New Zealand
Blood Service

NZBLOOD
Te Ratonga Toto O Aotearoa

National Haemovigilance Programme

Annual Report
2024

NEW ZEALAND BLOOD SERVICE HAEMOVIGILANCE PROGRAMME

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Acknowledgements: Carolyn Jeffrey, Rosie Hawes, Leigh Mosen, Young Kim.

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CONTENTS

ABBREVIATIONS AND DEFINITIONS	
AABB	Association for the Advancement of Blood & Biotherapies (formerly American Association of Blood Banks)
AHTR	Acute haemolytic transfusion reaction
aHUS	Atypical haemolytic uraemic syndrome
APH	Apheresis
ATR	Adverse transfusion reaction
Blood Component	A therapeutic constituent of human blood (red cells, fresh frozen plasma, platelets, cryoprecipitate) that can be collected by apheresis or separated from whole blood.
BNP	Brain (or B-type) Natriuretic Peptide
CAG	Clinical Advisory Group
CI	Confidence interval
DAE	Donor adverse event
DAT	Direct antiglobulin test
DHB	District Health Board
DHTR	Delayed haemolytic transfusion reaction
DSTR	Delayed serologic transfusion reaction
eTraceline	The national blood management system used by all Blood Banks to record all pre-transfusion testing and issuing of blood components and products. The system is administered by NZBS.
FNHTR	Febrile non-haemolytic transfusion reaction
Hb	Haemoglobin
HBsAg	Hepatitis B surface antigen
HBV	Hepatitis B virus
HCV	Hepatitis C virus
HPC	Haematopoietic progenitor cells
HIV	Human immunodeficiency virus
HTLV I/II	Human T-Cell Lymphotropic virus Types I and II
IAT	Indirect antiglobulin test
IBCT	Incorrect blood component transfused
IgO	NZBS software application for approval of immunoglobulin requests
IHN	International Haemovigilance Network
ISBT	International Society of Blood Transfusion

GLOSSARY

LDH (or LD)	Lactate dehydrogenase
MCV	Mean cell volume
NHI	National health index
NZBS	New Zealand Blood Service
PAS	Platelet additive solution
PNH	Paroxysmal nocturnal haemoglobinuria
PTP	Post-transfusion purpura
RCNR	Red cells not returned (in relation to apheresis collections)
SHOT	Serious Hazards of Transfusion – the UK haemovigilance programme
TACO	Transfusion-associated circulatory overload
TAD	Transfusion-associated dyspnoea
TA-GVHD	Transfusion-associated graft-versus-host disease
TAH	Transfusion-associated hypotension
TMS	Transfusion Medicine Specialist
TNS	Transfusion Nurse Specialist
TRAE	Transfusion-related adverse event (includes reactions and errors)
TRALI	Transfusion-related acute lung injury
TTI	Transfusion-transmitted infection
UCT	Unclassifiable complication of transfusion
WB	Whole blood
WBIT	Wrong blood in tube

BLOOD COMPONENTS	
FFP	Fresh frozen plasma
Fresh Frozen Plasma Neo	Fresh frozen plasma for neonatal transfusions, volume 45 – 90 mL
Platelets APH	Platelets prepared by apheresis and suspended in plasma
Platelets APH PAS	Platelets prepared by apheresis and suspended in PAS, introduced 2012
Platelets Neo	Platelets for neonatal transfusions, volume 30 – 60 mL
Platelets Pooled PAS	Pool of platelets from buffy coats suspended in PAS, introduced 2011
RBC	Red blood cells
Red Cells Neo	Red cells for neonatal transfusions, volume 55 – 85 mL
SED	Serum eye drops

GLOSSARY

BLOOD PRODUCTS	
Albumex® 4	4% human albumin solution for intravenous infusion
Albumex® 20	20% human albumin solution for intravenous infusion
Alburex® 5 NZ	5% human albumin solution for intravenous infusion
Alburex® 20 NZ	20% human albumin solution for intravenous infusion
Biostate®	Human coagulation factor VIII and von Willebrand factor complex
Evogam®	16% human normal immunoglobulin solution for subcutaneous use
Gamunex®	10% human normal immunoglobulin solution for intravenous infusion
Hizentra®	20% human normal immunoglobulin solution for subcutaneous use
Hizentra® NZ	20% human normal immunoglobulin solution for subcutaneous use
Intragam® P	6% human normal immunoglobulin solution for intravenous infusion
Privigen®	10% human normal immunoglobulin solution for intravenous infusion
Privigen® NZ	10% human normal immunoglobulin solution for intravenous infusion
Prothrombinex®-VF	Human coagulation factors II, IX and X and low levels of Factor VII
Rh(D) Immunoglobulin-VF	Human anti-D immunoglobulin solution for intramuscular injection

CHAPTER 01

INTRODUCTION

01 INTRODUCTION

Welcome to our national Haemovigilance Programme Annual Report for 2024 – a milestone year marking twenty years since the first publication of this report.

This report covers a year of continual change and rising demand across the health sector and a challenging period for the New Zealand Blood Service. The year was marked by ongoing industrial action across Health NZ, the wider pathology sector and, in May 2024, a period of action which had a significant impact on the collection and manufacturing of blood and blood products as well as blood banking and laboratory services provided by NZBS.

I wish to acknowledge our colleagues in hospitals and blood banks across the country who have continued to refer adverse events and errors to our Clinical Surveillance team, despite competing pressures for their time. Thanks also to our Collections teams, who are continually monitoring donor adverse events, and providing clinical support to our donors. As always, this report was the result of many hours spent by our Transfusion Nurse Specialist, Transfusion Medicine Specialist and our Clinical Surveillance team, all of whom play an important part in the collation, assessment and management of reports.

Reports of Acute Transfusion Reactions have risen to a new high of 596 this year, affecting 540 patients (Chapters 2 and 3). In addition, reports of adverse reactions to fractionated plasma products are still rising, possibly related to the ongoing changes in products as part of 'Process Migration' of the New Zealand product range, but also due to continued increases in prescribing (Chapter 5). Error and near miss reporting has reduced slightly from a peak in 2023 (Chapter 4).

Demand for blood components has risen consistently since 2020, with red cell demand now at 20.8 per 1,000 population and increasing use of platelets and cryoprecipitate. Immunoglobulin demand has produced the greatest challenge, continuing to rise at 10% per year for the past decade. This has meant that, despite increasing collection, 22.9% of immunoglobulin product is now sourced from international commercial providers. NZBS continued to invest in new capacity for blood and plasma collection in 2024, opening a new mobile centre in Henderson and advancing plans for new centres in Auckland and Wellington.

As demand rises, it is important to focus on ensuring that all use of blood and blood products is appropriate, and that opportunities to reduce unnecessary blood use are implemented. Patient Blood Management (PBM) is endorsed by the WHO and defined as 'a patient-centred, systematic, evidence-based approach to improve patient outcomes by managing and preserving a patient's own blood while promoting patient safety and empowerment'. In 2024, NZBS convened the first National PBM Meeting which brought together interested clinicians and expert speakers to review the latest PBM research. We plan to continue this meeting, aligned with the National Hospital Transfusion Committee Meeting, annually.

The Process Migration project continued in 2024, with the rollout of Alburex® NZ 5% and 20%, replacing our longstanding Albumex® product range. The transition to new products should complete in 2025 with the introduction of our new 4-factor Prothrombin Complex Concentrate, Beriplex® NZ (replacing Prothrombinex®-VF).

We anticipate that maintaining balance between donation and demand for blood and blood products will become increasingly challenging. The rising age of our population, as birth rate falls and life-expectancy rises, is likely to lead to fewer donors and more recipients. For this reason we have, for the first time this year, increased the depth of our demographic reporting to include a more detailed look at age, gender and ethnicity of donors and patients (Chapter 2). Notably, it is evident that more than 50% of transfusion recipients are aged 65 years or older. Donor demographics suggest that we will need to work harder to encourage more young people, especially young men, to donate. People of European heritage make up the greatest proportion of donors and so raising awareness and improving access to donation for people of all ethnicities, across the country, will be important in coming years.

During the preparation of this report, our Clinical Surveillance Team has expanded, as we have welcomed Anna Zhou. Thanks go to all the team, Alex Milosavljevic, Meredith Smith, Wenhua Wei and Anna for this excellent report. Thank you to all of those who have supported this work, contributing to the continued safety of blood transfusion and donation in New Zealand.

Dr Sarah Morley

Chief Medical Officer
New Zealand Blood Service

CHAPTER 02

HAEMOVIGILANCE OVERVIEW

02 HAEMOVIGILANCE OVERVIEW

The NZBS Haemovigilance Programme receives reports for adverse transfusion reactions to blood components (ATR), fractionated product adverse events, error and near miss reports and adverse events associated with blood donation.

In 2024, the Haemovigilance Programme received 596 ATR reports, 116 fractionated product adverse event reports, 81 error and near miss reports and 8,132 donor adverse event reports. Figures 2-1 to 2-4 show overall reporting trends for the last six years. Further detail can be found in subsequent chapters of this report.

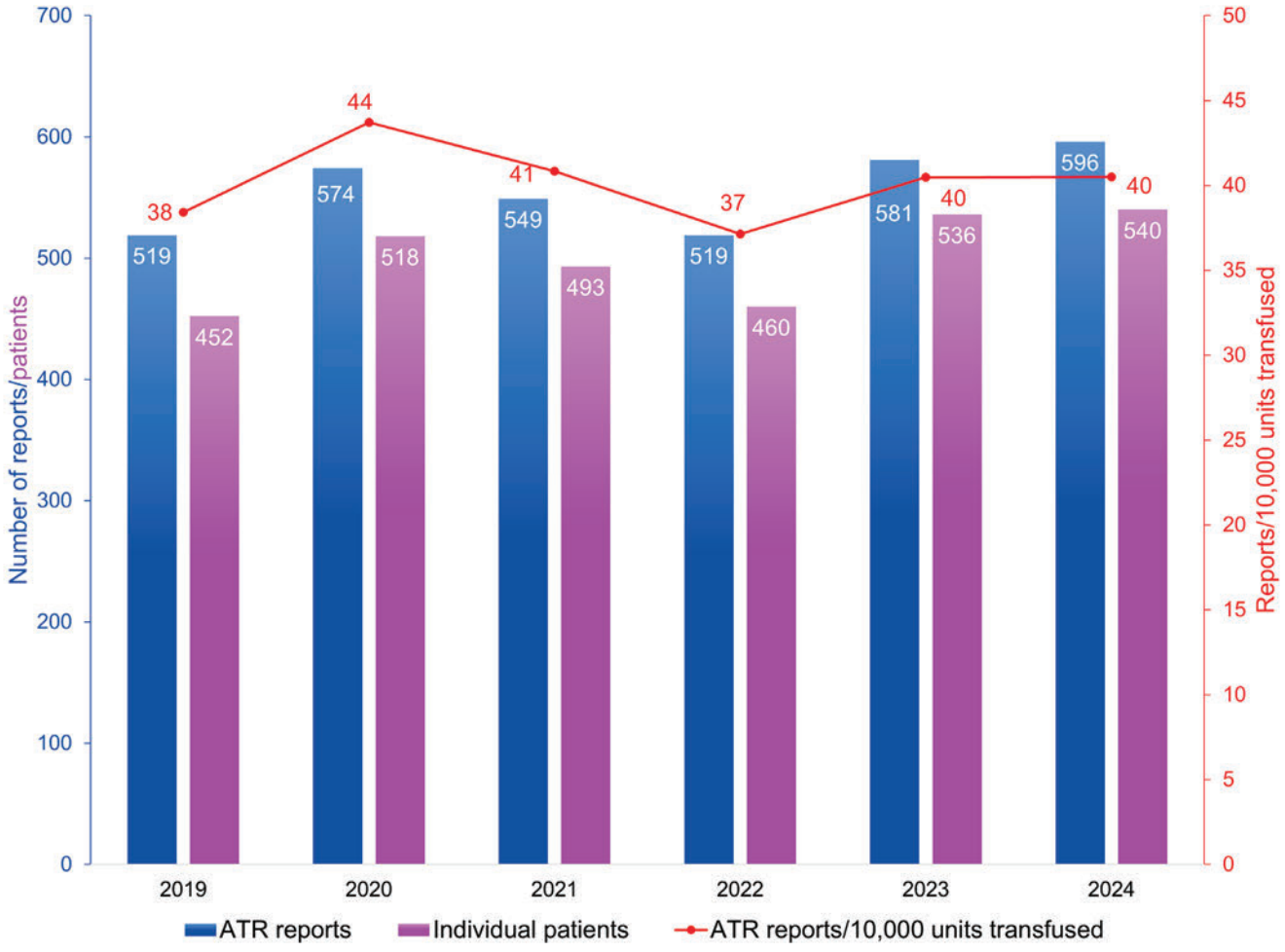


Figure 2-1: Adverse transfusion reaction reports: annual number and reporting rate 2019 to 2024

A substantial increase in the number of fractionated product adverse event reports was observed in both 2023 and 2024 compared to 2022 (Figure 2-2). During 2023 Intragam® P was phased out, and an alternative intravenous immunoglobulin, Privigen® NZ, was introduced. The fractionated product adverse event reports are discussed further in Chapter 5.

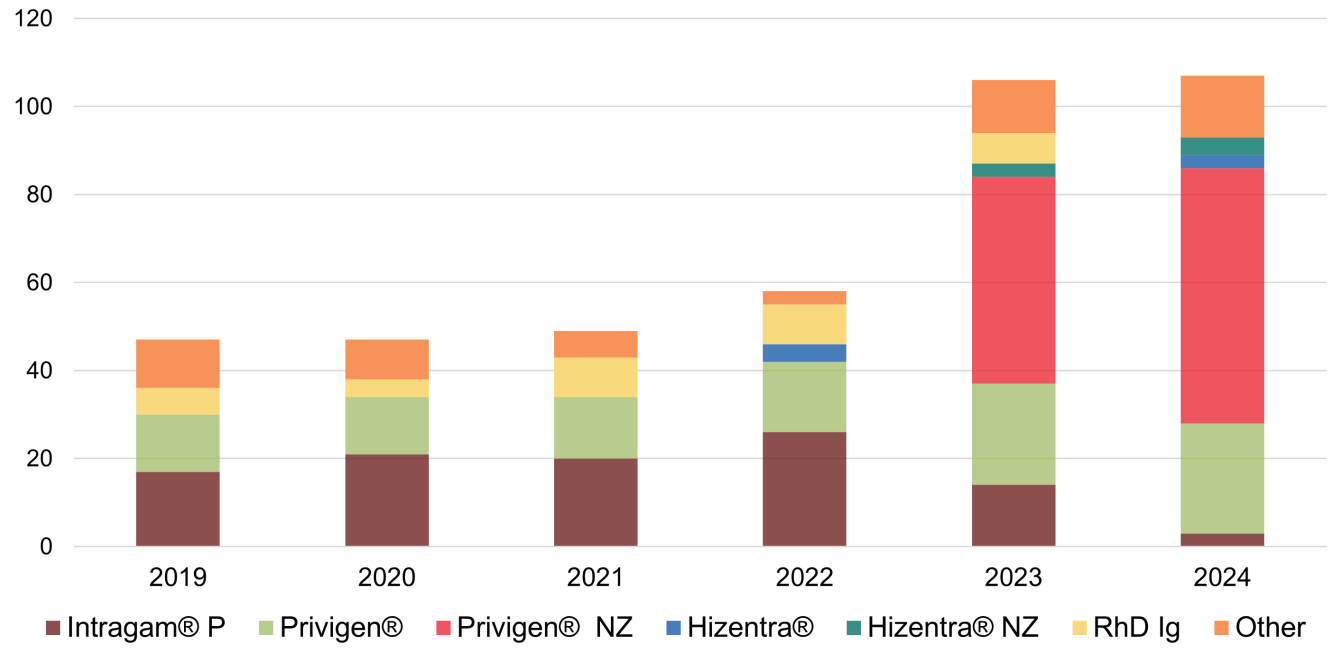


Figure 2-2: Number of fractionated product adverse event reports 2019 to 2024

There were 81 error and near miss reports in 2024, a decrease from 2023 where 101 reports were received (Figure 2-3). Error reports are discussed in Chapter 4.

