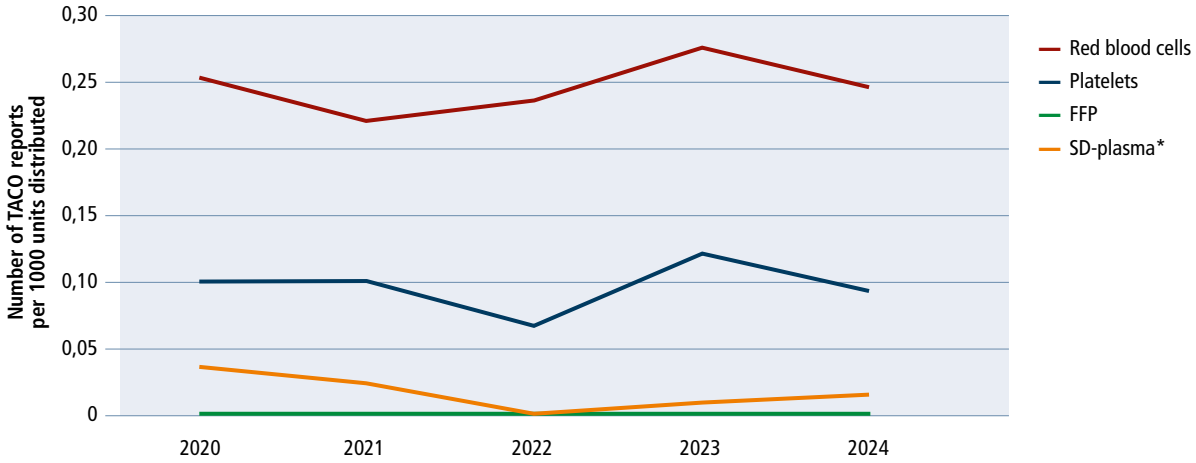

Figure 8 Number of TACO reports with an imputability of definite, probable, or possible per 1,000 blood products distributed, 2020-2024

Reactions associated with more than one type of blood product were proportionally attributed to the respective blood product types
** As distribution figures for SD plasma have been absent since 2021, for the years from 2021 onwards reactions are shown per 1,000 units transfused.*

Transfusion-related acute lung injury (TRALI)

Symptoms of acute lung injury such as dyspnea and hypoxia during or within 6 hours after a transfusion, with chest X-ray showing bilateral pulmonary infiltrates.

- In 2024, two TRALI reports were submitted, both reported with an imputability of definite.
- Both TRALI cases occurred in adult males after the full transfusion of a platelet unit (Figure 9).
- Seriousness in both reports was 2.
- In both TRALI cases, further studies were carried out into the donors from whom the composite platelet product had been derived. In one case, one of the five donors had been diagnosed with HLA antibodies directed against the patient's HLA antigens, which may possibly have contributed to the onset of symptoms. In the other case, several donors have been found to have HLA antibodies directed against the patient's HLA antigens, possibly causative for the TRALI image.

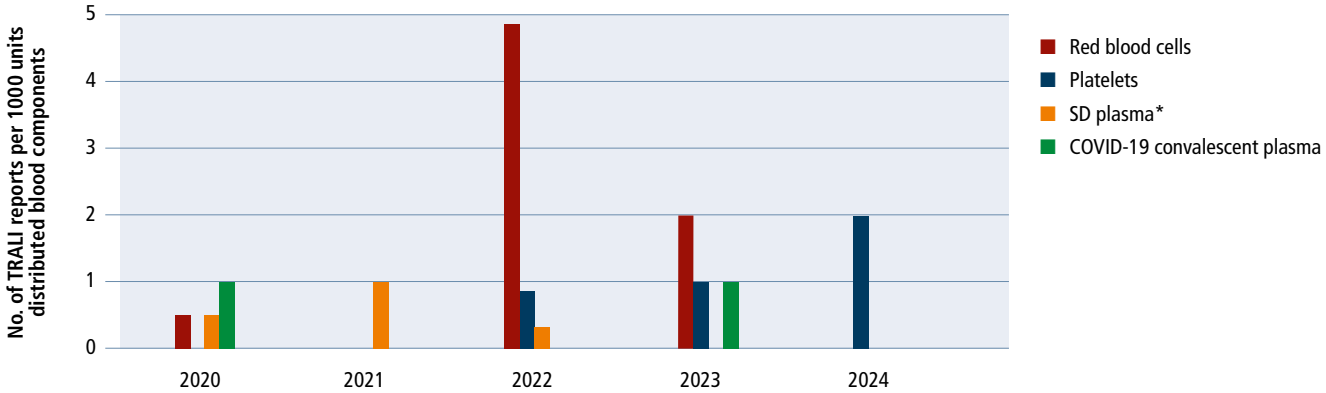

Figure 9 TRALI case per type of blood product (imputability of definite, probable, or possible), 2020-2024

** Reactions associated with more than one type of blood product were proportionally attributed to the respective blood product types*

Transfusion-associated dyspnea (TAD)

Shortness of breath or hypoxia during or within 24 hours after transfusion, not compliant with the criteria for TRALI, circulatory overload or anaphylactic reaction. Respiratory problems are the most prominent symptom;they cannot be explained by the patient's underlying medical condition or another known medical cause.

In 2024, 11 reports of TAD were received, of which 10 with an imputability of definite, probable, or possible (Table 11).

- Six of these reports were derived from one hospital.
- TAD has been registered twice with another reaction in the sub-category, due to additional symptoms that are not consistent for TAD.
- TAD was registered once as a sub-category with another type of transfusion reaction.
- Figure 10 shows the number of TAD reports per 1,000 distributed blood products over the period 2020-2024.

Table 11 Overview of TAD reports in 2024 with an imputability of definite, probable or possible

	TAD N = 10
Gender (%)	
Female	7 (70%)
Male	3 (30%)
Age (years)	69 (47 – 90)
Time interval between start of transfusion and occurrence of transfusion reaction (hrs:min)	2:20 (0:32 – 3:45)
Seriousness of transfusion reaction (%)	
Seriousness 1	7 (70%)
Seriousness 2	3 (30%)
Imputability (%)	
Probable	3 (30%)
Possible	7 (70%)

Values are expressed in numbers (%) or medians (ranges)

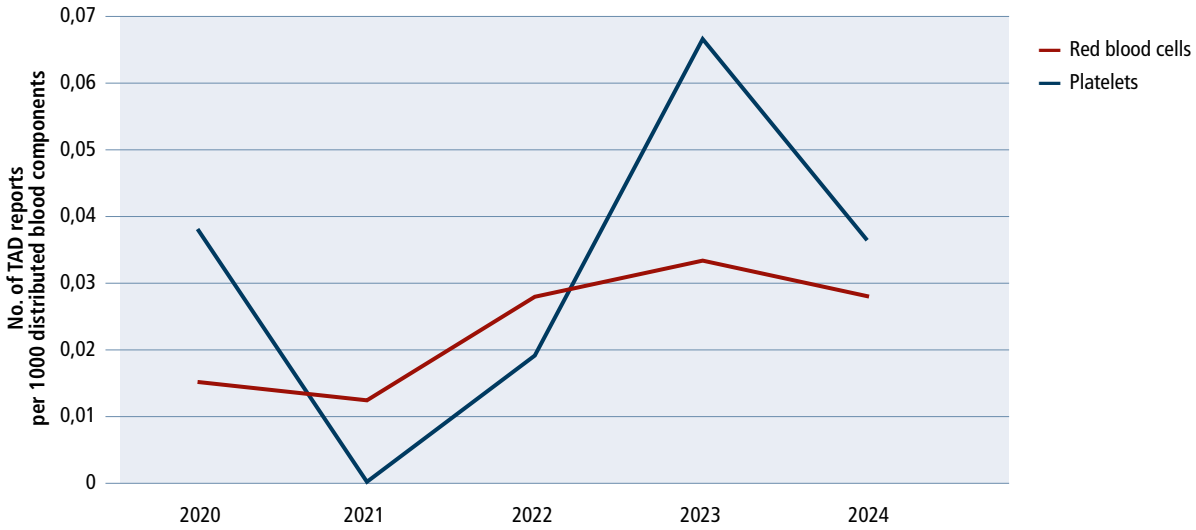

Figure 10 Number of TAD reports with an imputability of definite, probable, or possible per 1,000 blood products distributed, 2020-2024

The reactions associated with more than one type of blood product were proportionally attributed to the respective blood product types.

Investigation into respiratory transfusion reactions

TACO and TRALI are respiratory transfusion reactions with high morbidity and mortalitya. TACO is characterised by hydrostatic pulmonary edema occurring during or after a blood transfusionb. Although increased pressure in lung capillaries due to increased circulating volume plays an important role in the pathogenesis, it is assumed that other factors are also the underlying cause of TACO, such as endothelial damage, mechanotransduction and inflammationc. TRALI is a transfusion reaction in which non-cardiogenic capillary permeability develops as a result of an inflammatory processb.

TACO and TRALI may manifest with comparable clinical symptoms, making both conditions difficult to distinguish. In addition, respiratory reactions occur that do not comply with the definitions of TACO and TRALI, and are classified as TAD or other reactions. Appropriate diagnosis is important because the treatment of transfusion reactions with respiratory signs or symptoms varies. On the basis of recent research, the question has arisen as to whether TACO, TRALI, and TAD can be a manifestation of a pathophysiological continuum, where there are common mechanisms underlying the cause of these reactionsd.

In collaboration with TRIP, Amsterdam UMC started a retrospective study into respiratory transfusion reactions in the Netherlands for the period 2019-2024. This study focuses on the question of whether there is also a diagnostic spectrum of respiratory transfusion reactions. The classification of the case with respiratory signs or symptoms based on diagnostic characteristics is examined for patterns that support the existence of a clinical continuum. Additionally, the frequency and distribution of the main symptoms and findings of supplemental research will also be identified. The aim of the research group is to contribute to the recognition and adequate diagnosis of the different types of respiratory transfusion reactions.

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d Phelp PG, van Wonderen SF, Vlaar APJ, Kapur R, Klanderman RB. Developments in Transfusion Medicine: Pulmonary Transfusion Reactions and Novel Blood Cell Labeling Techniques. Anesth Analg. 2024 Sep 13. Epub ahead of print.

Acute hemolytic transfusion reaction (AHTR)

Signs or symptoms of hemolysis occurring within a few minutes of commencement or until 24 hours after a transfusion, such as a drop in systolic and/or diastolic blood pressure of ≥ 20 mmHg, fever/chills, nausea/vomiting, back pain, dark or red urine, no or slight increase of Hb level or an unexpected Hb level drop.

A total of eight AHTR reports were received (compared to 18 in 2023), all occurring during or after transfusion of RBC units. Seven reporting hospitals (8%), range 1-2 reports per hospital.

- All reports have an imputability of definite, probable, or possible, refer to Table 12.
- Seven reports of serious reactions (seriousness 2 and higher) with an imputability of definite, probable, or possible, refer to Figure 11.
- Five reports concern patients with previously undetected irregular antibodies. In three cases, the transfused units were antigen-positive for the newly identified antibody in the patient. In one report, the antibody had likely already developed in the patient but undetected in the Type-and-Screen (anti-Di(a)). There was probably hemolysis in booster reaction. It is unclear whether one of the RBC units was Di(a) positive. The fifth report concerns a recipient known to have a beta-thalassaemia, in whom both anti-Le(a) and anti-Le(b) were found after transfusion. It is unclear whether the unit was positive for these antigens.
- One report has a post-transfusion bacteremia/sepsis in the sub-category. In addition to worsening hemolysis, there was a relevant positive blood culture *(S. Aureus)* following transfusion, for which the patient received antibiotics. The cultures of the blood product were negative.