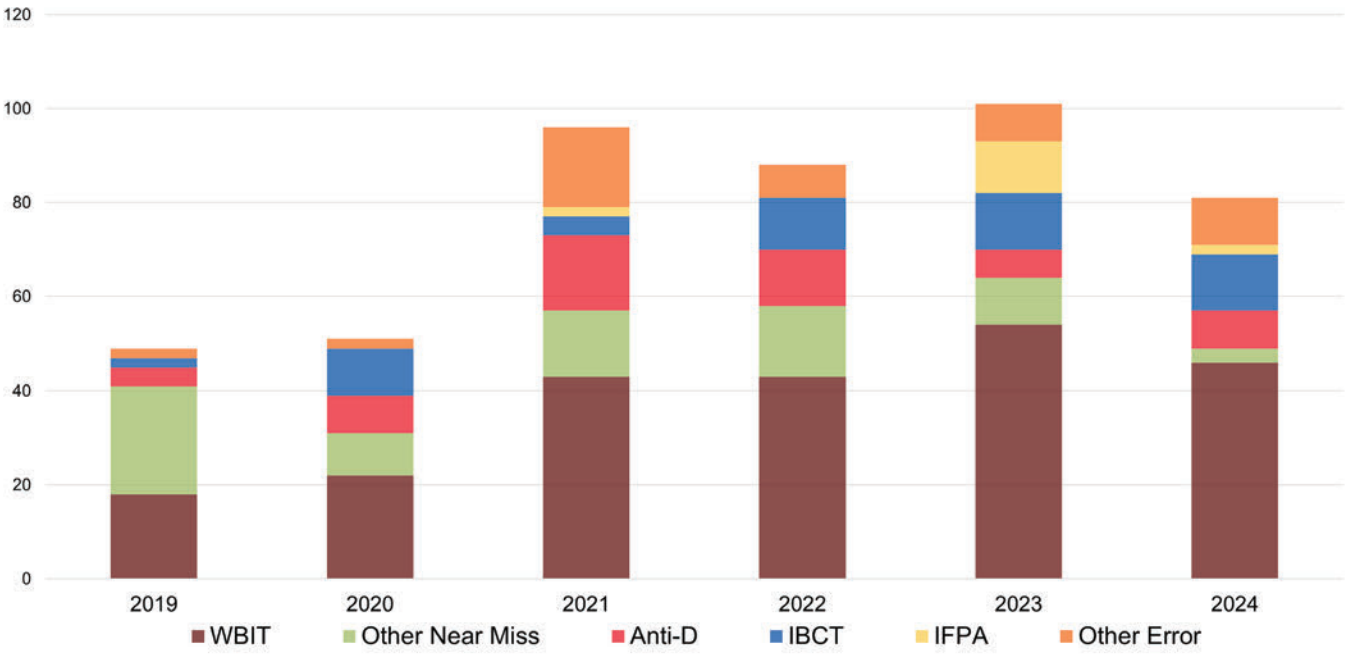


Figure 2-3: Number of error and near miss reports 2019 to 2024

The reporting rate for donor adverse events has increased 21% since 2020 (Figure 2-4).

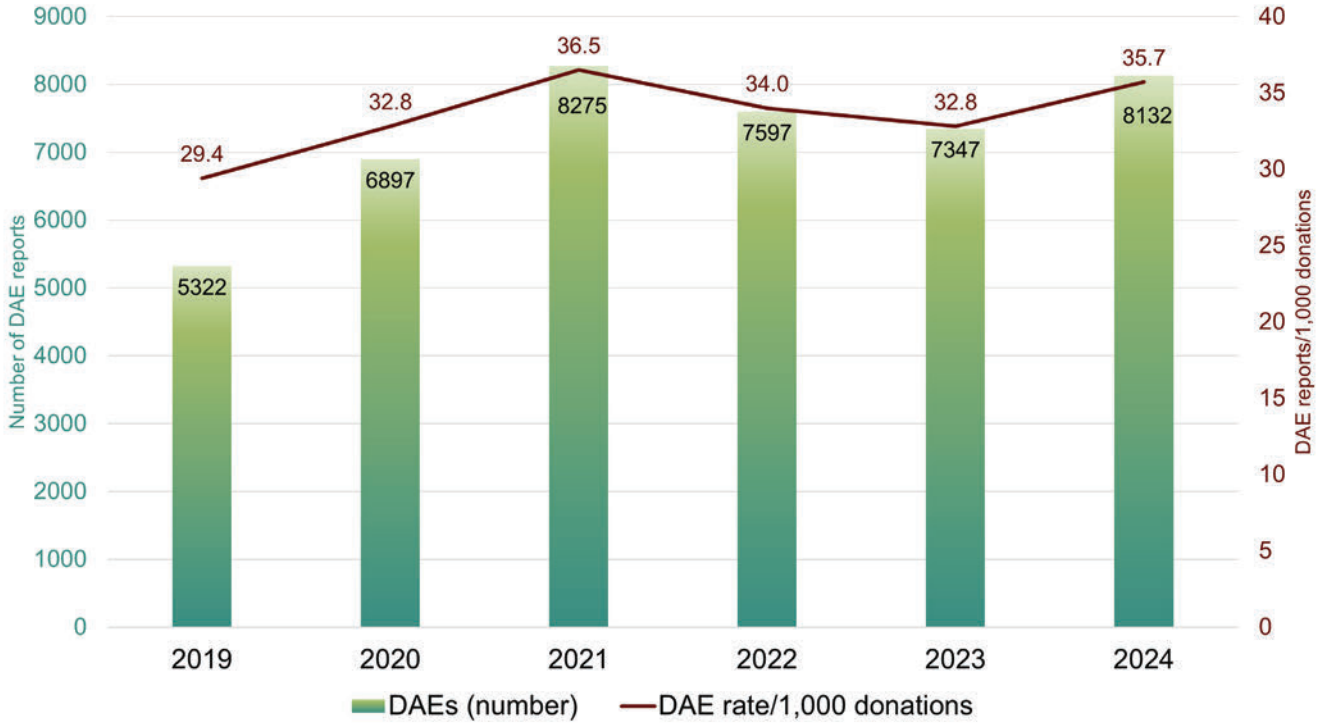


Figure 2-4: Donor adverse event reports: annual number and reporting rate 2019 to 2024

2.1 BLOOD DONOR DEMOGRAPHICS

There were 98,254 blood donors in 2024. Figure 2.1-1 presents the prioritised ethnicity of blood donors, alongside New Zealand Census 2023 data.[1]

Ethnicity data for donors was extracted from eProgesa, the NZBS blood management system. Certain donors may have had more than one ethnicity recorded in eProgesa.

For the purposes of this report, ethnicity was determined using a prioritised definition, meaning each donor was assigned a single ethnic group using a predefined priority system. This approach, commonly used in Ministry of Health statistics, simplifies analysis and ensures that smaller ethnic groups and those of policy significance are not swamped by the European ethnic group.[2] The ethnic priorities in descending order are: Māori, Pacific Peoples, Asian, Middle Eastern/ Latin American/African (MELAA), Other ethnicity, European, Residual categories. While this method offers practical benefits for reporting, it has notable limitations. It overrides the principle of self-identification and can lead to the over-representation of certain ethnic groups at the expense of others.

Each donor has been counted only once regardless of multiple blood donations.

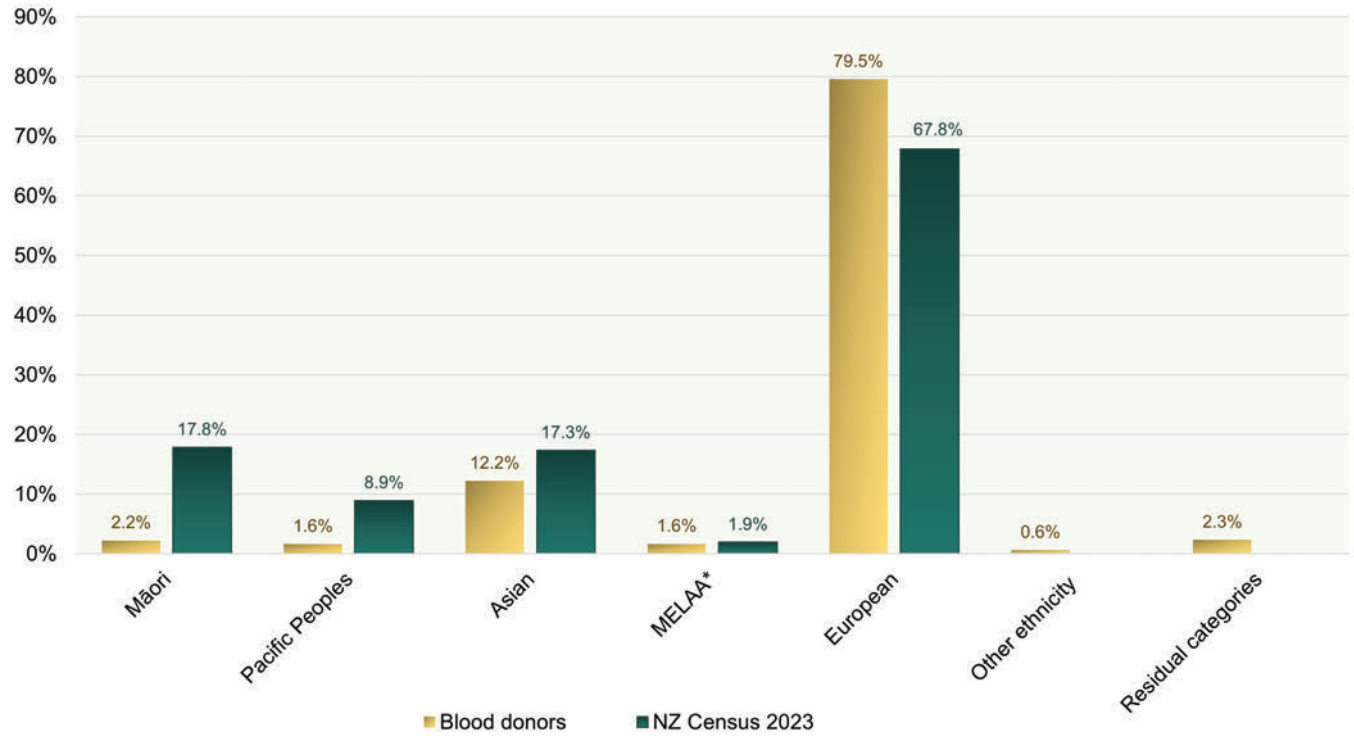


Figure 2.1-1: Prioritised ethnicity of blood donors 2024

** MELAA = Middle Eastern, Latin American and African. Note: 'Other ethnicity' refers to other smaller or less common ethnicities that do not have their own standalone category due to limited population size. 'Residual categories' are used when ethnicity data is incomplete, ambiguous, or outside the scope of a standard classification (e.g., "not stated," "don't know," or "response unidentifiable").*

[1] Stats NZ. 2023 Census population counts by ethnic group, age, and Māori descent and dwelling counts [Internet]. Wellington: Stats NZ; 2024 [cited 2025 Aug 3]. Available from: https://www.stats.govt.nz/information-releases/2023-census-population-counts-by-ethnic-group-age-and-maori-descent-and-dwelling-counts

[2] Ministry of Health. HISO 10001: Ethnicity Data Protocols [Internet]. Wellington (NZ): Ministry of Health; 2017 [cited 2025 Jul 29]. Available from: https://www.tewhatuora.govt.nz/assets/Our-health-system/Digital-health/Health-information-standards/HISO-10001-2017-Ethnicity-Data-Protocols.pdf

Figure 2.1-2 shows the distribution of blood donors by gender and age categories in 2024. In all age categories there is a larger proportion of female donors compared to male donors.