Table 12 Overview of reports on acute hemolytic transfusion reactions (AHTR) with an imputability of definite, probable, or possible

	AHTR N = 8
Gender (%)	
Female	3 (37%)
Male	5 (62%)
Age (years)	56 (4-62)
Time interval between start of transfusion and occurrence of transfusion reaction (hrs:min)	02:29 (00:00–14:14)
Seriousness of transfusion reaction (%)	
Seriousness 1	1 (12%)
Seriousness 2	5 (62%)
Seriousness 3	2 (25%)
Imputability (%)	
Definite	4 (50%)
Probable	2 (25%)
Possible	2 (25%)
Cause	
Irregular antibodies not previously shown	5
• anti-E, anti-c, anti-K	
• anti-Le(a), anti-Le(b)	
• anti-Wr(a)	
• anti-Jk(a)	
• anti-Di(a)	
Immune-mediated hemolysis in spherocytosis	1
Chronic hemolysis in reactive cold antibodies	1
Auto-immune hemolytic anaemia, worsening during transfusion	1

Values are expressed in numbers (%) or medians (ranges)

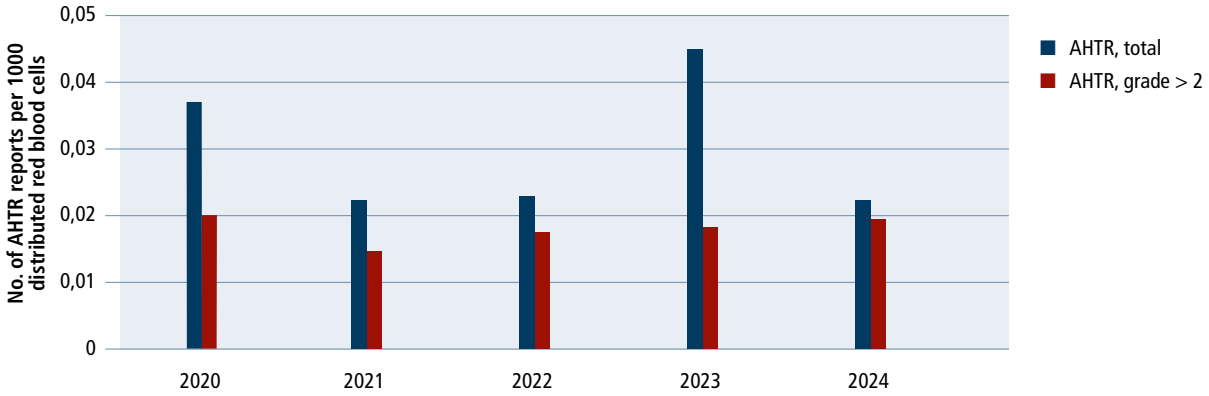

Figure 11 Number of acute hemolytic transfusion reaction reports with an imputability of definite, probable, or possible per 1,000 RBC concentrates distributed, 2020-2024

Including hemolytic reactions when incorrect blood product transfused or new antibody formation is detected

Delayed hemolytic transfusion reaction (DHTR)

Signs or symptoms of hemolysis occurring from 24 hours to a maximum of 28 days after transfusion, such as: unexplained drop in hemoglobin, dark urine, fever/chills.

Nine reports (eight for RBC units, one for SD plasma) received from seven hospitals.

- All reports with an imputability of definite, probable, or possible (Figure 12).
- In five cases, the formation of new antibodies was shown:
  - anti-E, anti-S, HTLA antibodies with specificity Cs(a)
  - anti-Jk(b)
  - anti-Jk(a)
  - anti-Jk(a)
  - anti-S, anti-M
- Once there was post-transfusion hemolysis in already known paroxysmal nocturnal hemoglobinuria and mycoplasma infection, and two hemolytic reactions in the same patient, in which the first reaction was antibody formation.
- In one reaction with seriousness 0, an ABO-incompatible plasma unit was administered during mass blood loss. The reporting category is incorrect blood product transfused and is described in Chapter 3.1.

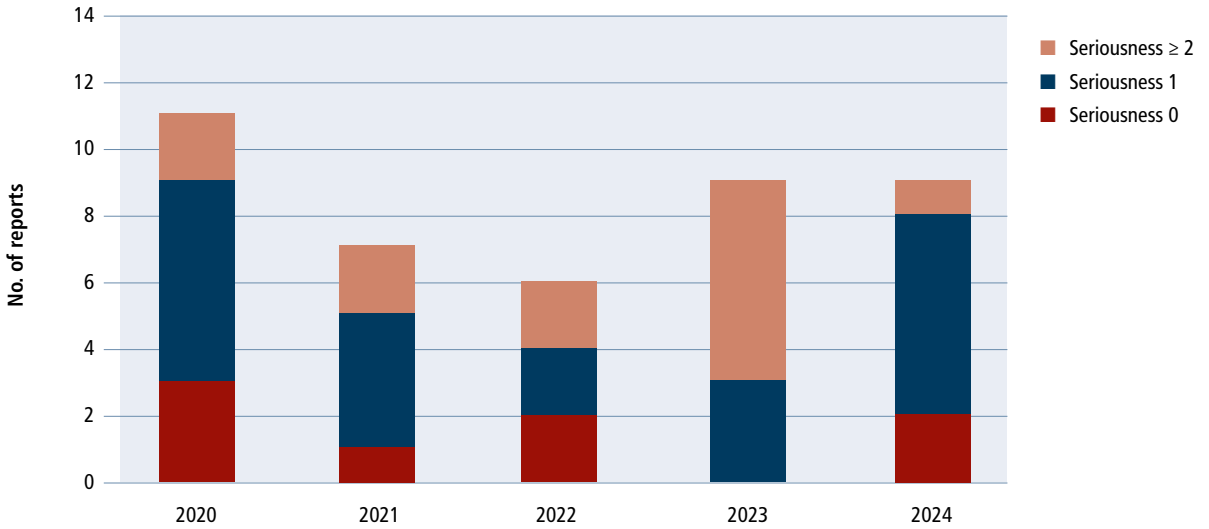

Figure 12 Seriousness of reports on delayed hemolytic transfusion reaction (imputability of definite, probable, or possible), 2020-2024

New antibody formation against blood cell antigens

After receiving a transfusion, demonstration of clinically relevant antibodies against blood cells (irregular antibodies, HLA or HPA antibodies) that were not present previously (as far as is known in that hospital). As of 2021, cases should only be reported to TRIP in special circumstances, e.g. in combination with a transfusion reaction, (suspected) hemolysis and/or antibody formation due to incorrect blood product selection.

- Two reports of new antibody formation were received from two different hospitals.
- Two reports concerned antibody formation (anti-D; anti-E) as a result of incorrect product selection. These were reported as incorrect blood product transfused and are described in Chapter 3.1.