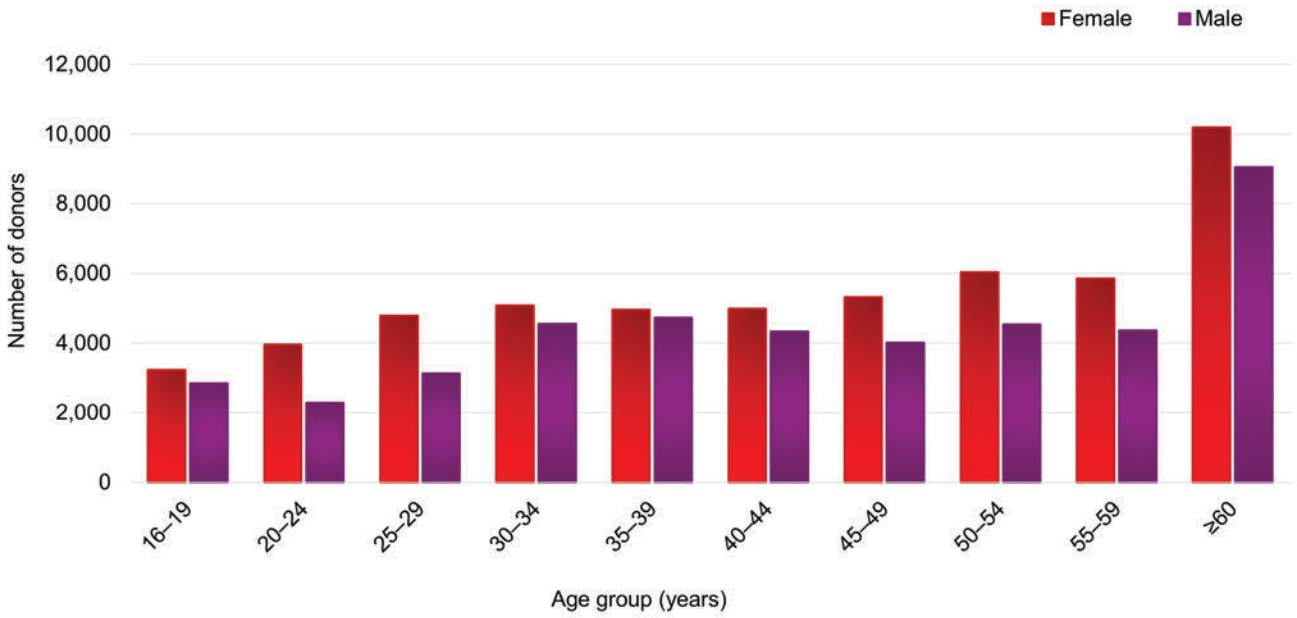
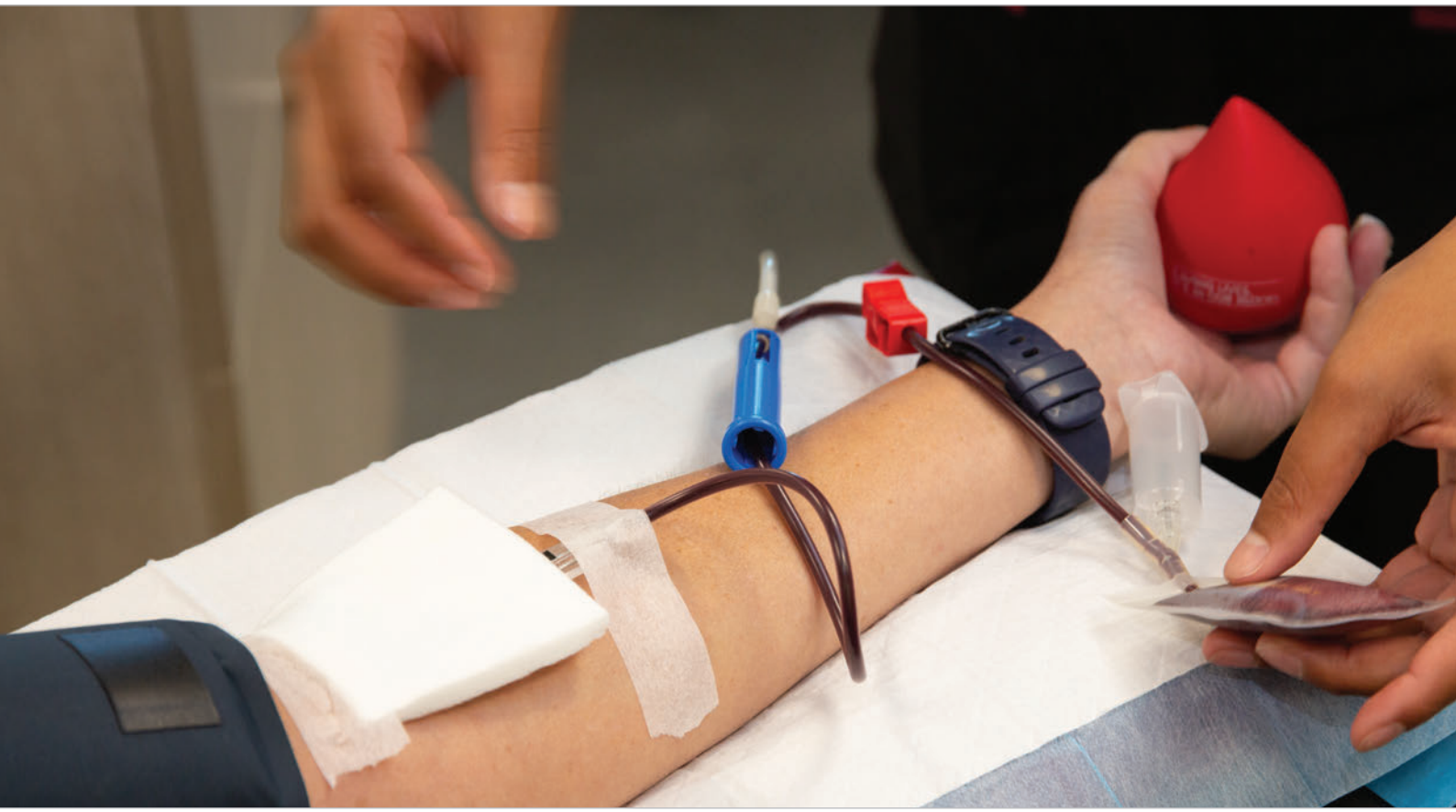


Figure 2.1-2: Distribution of blood donors by gender and age categories 2024



2.2 BLOOD COMPONENTS TRANSFUSED

The total number of blood components transfused in 2024 was 147,183. Figure 2.2-1 shows the numbers of each component type transfused annually from 2019 to 2024. There has been an 11% increase in components transfused since 2020. Neonatal blood component usage in 2024 was slightly greater than that in 2023 (Figure 2.2-2).

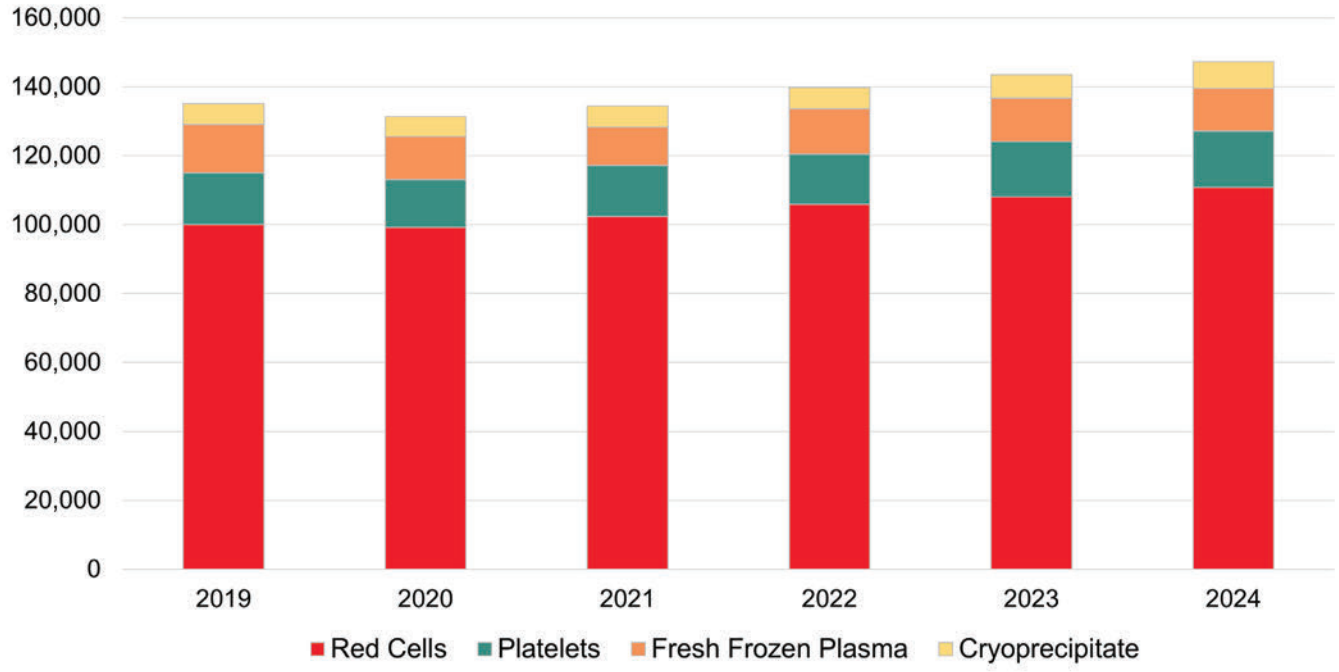


Figure 2.2-1: Annual number of blood components transfused 2019 to 2024

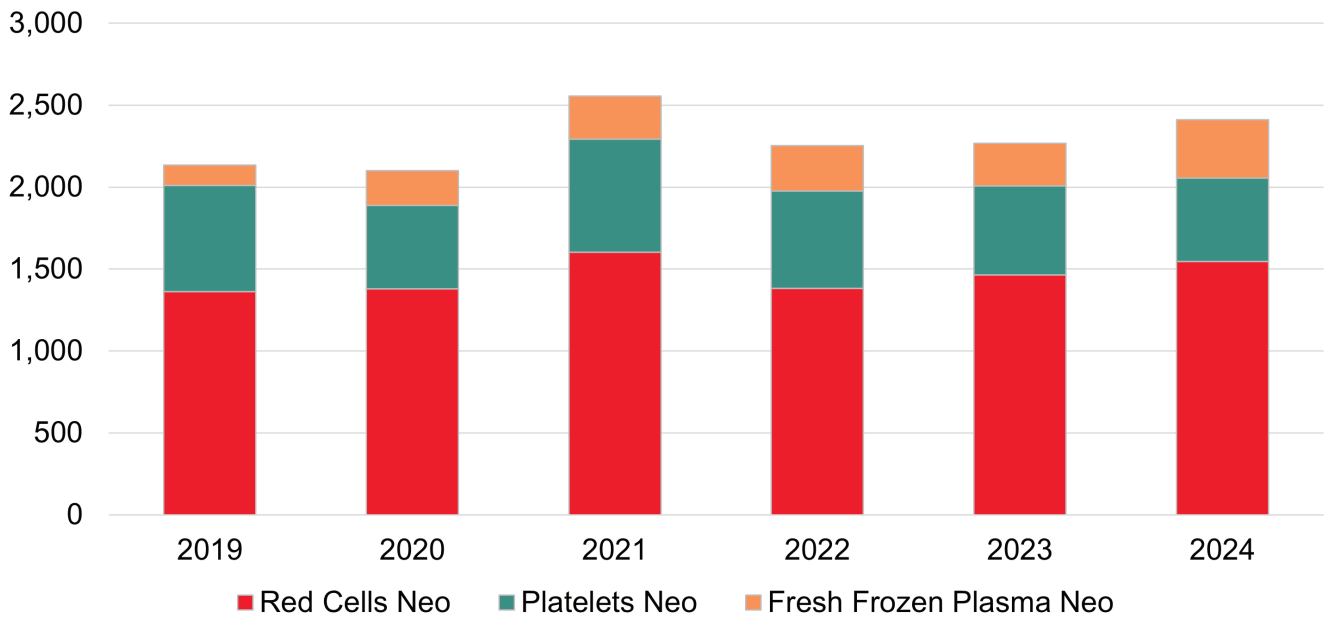


Figure 2.2-2: Annual number of neonatal blood components transfused 2019 to 2024

Figures 2.2-3 shows the rate of red cell transfusion per 1,000 population over the last six years.

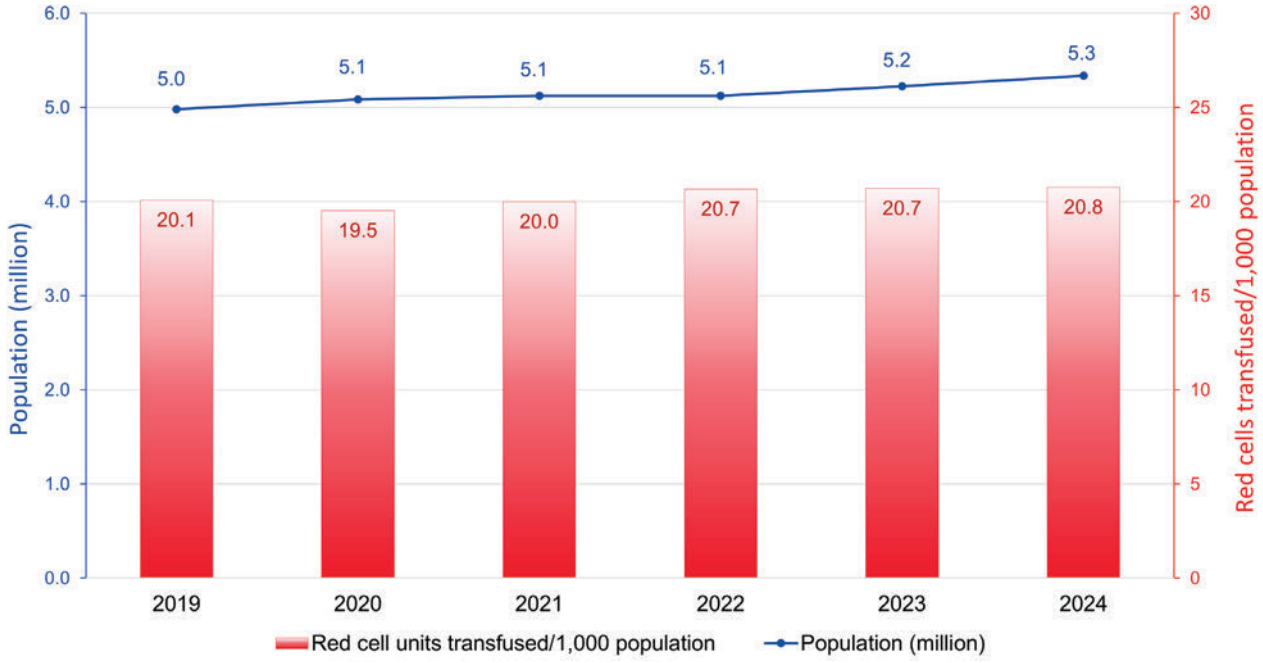


Figure 2.2-3: Annual rate of red cells transfused/1,000 population 2019 to 2024

The proportion of red cell single unit transfusions (SUT) in non-bleeding and stable patients has been used as a surrogate marker of the implementation of optimal blood management. Figure 2.2-4 shows that there is a continuous and sustained increase in the proportion of transfusions using SUT around the country. This data provides reassurance of the transfusion practices, even in a scenario of small increases in the annual rate of red cells per 1,000 population (Figure 2.2-3). The determination of a target and comparisons with other centres/nations should be done with caution as the population assessed, and the complexity of care across centres, might be different and the definition of SUT is not standardised.

For this report the definition of SUT was determined using:

1. Number of red cell transfusions, < 3 units for a patient on a particular day (this removes patients who have had multiple red cell units, meaning they may be unstable and would not be suitable for the single unit strategy).

2. Exclude patients who have > 24 units of red cells in the year (this is to remove the regular/chronically transfused patients).

3. Exclude patients who had cryoprecipitate or FFP on the same day as the red cells (this removes patients who may be bleeding or have coagulopathy).

4. The issue time of a red cell unit is separated from other red cell units issued by at least 90 minutes

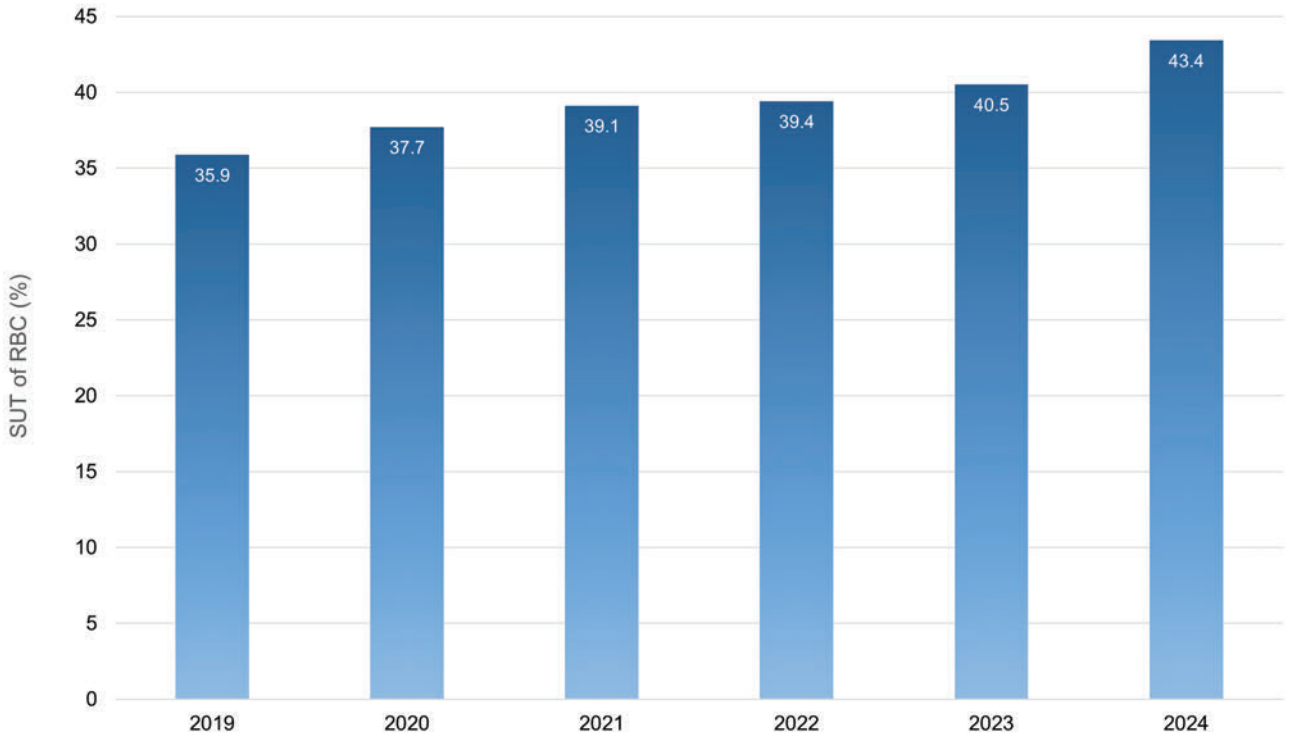


Figure 2.2-4: Single unit RBC transfusions as a percentage of total RBC transfusions 2019 to 2024

**Note data presented in the graph above differs slightly from that included in last year's report. This variation arises from a change in inclusion criteria: this year, centres with fewer than 600 red cell transfusions over the past six-years were excluded, whereas last year's analysis excluded centres with fewer than 1,000 transfusions over a ten-year period.*

Figures 2.2-5 shows the rate of transfusion per 1,000 population for platelets, FFP, and cryoprecipitate over the last six years.

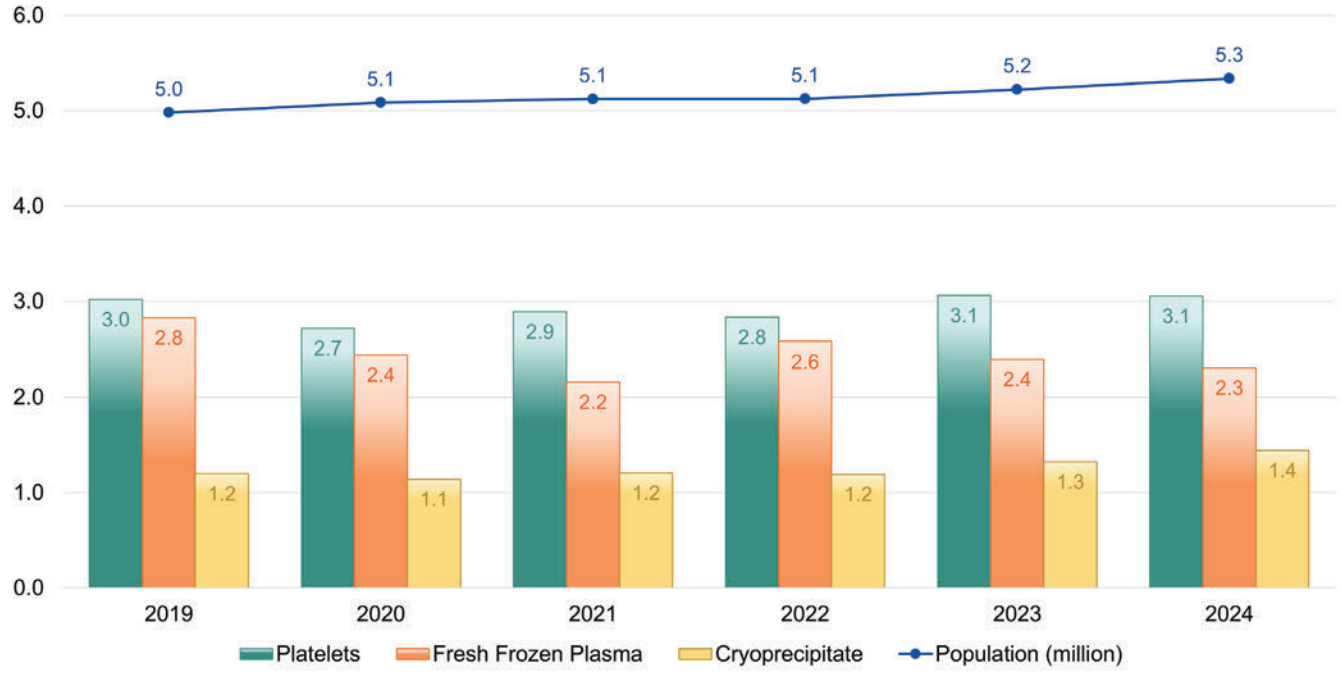


Figure 2.2-5: Annual rate of platelets, FFP and cryoprecipitate transfused/1,000 population 2019 to 2024

2.3 RECIPIENTS OF BLOOD COMPONENTS

The total number of recipients transfused in 2024 was 28,525.

Over the last six years the annual number of red cell recipients has increased by 18.3% (Figure 2.3-1). The New Zealand population has increased by an estimated 8.57% over the six-year time period.

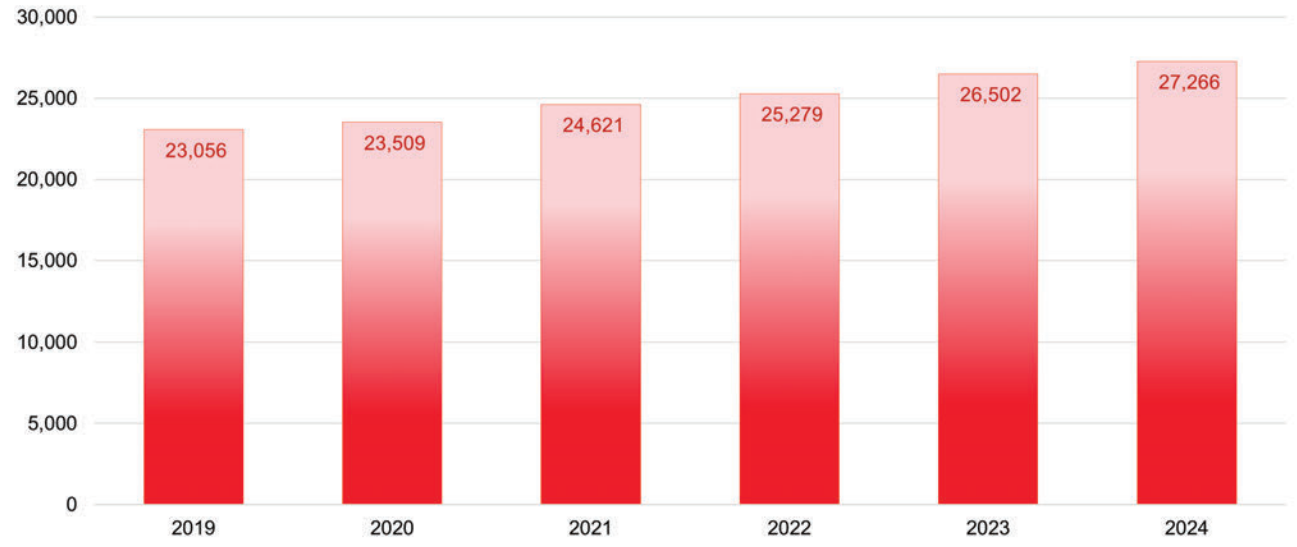


Figure 2.3-1: Annual number of red cell recipients 2019 to 2024

There has been an increase in the number of recipients of platelet transfusions over the last five years (Figure 2.3-2). However, the number of recipients for cryoprecipitate in 2024 is the lowest it has been over the last eight years (in 2017 there were 1,158 recipients).

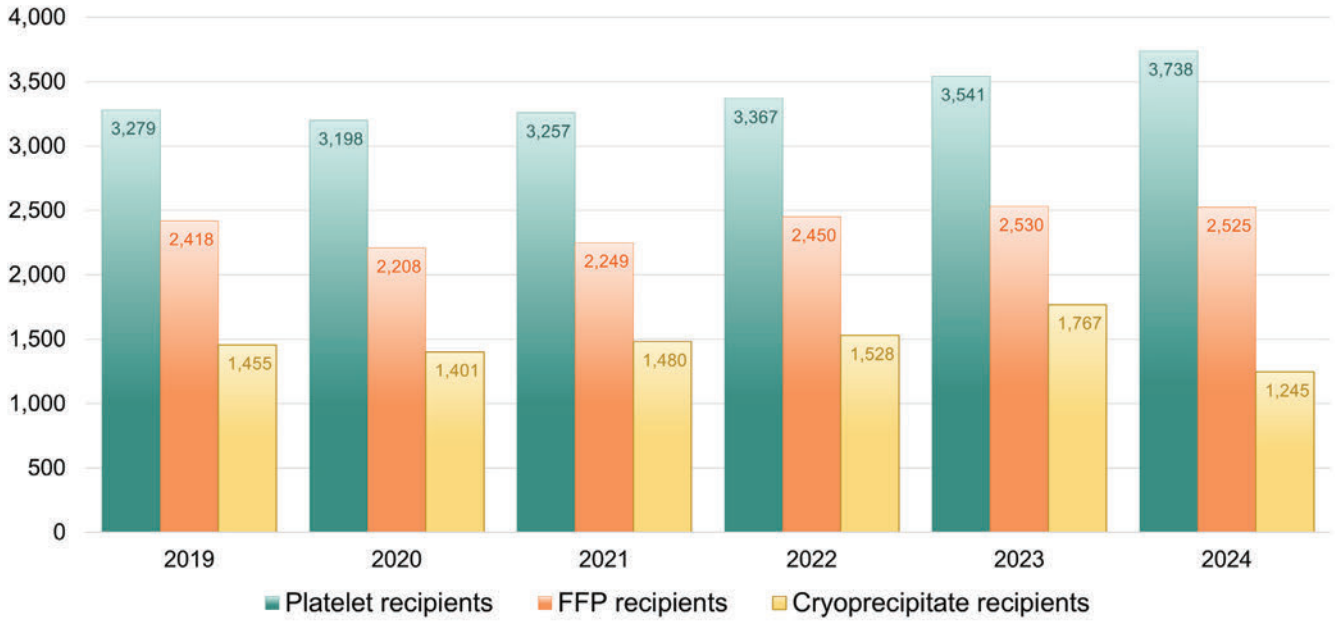


Figure 2.3-2: Annual number of platelet, FFP and cryoprecipitate recipients 2019 to 2024

Table 2.3-1 shows recipients of components by gender. Females are more likely to receive red cells, but less likely to receive platelets, FFP and cryoprecipitate than males. This observation is consistent with the data from 2021 to 2023.

Table 2.3-1: Recipients of blood components 2024

		Blood Component			
		Red Cells	**Platelets**	**FFP**	**Cryoprecipitate**
Recipient gender (number)	Female	15,415	1,407	959	506
	Male	11,829	2,329	1,559	737
	Unknown	22	2	7	2
	Total	**27,266**	**3,738**	**2,525**	**1,245**
Units transfused per recipient over 1 year	Median	2	2	2	3
	Maximum	108	169	348	39

Figures 2.3-3 and 2.3-4 show the age group distribution of female and male recipients for the three main components (red cells, FFP, platelets). There are peaks and troughs in the usage of each component between the genders, at various ages. The figures show there are minor gender differences in paediatric transfusions (before 16 years). However, as female recipients enter their childbearing years there is a peak in red cell and FFP transfusions, which is not observed in male recipients.