TRIX (Transfusion Register of Irregular Antibodies and Cross (X)-match problems) is a nationwide data system, in which patients who are known to have antibodies against blood groups or cross-matching problems, such as stem cell transplants, are registered. Hospital laboratories use this database to complete information on antibodies in patients and pregnant women. As a result, TRIP only receives reports of new antibodies where there were details, i.e. a transfusion reaction or an event where new antibody formation was detected. Information on reported antibodies 2024 in TRIX can be found here.

Allergic reaction

Rapidly developing allergic reaction occurring within a few seconds after the start of transfusion or until a short time after transfusion, with symptoms such as stridor, drop in systolic and/or diastolic blood pressure ≥ 20 mmHg, nausea/vomiting, diarrhoea, back pain, skin rash.

Allergic reaction case in 2024

- In 2024, 133 cases of allergic transfusion reactions were reported by 38 hospitals (48%), with a range of 1 to 19 reports per hospital.
- Once, a non-serious allergic reaction was determined as a sub-category in a non-hemolytic transfusion reaction, in which the increase in temperature and chills were prominent.
- 128 (96%) of the reports of allergic reaction have an imputability of definite, probable, or possible.

Allergic reaction with an imputability of definite, probable, or possible (Table 13):

- Twice, an allergic reaction was reported in combination with an event (refer to Table 13).
- 17 cases (13%) were classified as serious. In 12 of these cases, there was dyspnoea, saturation drop and/or stridor.
- Allergic reactions are most often seen after transfusion of platelets (Figure 13).
- 29 (23%) patients with an allergic reaction were younger than 18 years old, compared to 43 (5%) in the other categories of transfusion reactions combined. The median age in the allergic transfusion reaction group is 55 years old, compared to 71 years old in the combined group of other post-transfusion reactions.
- 12 reports describe that, in response to the reaction, the IgA level is determined. One patient who had a serious allergic reaction had an IgA level of < 0.7 g/l determined and IgA antibodies were detected. A following transfusion with washed red blood cells and prior clemastine went smoothly.

Table 13 Overview of reports of allergic reactions with an imputability of definite, probable, or possible in 2024

	Allergic reaction (N = 128)
Gender (%)	
Female	68 (53%)
Male	60 (47%)
Age (years)	55 (21-70)
Time interval between start of transfusion and occurrence of transfusion reaction (hrs:min)	01:05 (00:34–02:26)
Seriousness (%)	
Seriousness 1	111 (87%)
Seriousness 2	17 (13%)
Imputability (%)	
Definite	11 (9%)
Probable	64 (50%)
Possible	53 (41%)
Product (%)	
RBC concentrate	51 (40%)
Platelet concentrate	55 (43%)
SD plasma	14 (11%)
Anti-COVID convalescent plasma	1 (1%)
Combination of blood products	7 (5%)
Symptoms (number of reports)	
Itching, urticaria, redness – local	40
Itching, urticaria, redness – generalised	56
Swelling of tongue, lips, eyelids	16
Glottic oedema	2
Increase in temperature 1-2 °C	14
Increase in temperature ≥ 2 °C	3
Chills	12
Reduced responsiveness	1
Dyspnoea/saturation drop	22
Hypotension	15
Nausea/vomiting/diarrhoea	12

Values are expressed as numbers (%) or medians (IQR)

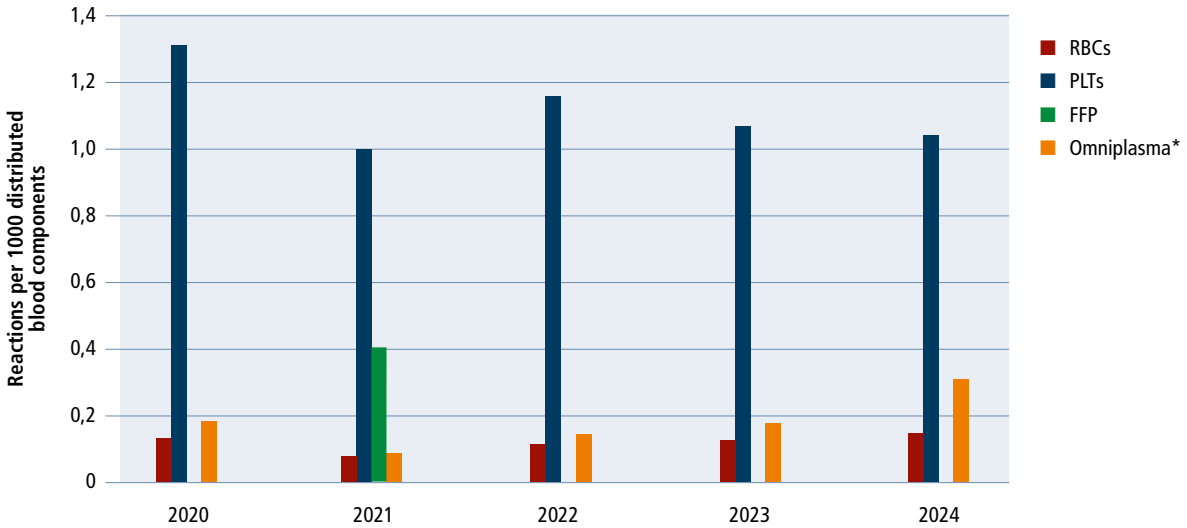

Figure 13 Number of allergic reaction reports with an imputability of definite, probable, or possible per 1,000 blood products distributed, 2020-2024

Reactions associated with more than one type of blood product were proportionally attributed to the respective blood product types. One reaction after COVID-19 convalescent plasma (5.9/1,000 distributed CCP units).
** For SD plasma (Omniplasma®), only units actually transfused were reported in 2021-2024.*

Non-hemolytic reactions

Non-hemolytic transfusion reaction (NHTR)

Increase in temperature of ≥ 2 °C (with or without chills) during or in the first two hours after a transfusion, with normalisation within 24 hours after the transfusion, or chills within the same time limits, without other relevant symptoms or signs.

Mild non-hemolytic febrile reaction (mild NHFR)

Increase in temperature ≥1 °C (< 2 °C) (during or in the first two hours after a transfusion with normalisation within 24 hours after the transfusion, without other relevant symptoms or signs.

Total of 538 reports of non-hemolytic reactions, non-hemolytic transfusion reactions and mild non-hemolytic febrile reactions (251 and 287, respectively), compared to 621 reports (292 and 329, respectively), including late reports from 2023. Number of reporting hospitals: 66 hospitals (84%), range: 1-34 reports per hospital.

- Number of reports with an imputability of definite, probable, or possible is 479 (89%), NHTR 213 (84%) and mild NHFR 266 (92%).
- The number of reports (N = 28) of serious non-hemolytic transfusion reactions (seriousness 2 or higher) with an imputability of definite, probable, or possible is comparable to that in 2023 (N = 19).
- Twelve times, a mild NHFR or an NHTR was reported as the sub-category in combination with an other type of transfusion reaction: 6× for allergic reaction, 3× for circulatory overload, 2× for other reaction and 1× for TAD.
- Information on the reports is summarised in Table 14.

Table 14 Overview of reports of non-hemolytic reactions with an imputability of definite, probable, or possible

	NHTR (N = 213)	Mild NHFR (N = 266)
Gender (%)		
Female	102 (47%)	122 (45%)
Male	111 (52%)	144 (54%)
Age (years)	68 (54-76)	69 (54-77)
Seriousness (%)		
Seriousness 1	193 (90%)	259 (97%)
Seriousness 2	21 (9%)	7 (2%)
Imputability (%)		
Definite	2 (0%)	0 (0%)
Probable	29 (13%)	32 (12%)
Possible	180 (84%)	234 (87%)
Product (%)		
RBC concentrate	165 (77%)	258 (96%)
Platelet concentrate	31 (14%)	5 (1%)
Combination of blood products	17 (7%)	3 (1%)
Symptoms (number of reports):		
Chills	6 (2%)	11 (4%)
Increase in temperature < 1 °C	13 (6%)	17 (6%)
Increase in temperature 1-2 °C	76 (35%)	246 (92%)
Increase in temperature ≥ 2 °C	100 (46%)	
Chills	163 (76%)	
Tachycardia	50 (23%)	26 (9%)
Hypertension	35 (16%)	15 (5%)
Hypotension	8 (3%)	6 (2%)
Dyspnoea/saturation drop	14 (6%)	7 (2%)
Nausea/vomiting	18 (8%)	8 (3%)

Values are expressed as numbers (%) or medians (IQR)

Other reactions

Transfusion reaction which does not fit into the categories above.

- In 2024, 256 reports as 'Other reactions' were submitted by 62 hospitals, 190 of which were with an imputability of definite, probable, or possible.

For classification and analysis of the other reactions, TRIP uses a subdivision into subgroups (Table 15 and Figure 14). A large group of reactions concern the transfusion reactions with hypotension. Six of these 44 cases fall under the ISBT definition of a hypotensive reaction, which must comply with the criteria of systolic blood pressure ≥ 80 mmHg and a hypotension of ≥ 30 mmHg. Another large group concerns the other signs or symptoms, in which symptoms have occurred that are not consistent for a specific type of transfusion reaction and may be partly related to the underlying condition of the patient.

Table 15 Overview of reports of other reactions with an imputability of definite, probable, or possible

Type of reaction		Seriousness ≥ 2[a]
Reactions with hypotension	44	1 (7)
Subgroup hypotensive reaction (ISBT)[b]	6	0 (1)
Reactions with dyspnoea	36	7 (4)
Hypertension	28	1 (3)
Cardiac symptoms	7	1 (2)
Did not fully comply with TRIP definitions of standard categories	31	5 (7)
Other symptoms	44	13 (16)
Total	**190**	**28 (39)**

[a] *Number in 2024 (number in 2023)*
[b] *Systolic blood pressure ≤ 80 mmHg and drop ≥ 30 mmHg*

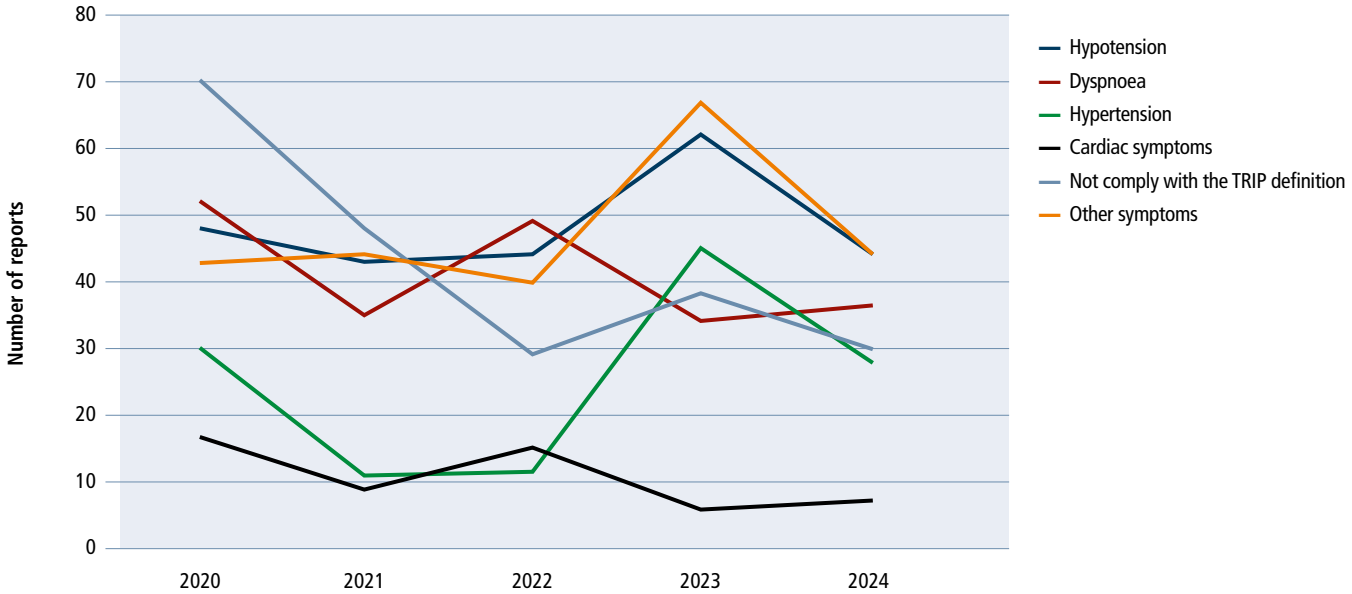

Figure 14 Number of reports of other reactions with an imputability of definite, probable, or possible categorised by subtype, 2020-2024

3.3 Infectious transfusion complications

Bacterial problems in blood transfusion

Post-transfusion bacteremia/sepsis
Clinical symptoms of bacteremia/sepsis arising during, directly after or some time subsequent to a blood transfusion, with a relevant positive patient blood culture result; a causal link to a transfused blood product may or may not be confirmed.