The use of platelet transfusions in both females and males increases as individuals age and these transfusions peak later in life (at 65-74 years). Platelet use is more common in older individuals due to a higher incidence of cancer and age-related conditions which may affect platelet count and function.[3]

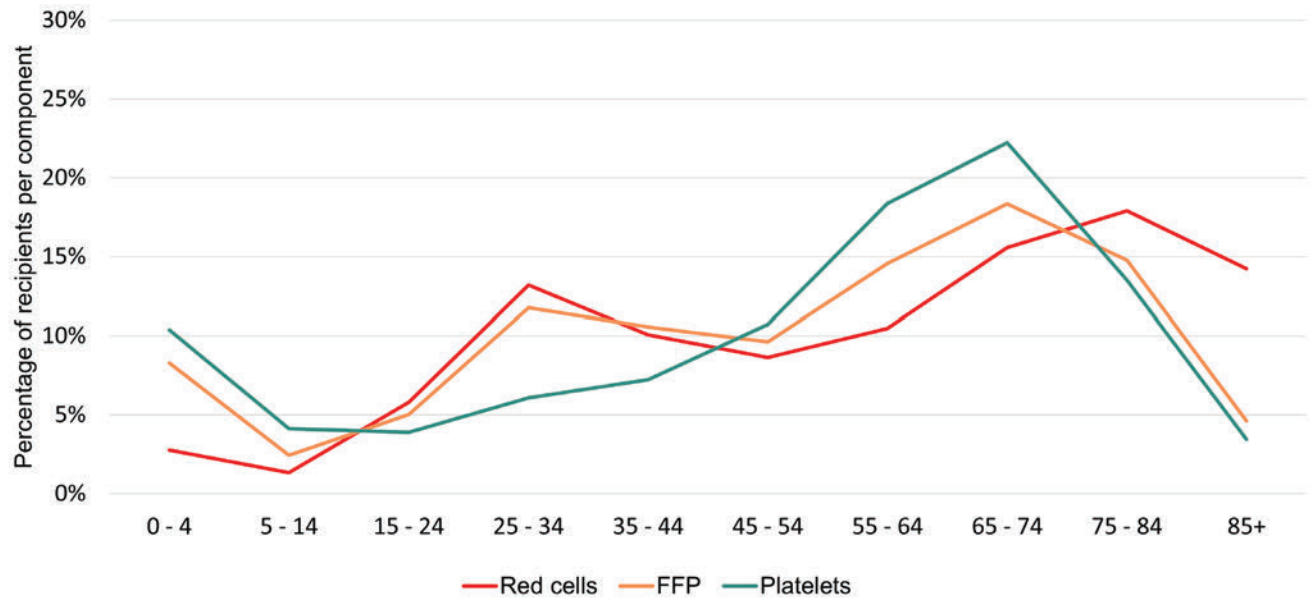


Figure 2.3-3: Age group distribution of female recipients from 2017 to 2024

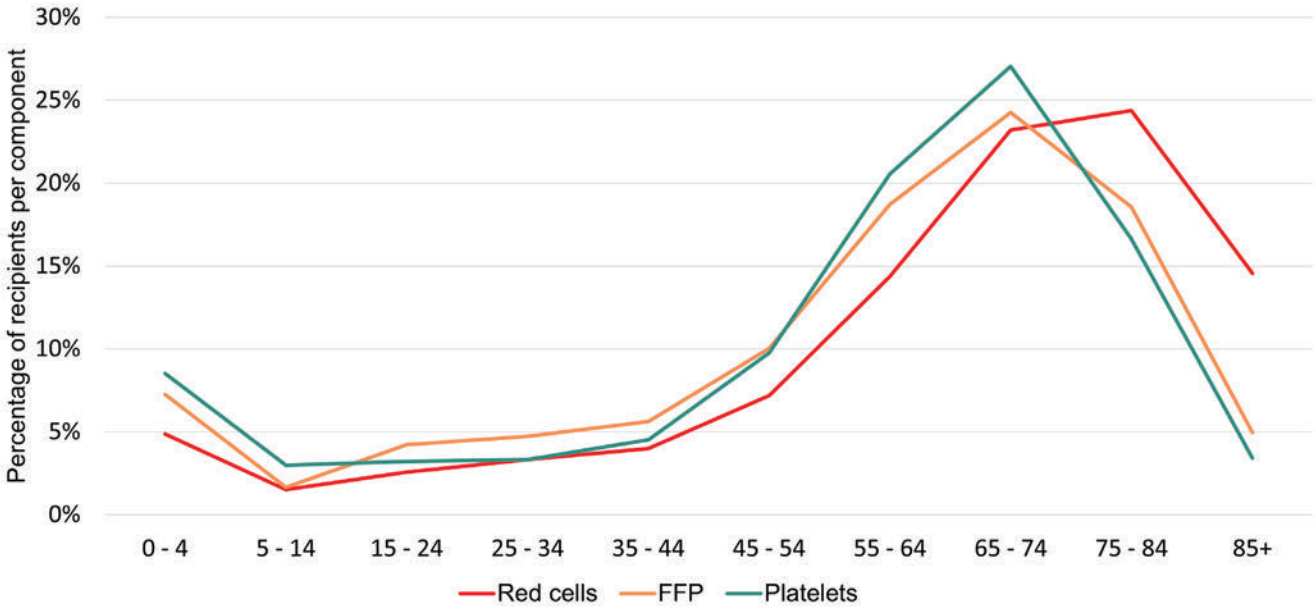


Figure 2.3-4: Age group distribution of male recipients from 2017 to 2024

[3] Faria AVS, Andrade SS, Peppelenbosch MP, Ferreira-Halder CV, Fuhler GM. Platelets in aging and cancer—"double-edged sword". Cancer Metastasis Rev. 2020 Dec;39(4):1205–21. doi: 10.1007/s10555-020-09926-2.

Figure 2.3-5 shows the age distribution of recipients of blood components compared with that of the New Zealand population in 2024. In 2024, most blood component transfusion recipients were aged 55 years or older (67.0%). However, 28.5% of the New Zealand population were aged 55 years and older.

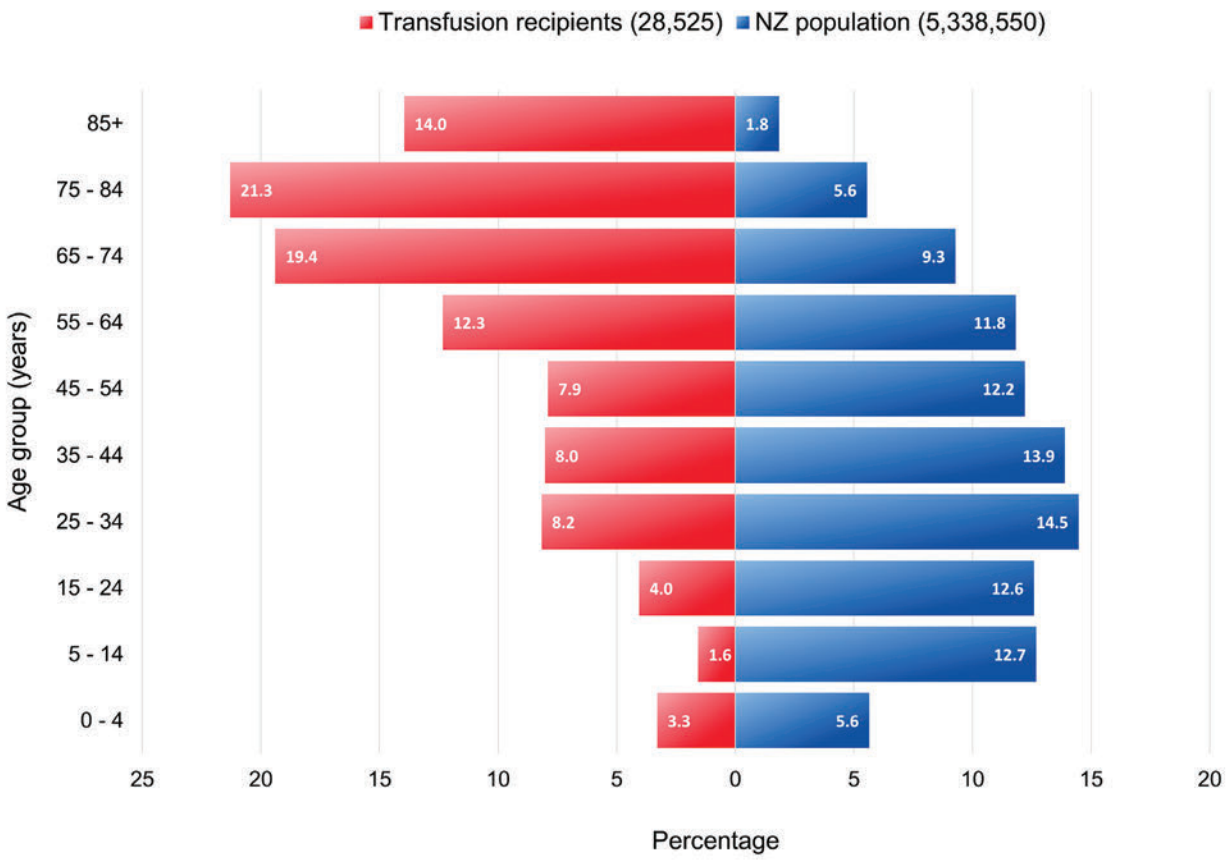


Figure 2.3-5: Age group distribution of blood component recipients compared with NZ population 2024

Figure 2.3-6 presents the prioritised ethnicity of blood recipients, alongside New Zealand Census 2023 data.[4]

The Ministry of Health provides ethnicity data on blood recipients to NZBS. The Ministry of Health provides NZBS up to three ethnicities for each blood recipient.

For the purposes of this report, each recipient was assigned a single ethnic group using a predefined priority system. This approach, commonly used in Ministry of Health statistics, simplifies analysis and ensures that smaller ethnic groups and those of policy significance are not swamped by the European ethnic group.[5] The ethnic priorities in descending order are: Māori, Pacific Peoples, Asian, Middle Eastern/Latin American/African (MELAA), Other ethnicity, European, Residual categories.

Each blood recipient was counted only once regardless of whether they received multiple transfusions.

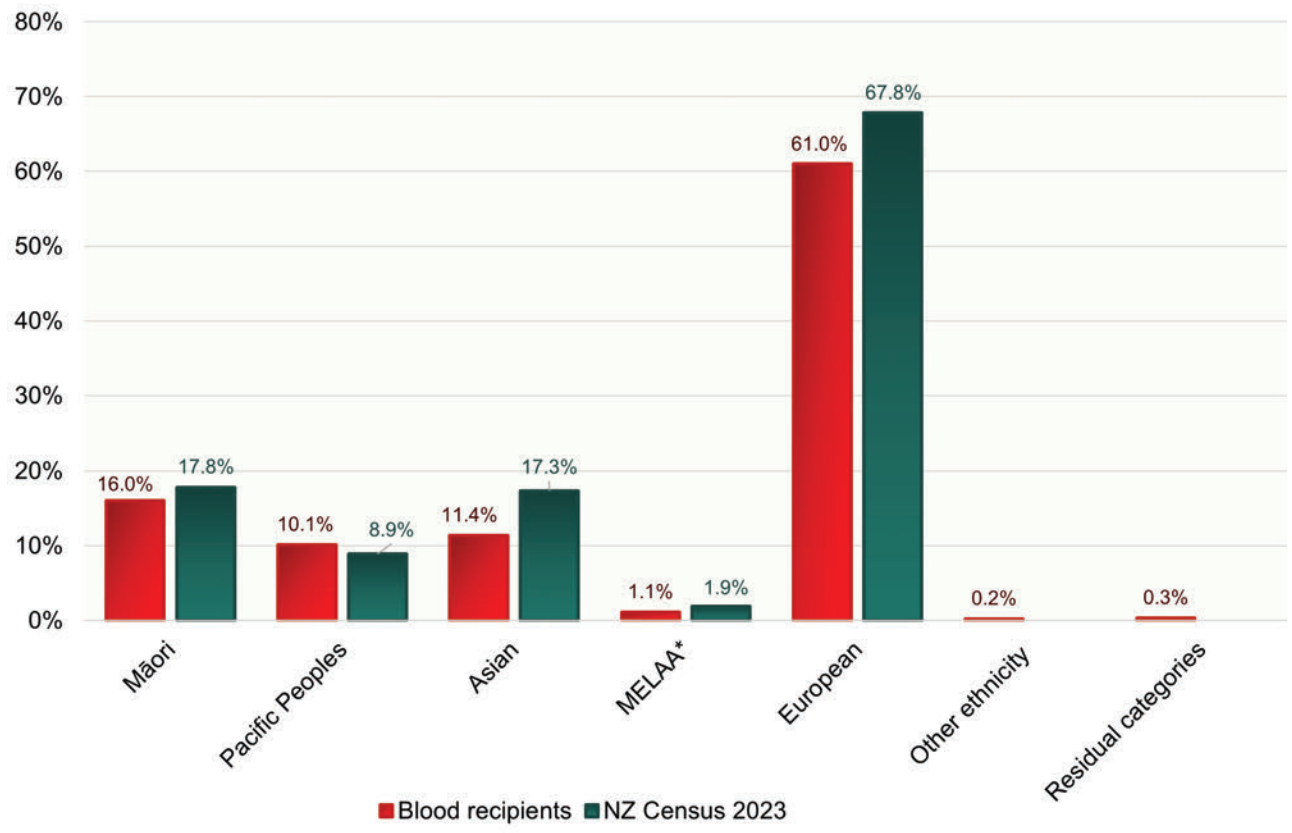


Figure 2.3-6: Prioritised ethnicity of blood recipients 2024

** MELAA = Middle Eastern, Latin American and African. Note: 'Other ethnicity' refers to other smaller or less common ethnicities that do not have their own standalone category due to limited population size. 'Residual categories' are used when ethnicity data is incomplete, ambiguous, or outside the scope of a standard classification (e.g., "not stated," "don't know," or "response unidentifiable").*

[4] Stats NZ. 2023 Census population counts by ethnic group, age, and Māori descent and dwelling counts [Internet]. Wellington: Stats NZ; 2024 [cited 2025 Aug 3]. Available from: https://www.stats.govt.nz/information-releases/2023-census-population-counts-by-ethnic-group-age-and-maori-descent-and-dwelling-counts

[5] Ministry of Health. HISO 10001: Ethnicity Data Protocols [Internet]. Wellington (NZ): Ministry of Health; 2017 [cited 2025 Jul 29]. Available from: https://www.tewhatuora.govt.nz/assets/Our-health-system/Digital-health/Health-information-standards/HISO-10001-2017-Ethnicity-Data-Protocols.pdf.

CHAPTER 03

ADVERSE TRANSFUSION REACTION REPORTS

03 ADVERSE TRANSFUSION REACTION REPORTS

3.1 OVERVIEW

During 2024, 596 adverse transfusion reaction (ATR) reports were received. Section 3.1.1 discusses all these 596 reports, regardless of their imputability. Analysis in all remaining sections of Chapter 3 are limited to reports with an imputability of "possible", "probable" or "certain", i.e., cases with an imputability of "unlikely" or "excluded" have been removed from further analysis.

3.1.1 Imputability

NZBS applies the following ISBT definitions[6] and scores for imputability when assessing reports:

1.	**Excluded**	When there is conclusive evidence beyond reasonable doubt for attributing the event to alternative causes.
2.	**Unlikely**	When the evidence is clearly in favour of attributing the event to causes other than transfusion.
3.	**Possible**	When the evidence is indeterminate for attributing the event either to the transfusion or alternative causes.
4.	**Probable**	When the evidence is clearly in favour of attributing the event to the transfusion.
5.	**Certain**	When there is conclusive evidence beyond reasonable doubt for attributing the event to the transfusion.

Out of 596 ATR reports received in 2024, 423 (71%) were assigned an imputability of "possible", "probable" or "certain" and will be analysed in the rest of Chapter 3.

The remaining 173 (29%) reports were of low imputability (excluded or unlikely).

See Figure 3.1.1-1 for the relative numbers of low and high imputability reports over the last ten years.