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

Total of 50 reports of post-transfusion bacteremia/sepsis, up from 47 in 2023, including late reports (Table 16). Number of reporting hospitals: 31 hospitals (39%), range: 1-5 reports per hospital.

- 23 reports (46%) were classified with an imputability of definite, probable, or possible, refer to Table 17.
- Two serious reactions with reporting category post-transfusion bacteremia/sepsis (seriousness 2 or higher) with an imputability of definite, probable, or possible, in comparison to four in 2023.
- None of the post-transfusion bacteremia/sepsis reports complied with the criteria for Transfusion-Transmitted Bacterial Infection (TTBI) in 2024.
- According to the TRIP definition, TTBI is diagnosed when identical micro-organisms are identified in both the recipient's blood culture as well as the blood product's culture, with transmission considered to be definite, probable, or possible after evaluation by TRIP experts. TTBI is excluded, if a patient's blood culture was negative or was not carried out and/or there is no positive culture of the blood product.
- Post-transfusion bacteraemia/sepsis has been reported six times in the sub-category, five times for circulatory overload, and once for acute hemolytic transfusion reaction. In these cases there was also a relevant positive blood culture from the patient, but the other reaction was more prominent.
- Five cases were reported of bacterial contamination in blood products: in three cases, there was a positive culture result from the unit, and in two cases a positive bacteriological screening after transfusion of the unit. In all cases, the patient had a non-serious other reaction, four times with an increase in temperature and once with hypotension, with patient recovery from these symptoms. No positive blood culture of the patient was observed in any of the cases.

Table 16 Overview of reports from hospitals relating to bacterial problems, 2020-2024

	2020	2021	2022	2023	2024
Post-transfusion bacteremia/sepsis	74	58	61	47	50
(of which evaluated as TTBI)	(0)	(1)	(1)	(0)	(0)
Post-transfusion bacteremia/sepsis as sub-category for other reaction (no TTBI cases)	5	0	8	11	6
Bacterial contamination of blood product (including report of positive bacteriological screening*)	0	1	0	0	0
Bacterial contamination of blood product (including reports of positive bacteriological screening) as sub-category	9	7	2	5	5

* *Cases in which the patient showed symptoms of or experienced adverse consequences, such as postponement of surgery or administration of prophylactic medication*

Table 17 Overview of post-transfusion bacteremia/sepsis reports with an imputability of definite, probable, or possible

	Post-transfusion bacteremia/sepsis N = 23
Gender (%)	
Female	11 (48%)
Male	12 (52%)
Age (years)	69 (62.5-78)
Seriousness (%)	
Seriousness 1	21 (91%)
Seriousness 2	2 (9%)
Imputability (%)	
Probable	4 (17%)
Possible	19 (83%)
Product (%)	
RBC concentrate	18 (78%)
Platelet concentrate	3 (13%)
Combination of blood products	2 (9%)
Symptoms (number of reports)	
Increase in temperature ≥ 1 < 2 °C	11 (48%)
Increase in temperature ≥ 2 °C	10 (43%)
Chills	9 (39%)
Dyspnoea/saturation drop/tachypnea	2 (9%)
Hypotension (≥ 20 mmHg syst and/or diast)	6 (26%)
Hypertension (≥ 20 mmHg syst and/or diast)	4 (17%)
Tachycardia	12 (52%)
Nausea and/or Vomiting	4 (17%)

Values are expressed as numbers (%) or medians (IQR)

Table 18 Overview of positive bacteriological screening of platelets from units already issued by Sanquin

Total reported by Sanquin	2020	2021	2022	2023	2024
Number already administered (platelet concentrates and associated RBCs)	84	73	63	74	88*

* *In all cases, a recall was made on at least 1 of the products, where the products had already been administered. A transfusion reaction was reported to Sanquin by one hospital, which met the definition of serious adverse reaction, and was also reported as such, but with imputability excluded.*

Post-transfusion other infection

Detection of a potential blood-borne infection, other than viral or bacterial, in the recipient following or some time after a blood transfusion, whether or not a causal relationship to a transfused blood product can be established.

In 2024, three reports were registered in the reporting category post-transfusion other infection. After transfusion, there appeared to be a febrile reaction and a positive blood culture in the patient with a yeast or fungal infection. In none of these cases was the yeast or fungus found in the culture of the unit. All three reports were classified with seriousness 1 and an imputability of unlikely.

Post-transfusion viral infection

Detection of a viral infection in a patient within an appropriate interval following a blood transfusion, investigating a causal relationship to a transfused blood product.

Information from hospitals

In 2024, there were no reports of post-transfusion viral infections.

Look-back/recall by the supplier

Retrospective identification of an unjustified or possibly infectious donation (other than a bacterial contamination blood product) leading to testing of the recipient for that infection or possible consequences.

Information from hospitals

Hospitals only report a look-back to TRIP if there were consequences for the patient (a reaction, prolonged hospital stay, additional treatment, etc.). In 2024, no reports of look-backs/recalls were received from hospitals.

Information from Sanquin

In 2024, in line with protocol, Sanquin performed look-backs following ten seroconversions (8× *Treponema pallidum*, 2× HEV). The hospitals have been requested to track down the recipients for the purpose of informing them; no transmitted infections have been detected.

Conclusion on infectious transfusion complications

No reports of transmitted infections were received in 2024.