[6] Popovsky M, Robillard P, Schipperus M, Stainsby D, Tissot J-D, Wiersum-Osselton J. Proposed standard definitions for surveillance of non-infectious adverse transfusion reactions. International Society of Blood Transfusions; 2011 [updated 2013 Jun; cited 2025 Jul 07]. Available from: https://www.isbtweb.org/isbt-working-parties/haemovigilance/resources.html?sortBy=featured&information_type=definitions

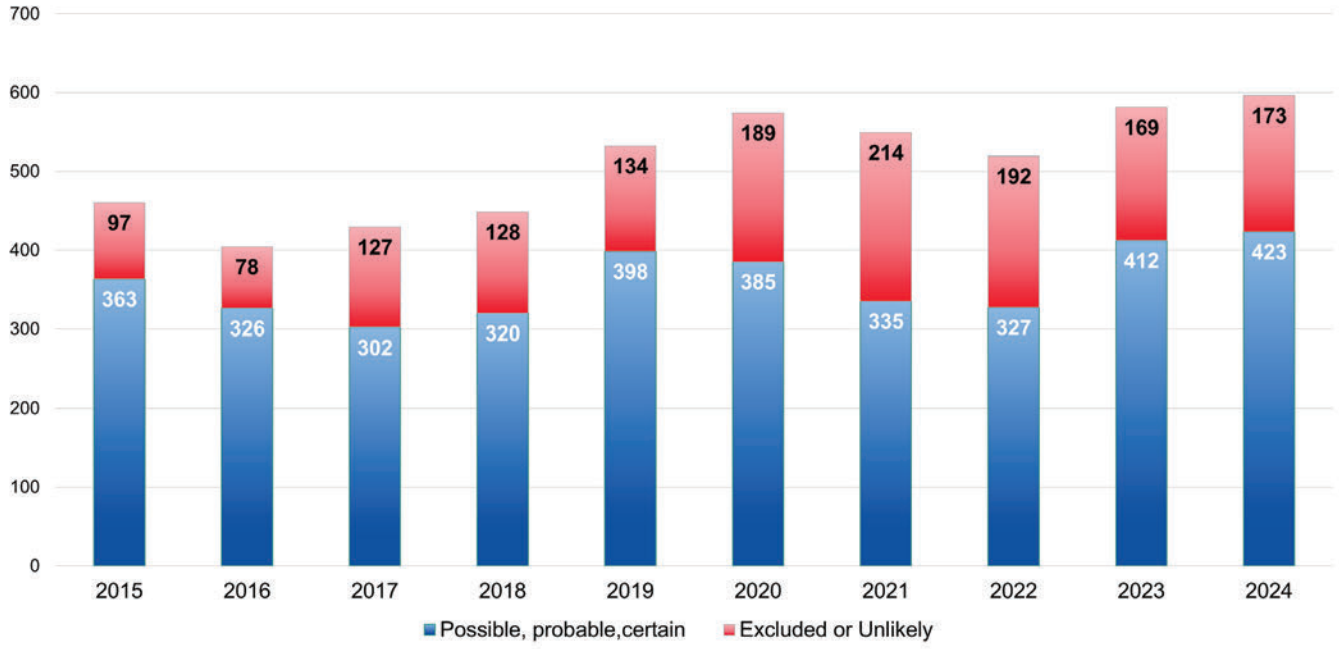


Figure 3.1.1-1: Imputability of reports received 2015-2024

Of the 173 reports classified as having low imputability, 81.5% were related to febrile non-haemolytic transfusion reactions (FNHTR). In addition, 42.7% of all FNHTR reports were assigned low imputability (Figure 3.1.1-2). Only 1% of allergic reactions, the second most frequently reported reaction, were assigned low imputability.

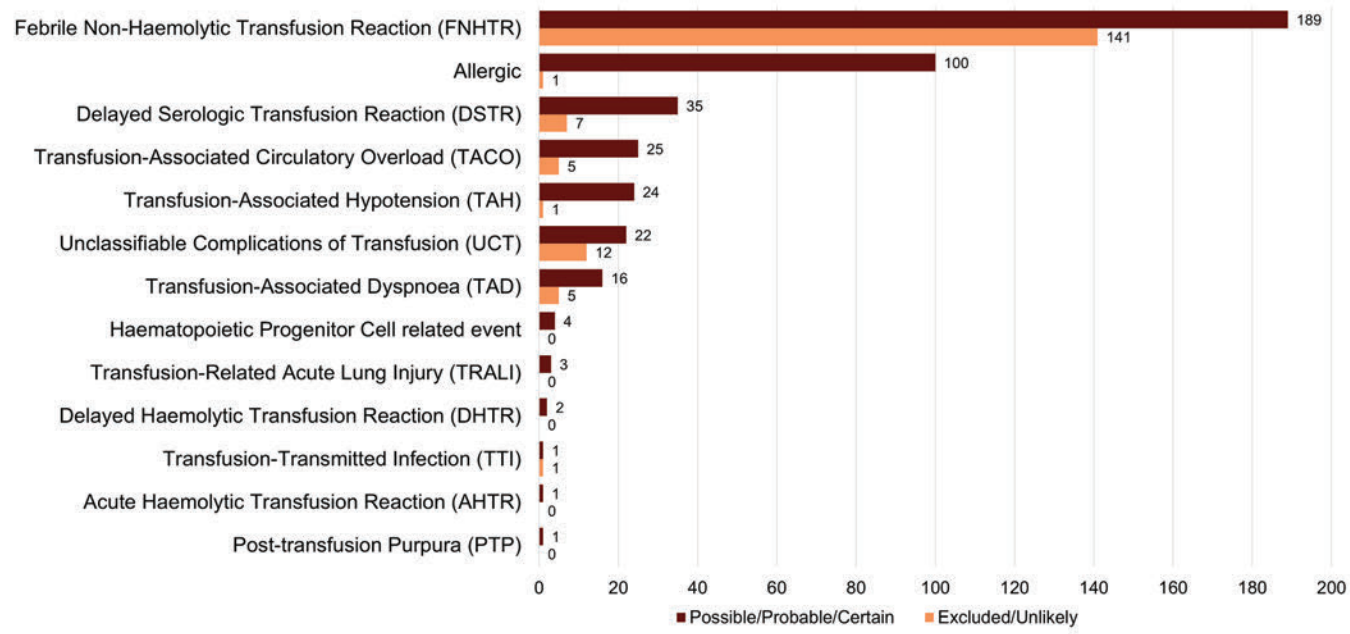


Figure 3.1.1-2: Adverse reaction reports by type and imputability 2024

3.1.2 Severity

NZBS applies the following ISBT definitions and scores for severity when assessing reports:

Grade 1	**Non-severe**	The recipient may have required treatment, but lack of such would not have resulted in permanent damage or impairment of a body function.
Grade 2	**Severe**	The recipient required hospitalisation or prolongation of hospitalisation directly attributable to the event; and/or the adverse event resulted in persistent or significant disability or incapacity; or the event necessitated medical or surgical intervention to preclude permanent damage or impairment of a body function.
Grade 3	**Life-threatening**	The recipient required major intervention following the transfusion (e.g., vasopressors, intubation, transfer to intensive care) to prevent death.
Grade 4	**Death**	The recipient died following an adverse transfusion reaction. Grade 4 should only be used if death is probably, or definitely, related to transfusion. If the patient died of another cause, the severity should be graded as 1, 2 or 3.

Table 3.1.2-1 shows transfusion reactions by type and severity. As observed in previous years, FNHTR and allergic reactions are the most common reaction types reported. 87.5% of reactions were mild and 50.3% of those were FNHTR. Of the 43 grade 2 reactions, most were TACO (41.9%). No deaths were reported.

Table 3.1.2-1: Adverse transfusion reactions by type and severity 2024

	Severity				
Reaction type	**Grade 1**	**Grade 2**	**Grade 3**	**Grade 4**	**Total**
FNHTR	186	3	0	0	189
Allergic	86	9	5	0	100
DSTR	35	0	0	0	35
TACO	6	18	1	0	25
TAH	20	4	0	0	24
UCT	19	1	2	0	22
TAD	14	2	0	0	16
HPC	3	0	1	0	4
TRALI	0	3	0	0	3
DHTR	1	1	0	0	2
AHTR	0	1	0	0	1
PTP	0	1	0	0	1
TTI	0	0	1	0	1
Total	**370**	**43**	**10**	**0**	**423**
% of total reactions	**87.5%**	**10.2%**	**2.4%**	**0.0%**	

3.1.3 Adverse transfusion reaction types

Table 3.1.3-1 shows five reaction types and the trend in reporting over the last ten years.

Table 3.1.3-1: Percentages and trending of selected reaction types* 2015 to 2024

	Percent (%) of total ATRs by year										
Reaction	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Sparkline trend
FNHTR	52.3	46.0	45.0	54.7	51.5	57.4	52.2	45.6	46.1	44.7	
Allergic	27.8	27.0	25.5	23.4	23.1	22.3	24.2	22.9	21.6	23.6	
TAH	1.4	3.4	3.3	3.4	3.5	4.7	2.4	2.4	3.4	5.7	
TACO	4.4	3.4	3.0	3.8	4.0	4.7	5.4	9.8	6.1	5.9	
TRALI	0.3	0.3	0.0	0.0	0.8	0.3	0.3	0.0	0.0	0.0	

** NOTE: The denominator used in this chart changed in 2022 from all ATRs to ATRs with imputability >2 (possible, probable, or certain). The percentages will not add to 100% because some categories were not included, e.g., UCT.*

3.1.4 Demographics

Table 3.1.4-1 shows adverse reactions by recipient gender for 2024 alongside historical data for the previous ten years.

Table 3.1.4-1: Distribution of adverse reactions by recipient gender 2024

	2024	2010 - 2023
Female	222 (52.5%)	2,617 (50.3%)
Male	201 (47.5%)	2,590 (49.7%)
Total	**423**	**5,207**

Multiple adverse reactions were reported in 25 recipients (Table 3.1.4-2). Majority of blood recipients had only one reaction in 2024 (93.5%). Of those recipients who had more than one reaction, most events were FNHTR followed by allergic reactions.

Table 3.1.4-2: Distribution of recipients with multiple adverse reactions 2024

	Number of reactions				
	Total	1 Reaction	2 Reactions	3 Reactions	≥4 Reactions
Recipient Numbers	387	362	16	8	1

Figure 3.1.4-1 shows that the age distribution of those patients having adverse reactions broadly follows the age distribution of recipients.

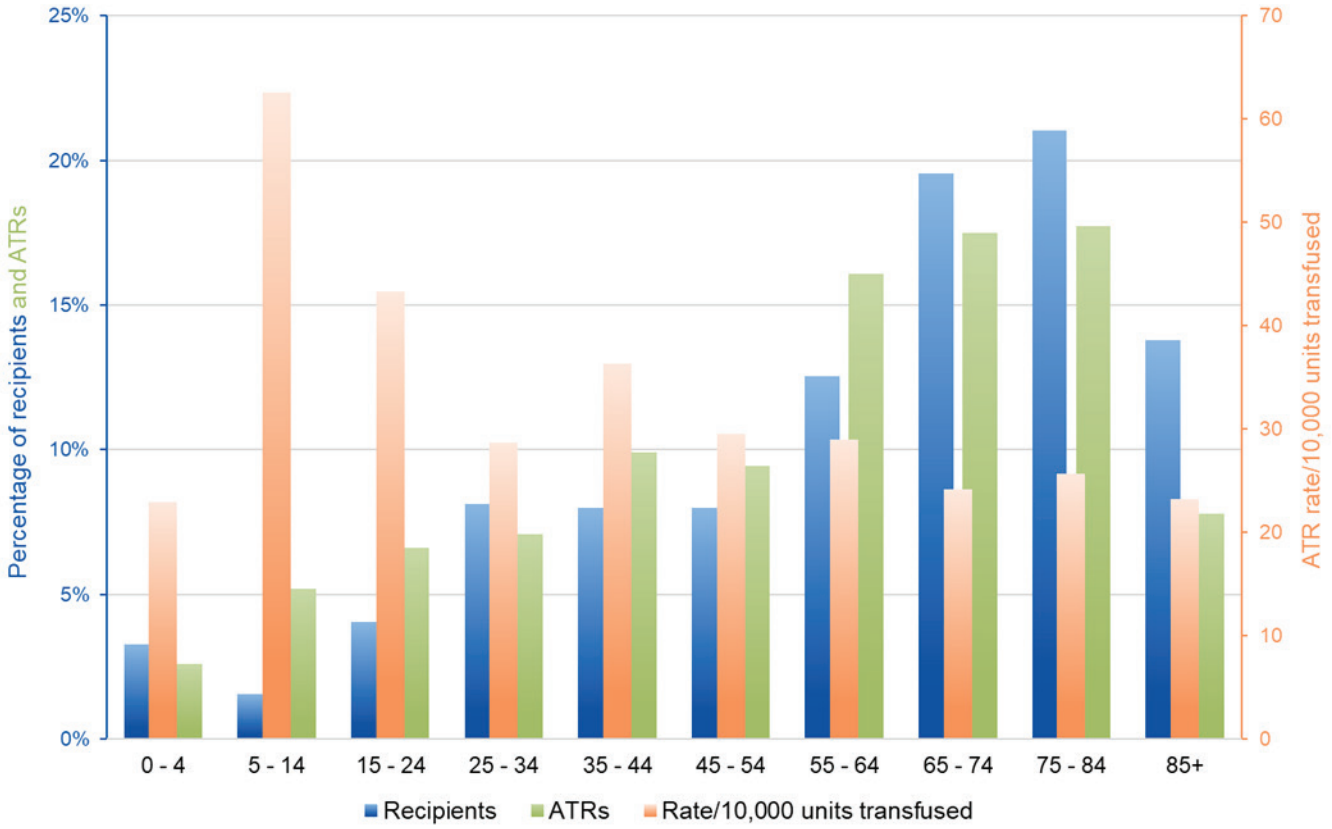


Figure 3.1.4-1: Percentage of all recipients and percentage of recipients with ATRs by age group 2024 (Rate of ATR/10,000 units transfused is overlaid)

3.1.5 Implicated Blood Components

In 2024, adverse transfusion reaction rates were lower for cryoprecipitate and red cells compared with other blood components (Table 3.1.5-1). Reaction rates for cryoprecipitate and red cells were statistically significantly lower than those for platelets. In contrast, the differences in reaction rates between platelets and both FFP and HPC were not statistically significant.

Table 3.1.5-1: Adverse transfusion reactions by blood component 2024

Component	Reactions*	Units Transfused	Frequency	Rate / 10,000 Units Transfused (95%CI)
Platelets	85	16,313	1:192	52.1 (42.1 to 64.4)
HPC Apheresis	4	766	1:192	52.2 (15.2 to 138.6)
Fresh Frozen Plasma	61	12,321	1:202	49.5 (38.5 to 63.6)
Red Cells	424	110,841	1:261	38.3 (34.8 to 42.1)
Cryoprecipitate	25	7,708	1:308	32.4 (21.7 to 48.1)

** Some reactions are associated with the transfusion of more than one component type.*

3.1.6 Reporting by Te Whatu Ora District

After the Haemovigilance Programme began in 2005 there was a steady increase in the national reporting rate to 2009. After that, there was a slight downward trend to 2017 and since then the rate has stabilised (Figure 3.1.6-1).

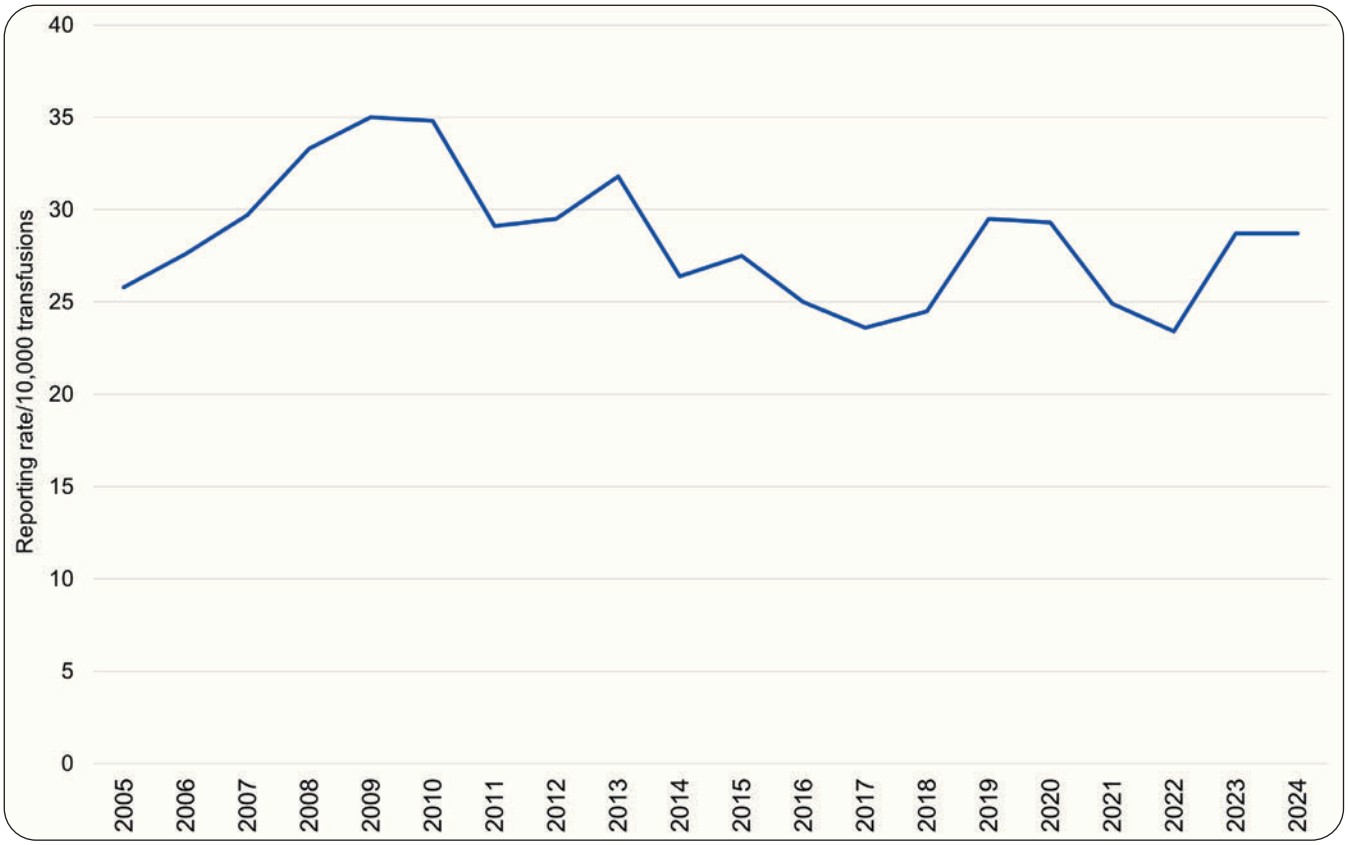


Figure 3.1.6-1: National ATR reporting rate (imputability >2) 2005-2024

During the earlier years of this Haemovigilance Annual Report, data had been reported by the 20 District Health Boards (DHBs). However, since 2023 these data are reported by the 19 Te Whatu Ora Districts (Figure 3.1.6-2). Capital & Coast and Hutt Valley have been combined into a single district.

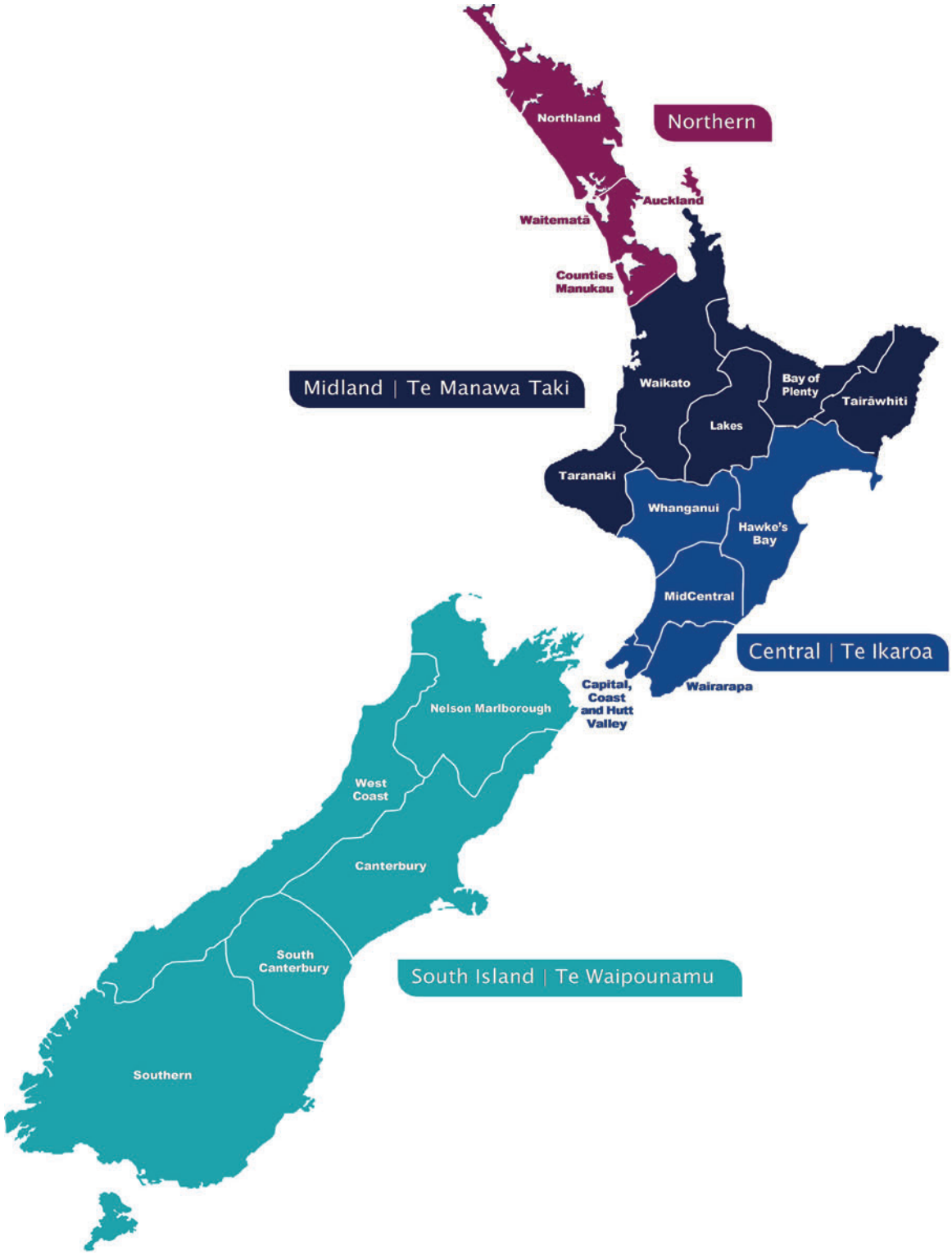


Figure 3.1.6-2: Te Whatu Ora Districts[7]

[7] Te Whatu Ora (Health New Zealand). Map [Internet]. Wellington (NZ): 2025 [updated 2025 Jun 18; cited 2025 July 08]. Available from: https://www.tewhatuora.govt.nz/corporate-information/about-us/map

Reporting rates by Te Whatu Ora district are shown in Figure 3.1.6-3. Tairawhiti has not submitted any reports since 2020. West Coast did not submit any reports in 2024.

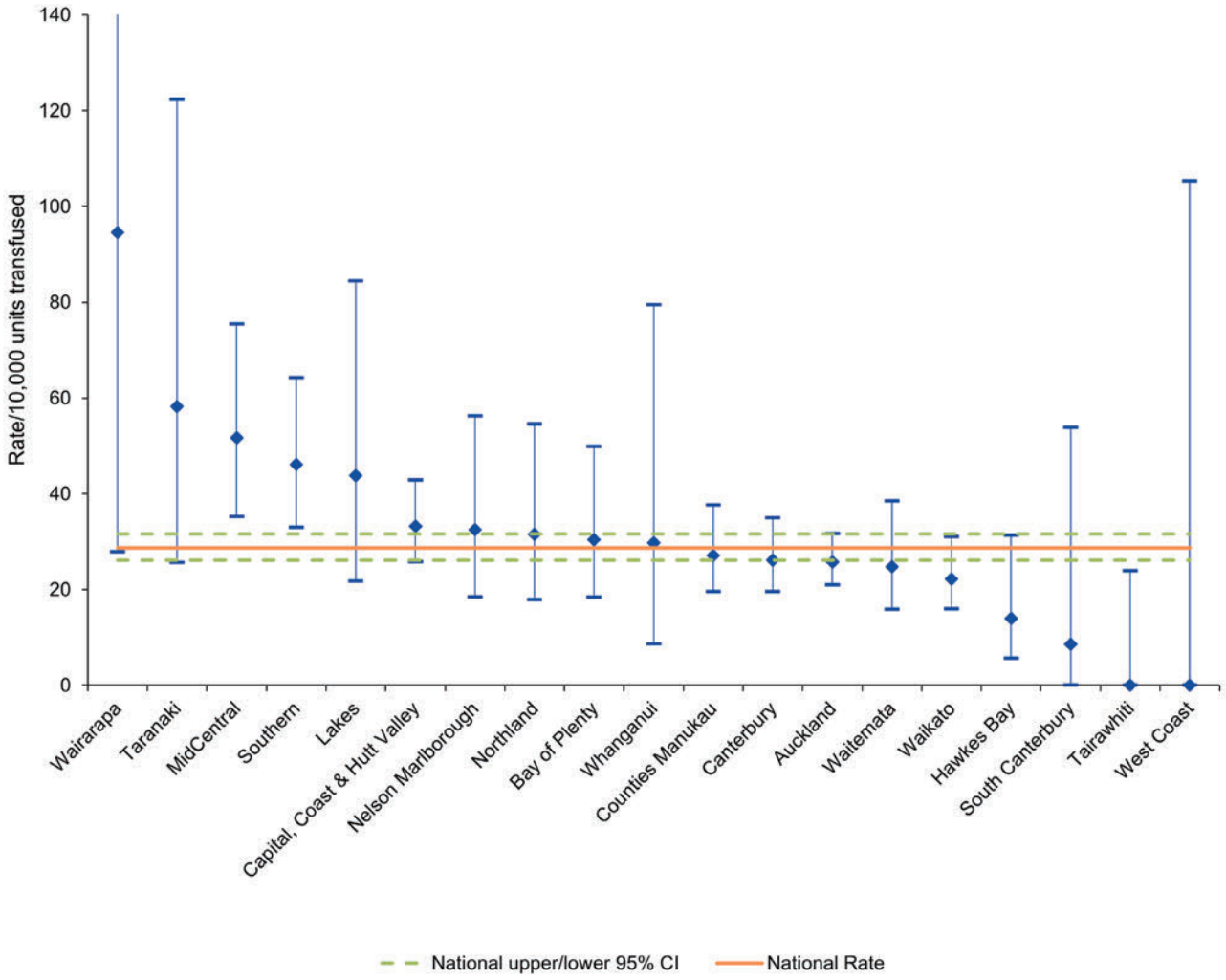


Figure 3.1.6-3: Adverse transfusion reaction reporting rate (with 95% CI) by district 2024

**Note: Each district's adverse reaction rate is depicted as a blue diamond, with vertical blue lines indicating the 95% confidence intervals. The national adverse reaction rate is depicted by an orange horizontal line, with green horizontal lines denoting the 95% confidence intervals.*

3.2 FEBRILE NON-HAEMOLYTIC TRANSFUSION REACTIONS (FNHTR)

Fever (≥38 °C and a change of ≥1 °C from pre-transfusion value) and/or chills/rigors occurring during or within 4 hours of transfusion without any other cause such as haemolytic transfusion reaction, bacterial contamination or underlying condition.

Febrile Non-Haemolytic Transfusion Reactions (FNHTR) are the most frequently reported adverse transfusion reaction in New Zealand blood component recipients. There were 189 FNHTRs reported in 2024 (and 190 in 2023). Most of these reactions are mild: 186 (98%) of severity grade 1 and 3 (2%) of severity grade 2.

Table 3.2-1 shows the rates of FNHTR by blood component. Most of the events were related to red cell transfusions.

Table 3.2-1: FNHTR by blood component type 2024

Component	Reactions*	Units transfused	Rate / 10,000 Units Transfused (95%CI)
Red Cells	180	110,841	16.2 (14.0 to 18.8)
Platelets	29	16,313	17.8 (12.3 to 25.6)
Fresh Frozen Plasma	2	12,321	1.6 (0 to 6.3)

** Some reactions are associated with the transfusion of more than one component type.*

The signs and symptoms identified on the FNHTR reports received in 2024 are shown in Figure 3.2-1. Fever, chills and rigors are the most frequently reported symptoms.