3.4 Reports regarding SD plasma (Omniplasma®) in 2024

Use of SD plasma in the Netherlands

SD stands for solvent/detergent, a virus-reducing treatment on pooled donor units of plasma. In 2014-2016, Omniplasma® in the Netherlands was introduced as a standard plasma product for transfusion. Omniplasma® is an SD plasma that is virus-inactivated as well as prion-reduced. Omniplasma® is prepared from plasma in the Netherlands for patients in the Netherlands. Since 2012, the product has been manufactured by Octapharma and Sanquin supplies plasma to Prothya, who has it processed by Octapharma into the medicinal product Omniplasma®. Sanquin distributes the products to hospitals as commissioned by Prothya. Figure 1 shows the progression of SD plasma use.

In accordance with agreements between TRIP and Lareb, in principle the TRIP route is used for reports of transfusion reactions or events. Since 2018, reactions (classified as definite, probable or possible) have been reported by TRIP to Lareb, with the exception of new antibody formation where cellular products have also been transfused, and not for events unrelated to product quality. Forwarding reports also applies if labile blood products have been transfused. After coding according to the pharmacovigilance system, reports are entered into the European Eudravigilance database. TRIP hemovigilance reporting helps maintain a complete picture of the transfusion chain at the same time.

In 2024, a total of 29 reactions for SD plasma and three events were reported to TRIP, compared to 18 reports in 2023.

- 24 reactions (83%) with an imputability of definite, probable, or possible, refer to Table 19. Reactions with an imputability of unlikely (4×) or definitely not (1×) have further been excluded.
- Eight reactions were classified as serious reactions, once with seriousness 4 and an imputability of possible (Table 4), and seven times with seriousness 2 of which two with an imputability of probable and five with possible (Table 19).
- Eleven reports also involved the transfusion of labile blood products prior to the reaction or event.
- The greatest number of reactions, as before with FFP, were the allergic reactions (16/29=55%).

Table 19 Reports of reactions with an imputability of definite, probable, or possible as well as events with SD plasma in 2024 (N = 27)

	Not serious reactions		Serious reactions[a]	
Types of reaction	**Only SD**	**SD in combination**	**Only SD**	**SD in combination**
Allergic reaction	11	1	3	1
Other reactions	2	2		2
Circulatory overload				2
Types of events	**Only SD**	**SD in combination**		
Near miss[b]	1			
Incorrect blood product transfused[b]	2			

[a] *Seriousness ≥ 2*
[b] *Refer to Chapter 3.1 for a description of the events*

4 GENERAL DATA

4.1 TRIP working methods and participation

A central registration system for blood transfusion reactions and events makes it possible to monitor the transfusion chain, detect weak links and make recommendations to improve transfusion safety. The incidence of known adverse effects of blood transfusions is monitored and previously unknown reactions to transfusion of current or new blood products can be detected in a good time.

The TRIP foundation (Transfusion (and Transplantation) Reactions in Patients) was founded in 2001 by representatives of the various professional associations involved in blood transfusion. The national TRIP Hemovigilance and Biovigilance Office has managed a registry for transfusion reactions and events since 2003 in collaboration with contacts at hospitals and the national blood service (Sanquin). Since August 2006, TRIP is also in charge of a national reporting system for serious adverse reactions and events in application of human tissues and cells (biovigilance). The biovigilance findings are reported in a separate annual biovigilance report, which is also available on www.tripnet.nl under publications/ trip-reports. TRIP is advised by the Hemovigilance and Biovigilance Advisory Boards, which consist of representatives from the professional associations.

In principle, reporting to TRIP is anonymous and voluntary. Nevertheless, reporting to TRIP is regarded as the professional standard by the Health and Youth Care Inspectorate (IGJ) and the national Blood Transfusion Policy Guidelines 2020. Reporting to TRIP is separate from the hospital's responsibility to provide quality of care. The new EU SoHO Regulation will apply in mid-2027, which not only relates to tissues and cells but also to blood products. From then on, there will be other requirements for reporting reactions and events and reporting activity figures, refer to Recommendations.

Reporters of transfusion reactions and events are asked to provide the results of relevant tests and investigations as well as the seriousness of clinical signs or symptoms. The imputability, i.e. the likelihood that a reaction can be ascribed to the administered blood transfusion, is also evaluated. If necessary, TRIP requests further explanation or details from the reporter. This enables the TRIP physicians to evaluate the coherence of reports and as a verification of the reported category of potentially serious reports. An Expert Committee (EC), consisting of experts from the Hemovigilance Advisory Board, advises on the classification of serious and complicated reports.

Under the requirements of Directive 2002/98/EC, it is mandatory to report serious adverse reactions and events which could relate to the quality and/or safety of blood products. In the Netherlands, these requirements have been implemented in the Healthcare Quality, Complaints and Disputes Act (Implementation Decree Wkkgz; *Wet kwaliteit, klachten en geschillen zorg*), under heading 'Hospital blood banks' (*ziekenhuisbloedbanken*), section 5.1, paragraph 3. Hospitals can submit reports with seriousness 2 or higher to the IGJ using the TRIP online reporting system and to Sanquin if necessary. TRIP performs the analysis of these reports for the competent authority, the Ministry of Health, Welfare and Sports, and the IGJ. TRIP compiles the annual mandatory overview of serious adverse events and reactions to be forwarded to the European Commission, via the Ministry of Health, Welfare and Sport.

At the end of each reporting year, TRIP receives a copy of Sanquin's annual overview of serious adverse reactions and serious adverse events as reported to the IGJ, as well as the figures for the distributed blood products. Each year, TRIP and Sanquin match up relevant serious reports which have been submitted via different routes using anonymous details (date of transfusion, age, gender, type of blood product and general type of reaction), the intention being to ensure that the information in the TRIP database is as complete as possible. If all reports to Sanquin are submitted through the TRIP reporting system, this will ensure that they can be matched and that Sanquin always has access to the final classification (diagnosis) of each reaction in the TRIP system.

Het nut van landelijk registreren en rapporteren van meldingen van transfusiereacties en -voorvallen The value of reporting and collecting transfusion reactions and events at a national level depends on the participation of all the reporting institutions. In 2024, there were 79 hospital contact addresses. In all, TRIP received reports from 70 hospitals (before the cut-off date). Four hospitals indicated that there had been no reports in the TRIP reporting categories in 2024. Two hospitals submitted the reports after the closing date (31-3-2025) for this report. Three hospitals had not submitted any information about reports when this annual report was drawn up. The participation rate among hospitals for reporting was 74/79=94% and for submitting data on transfused blood products was 79/79 (100%).

In addition to hospitals, there are seven 'designated institutions' registered at TRIP with accreditation to receive blood products from Sanquin to provide patients with transfusions. In 2024, three of the seven accredited institutions submitted data, of which one reported that it had not administered any blood products in that year. Four institutions informed TRIP that the blood product figures and reports of any reactions would be provided by the transfusion labs that supply products under contract, or by the main location of the institutions.

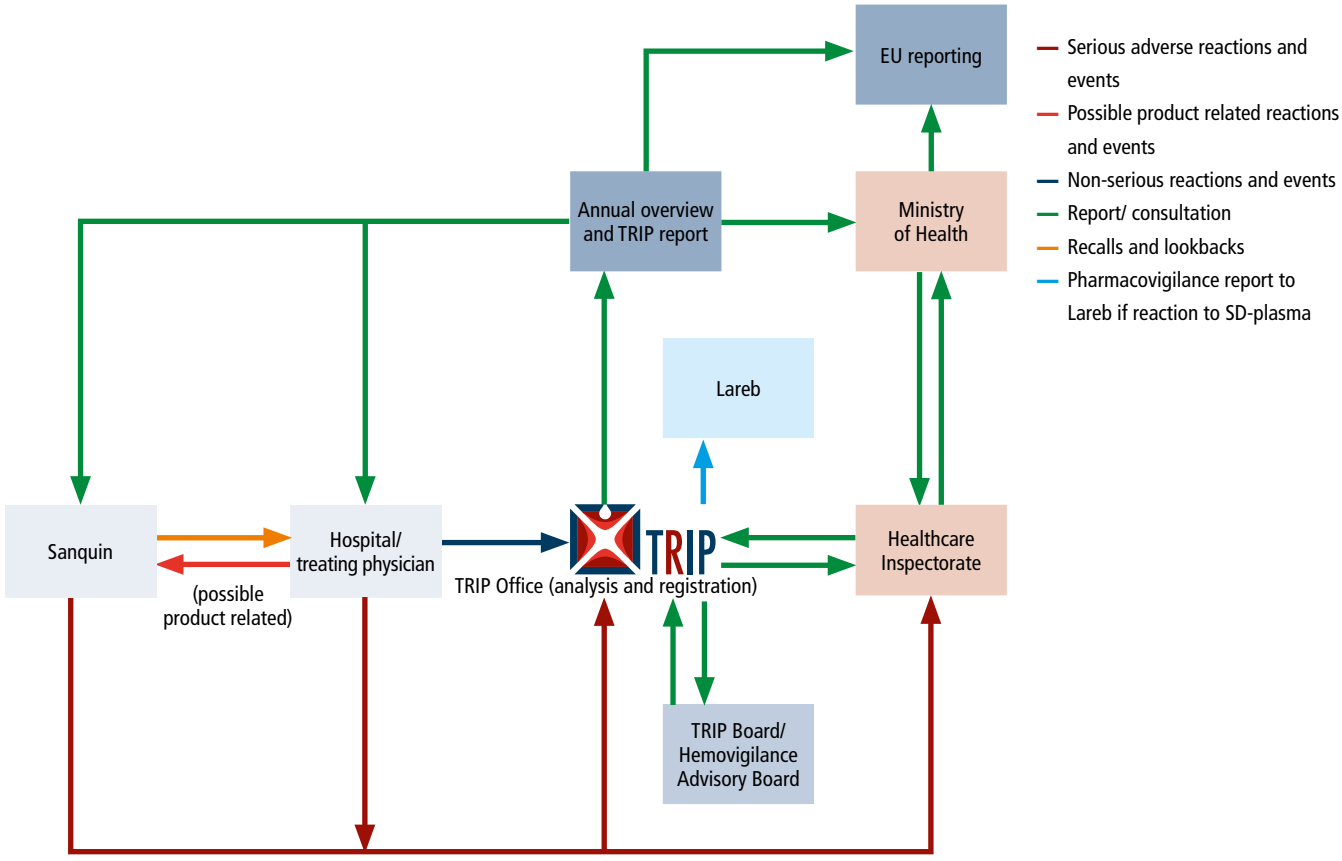

Figure 15 Flow of hemovigilance information and outputs in the Netherlands

LIST OF TERMS AND ABBREVIATIONS

A&E	Accident & Emergency department
AHTR	Acute hemolytic transfusion reaction
CCP	COVID-19 convalescent plasma
COPD	Chronic obstructive pulmonary diseases
COVID-19	Coronavirus disease 2019
DHTR	Delayed hemolytic transfusion reaction
EHR	Electronic health record
EU	European Union
FFP	Fresh frozen plasma
Hb	Haemoglobin
HLA	Human leukocyte antigen
ICU	Intensive Care Unit
IGJ	Inspectorate for Healthcare and Youth
IQR	Interquartile range
Irrab	Irregular antibodies (as used in risk group within the events)
IVIG	Intravenous immunoglobulin
Mild NHFR	Mild non-hemolytic febrile reaction
ml	Millilitres
NHTR	Non-hemolytic transfusion reaction
NIPT	Non-invasive prenatal test
NM	Near miss
OR	Operating room, could also refer to surgery
PC	Platelet concentrate
PICC	Peripherally inserted central catheter
PTP	Post-transfusion purpura
RBC	Erythrocyte concentrate (red blood cell concentrate)
Rh	Rhesus factor
Sanquin	Sanquin Blood Supply Foundation (national not-for-profit blood supply organisation)
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
SD plasma	Solvent/detergent plasma; in the Netherlands: Omniplasma®
SoHO	Substances of Human Origin (body materials)
T&S	Type and Screen, compatibility test
TACO	Transfusion-associated circulatory overload, after blood transfusion
TAD	Transfusion-associated dyspnoea
TA-GvHD	Transfusion-associated graft-versus-host disease
TMU	Transfusion Medicine Unit (Sanquin Blood Facility Foundation)
TR	Transfusion reaction
TRALI	Transfusion-related acute lung injury
TRIP	TRIP Foundation (Transfusion and Transplantation Reactions in Patients)
TTBI	Transfusion-transmitted bacterial infection
VWS	Dutch Ministry of Health, Welfare and Sport
Wkkgz	Healthcare Quality, Complaints and Disputes Act
y	Years