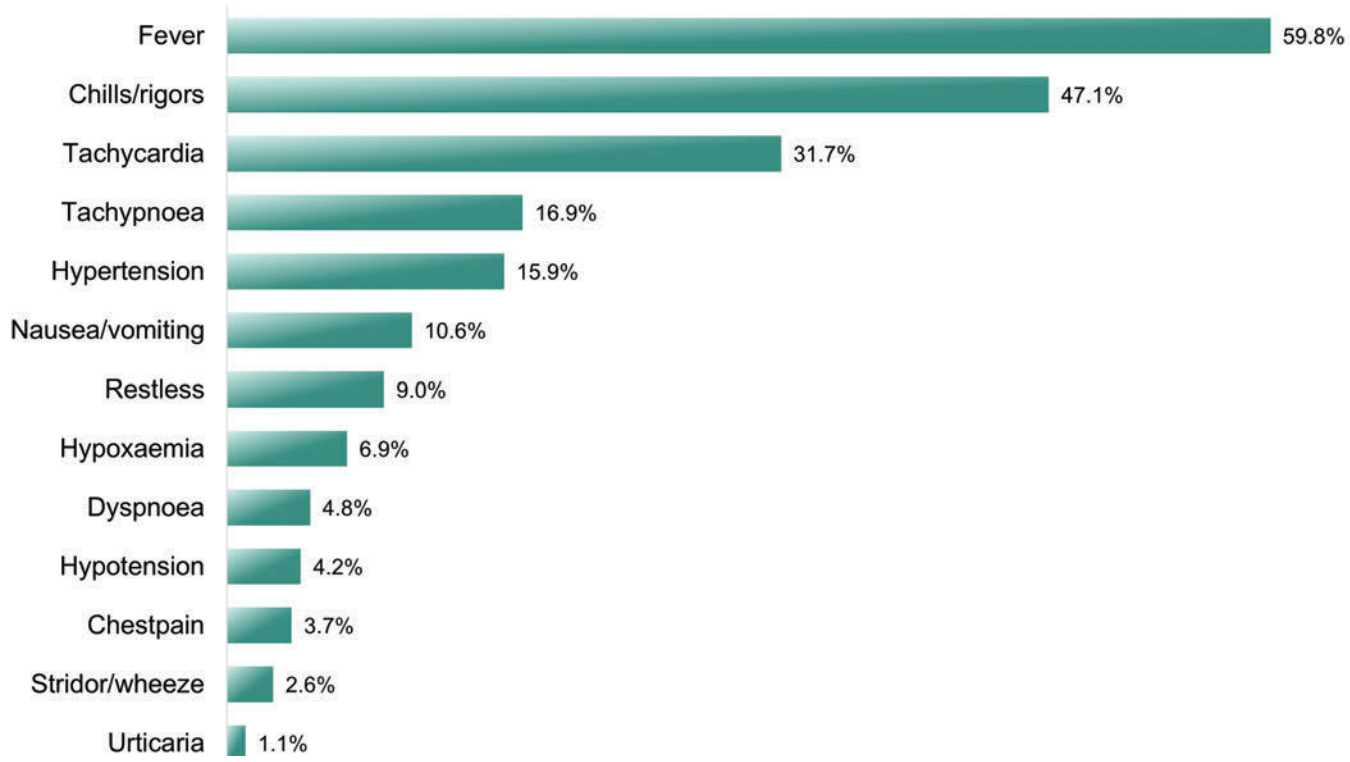


Figure 3.2-1: FNHTR by associated signs and symptoms 2024

CASE STUDY

Dr Aaron Hess, Transfusion Medicine Specialist

A 54-year-old woman with a history of lupus erythematosus, kidney failure, stroke, rheumatic heart disease, and hypertension was admitted to the hospital with concern for immune thrombocytopenia. Over the previous two years she had received dozens of blood transfusions without reactions. One hour after receiving a unit of irradiated, pooled platelets, she developed chills and rigors, tachycardia to the 150s per minute, hypertension with systolic pressures in the 150s mmHg, and oxygen saturation by pulse oximetry ~60%. There were no other visible signs or symptoms. The responsible house officer ordered 0.5 mg of intramuscular adrenaline. The patient's tachycardia, hypertension, and oxygen saturation worsened, she began to appear grossly unwell, and the bedside team decided to intubate. During intubation she had episodes of ventricular tachycardia that did not respond to two attempts at electrical cardioversion, and a metaraminol infusion was needed to maintain her blood pressure. A post-intubation CT of her chest was notable for a sub-segmental pulmonary embolism, but there was no evidence of pulmonary infiltrates or heart strain. The patient's vital signs gradually normalised over the next twenty-four hours, and she was extubated. On each of the next two days she received a red blood cell transfusion without incident. The patient subsequently discharged, and she has returned home and continues to live independently.

This case illustrates a misdiagnosed transfusion reaction with severe consequences. The patient's chills, rigors, hypertension, and tachycardia are most consistent with a febrile transfusion reaction. Hypoxia is not a feature of febrile reactions, but the observed desaturations are very likely a monitoring artefact caused by the patient's shaking limbs. Unfortunately, the doctor at the bedside focused on the apparent hypoxia and made a preliminary diagnosis of anaphylaxis, then administered adrenaline. Effects of adrenaline include tachycardia, hypertension, arrhythmias (such as ventricular tachycardia), reduction in peripheral circulation, and agitation. The patient's subsequent symptoms – worsening hypertension and tachycardia, refractory arrhythmias, and gradual recovery – are most consistent with the effects of the adrenaline. The lack of rash or oedema, and patient's long prior history of uneventful transfusions also argued strongly against the anaphylaxis. Transfusion-related acute lung injury (TRALI) was also considered at the time, but there were no radiographic or sonographic signs of cardiopulmonary involvement.

Pulse oximeters compare the transmission of light through tissue in systole versus diastole and use this to estimate the arterial oxygen saturation. Although it is accurate and precise, pulse oximetry is susceptible to motion artefact, particularly rhythmic motions like tapping, shaking, and shivering. It is very common to see patients suffering rigors and chills whose measured saturations drop – not because of hypoxia, but because the pulse oximeter cannot distinguish between movement of the limb and the movement of the blood. Temporarily immobilizing the monitored limb, e.g., holding the patient's hand still, will reduce any artefact and confirm the diagnosis. See Barker et al (Anesthesiology, 1997; 86:101-108) for a classic description of false hypoxia created by motion.[8]

Diagnosing a transfusion reaction requires attention. Many transfusion reactions are missed or misdiagnosed because the patient's caregivers did not consider that blood transfusions may cause reactions. But it is also possible for a transfusion reaction to be recognised and misdiagnosed, and the misdiagnosis to lead to harm.

[8] Barker SJ, Shah NK. The effects of motion on the performance of pulse oximeters in volunteers (revised publication). Anesthesiology. 1997 Jan 1;86(1):101-8.

3.3 ALLERGIC TRANSFUSION REACTIONS

Mucocutaneous signs and symptoms during or within 4 hours of transfusion: morbilliform rash with pruritus, urticaria, localised angioedema, oedema of lips, tongue and uvula, periorbital pruritus, erythema and oedema, conjunctival oedema. Severe reactions may include laryngeal symptoms including throat tightness, dysphagia, dysphonia, hoarseness, stridor. Pulmonary symptoms include dyspnoea, cough, wheeze/bronchospasm, hypoxaemia. Cardiovascular symptoms include hypotension, syncope.

During 2024, there were 100 adverse reaction reports classified as allergic reactions. Of these, 86 reports were classified as mild (grade 1), nine as severe (grade 2), and five as life-threatening (grade 3).

As seen in previous years, FFP and platelet components are associated with higher rates of allergic reactions than red cells (Table 3.3-1).

Table 3.3-1: Allergic transfusion reactions by component type 2024

Component	Reactions*	Units transfused	Frequency	Rate/10,000 units transfused (95% CI)
Fresh Frozen Plasma	47	12,321	1:262	38.1 (28.6 to 50.8)
Platelets	42	16,313	1:388	25.7 (19.0 to 34.9)
Cryoprecipitate	13	7,708	1:593	16.9 (9.5 to 29.2)
Red Cells	55	110,841	1:2,015	5.0 (3.8 to 6.5)

** Some reactions are associated with the transfusion of more than one component type*

Mucocutaneous and cardiovascular symptoms were the most frequently reported symptoms during allergic reactions, from 2022 to 2024 (Figure 3.3-1).

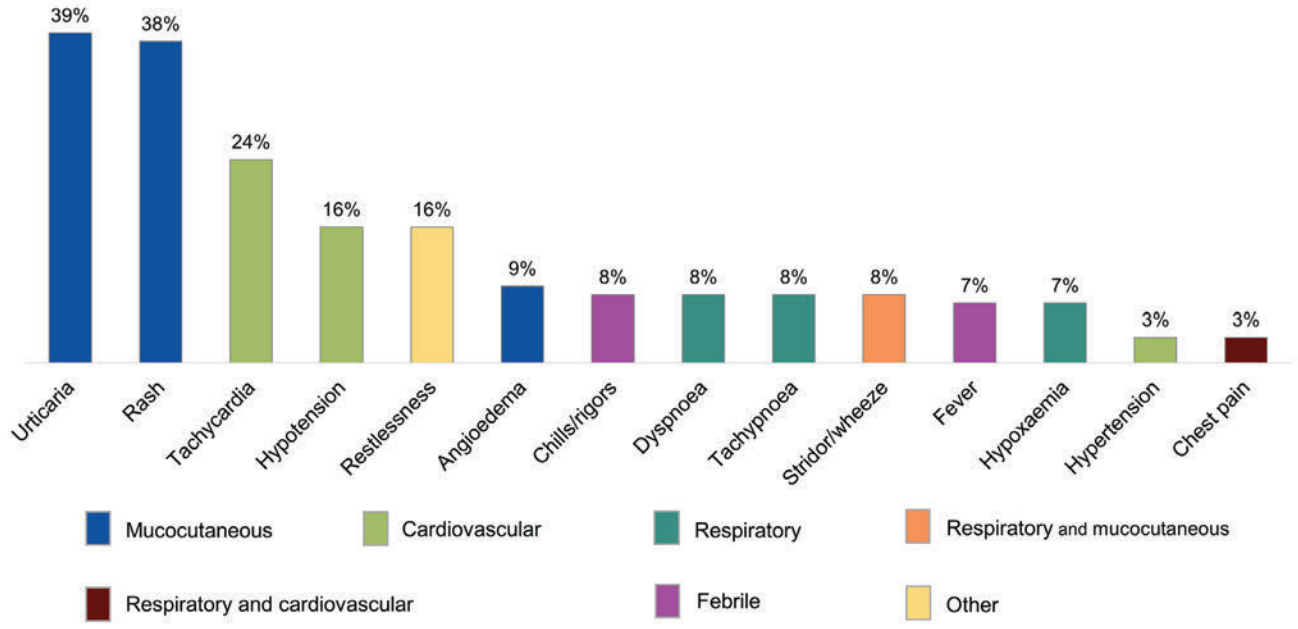


Figure 3.3-1: Allergic transfusion reactions by associated signs and symptoms 2024 (as % of cases – multiple symptoms per case)

3.4 TRANSFUSION-ASSOCIATED HYPOTENSION (TAH)

Decrease in systolic and/or diastolic blood pressure of >30 mmHg occurring during or within one hour of completing transfusion. All other categories of adverse reactions presenting with hypotension must have been excluded together with underlying conditions that could explain hypotension.

TAH is an infrequently reported event. In 2024, 24 cases were classified as TAH; 123 over the last 10 years. Red cells were implicated in all the cases of TAH in 2024 (Table 3.4-1).

Table 3.4-1: Components implicated in TAH reactions 2015 - 2024

Component	Number of Cases
Red cells	104
Platelets Pooled	11
Platelets Apheresis	3
Fresh Frozen Plasma	6
Cryoprecipitate	2
Multiple components	1
Total	**127**

Figure 3.4-1 shows the reporting rate for TAH over the last ten years.

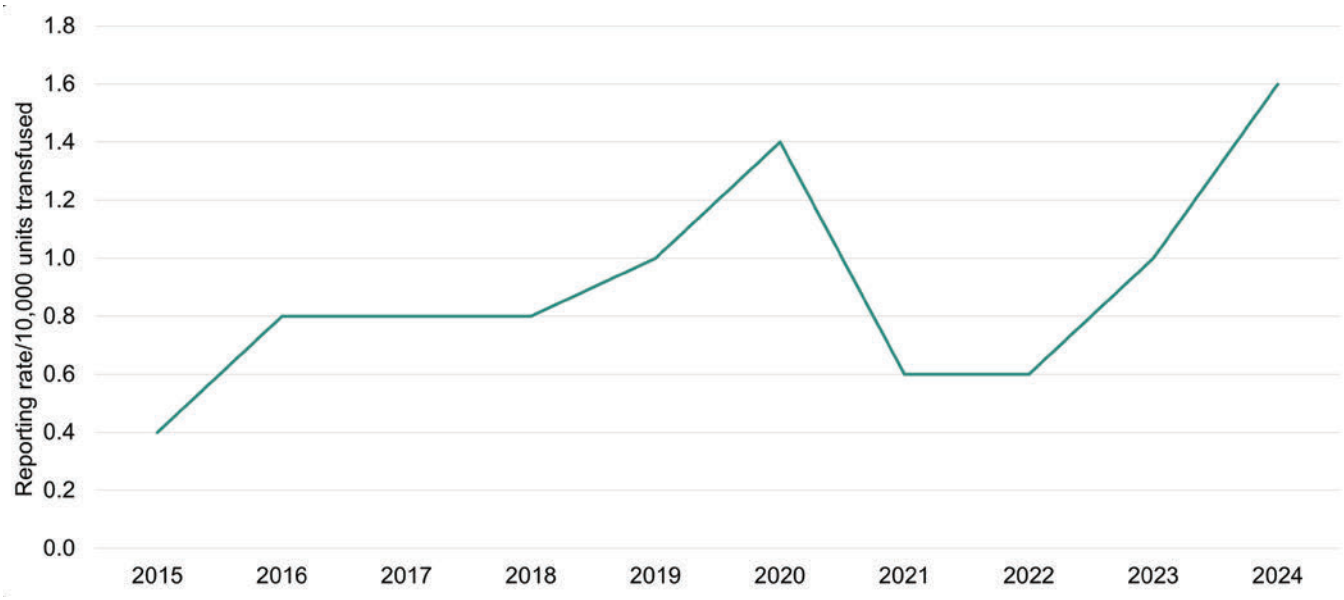


Figure 3.4-1: TAH reporting rate/10,000 units transfused 2015 - 2024

3.5 PULMONARY COMPLICATIONS

3.5.1 Transfusion-Related Acute Lung Injury (TRALI)

New acute lung injury (ALI) in a patient with no evidence of ALI prior to transfusion. Acute onset during or within 6 hours of completion of transfusion, hypoxaemia (PaO2/FiO2 <300 mmHg, oxygen saturation <90% on room air, or other clinical evidence), bilateral infiltrates on frontal chest radiograph, no left atrial hypertension or other evidence of circulatory overload, no temporal relationship to an alternative risk factor for ALI.

Since 2005, 56 reports received have been classified as TRALI cases. NZBS has taken a number of steps to reduce the risk of TRALI over that time and this has seen a dramatic reduction in the number of cases reported. Numbers of reported TRALI events now remain low.

Three TRALI events were reported in 2024. The HLA antibody investigations are summarised in Table 3.5.1-1.

Table 3.5.1-1 TRALI cases in 2024 - investigation summary

Case	Components transfused	TRALI investigation
Case 1	2 x red cells	HLA class I antibodies against the patient detected in one donor.
Case 2	1 x red cells 1 x apheresis platelets in PAS	No HLA antibodies against the patient detected in either donor.
Case 3	1 x red cells 1 x pooled platelets in PAS	Three female donors were tested. HLA class II antibodies against the patient detected in two of the donors in the platelet pool.

Figure 3.5.1-1 shows the measures introduced by NZBS since 2007 to reduce the incidence of TRALI.

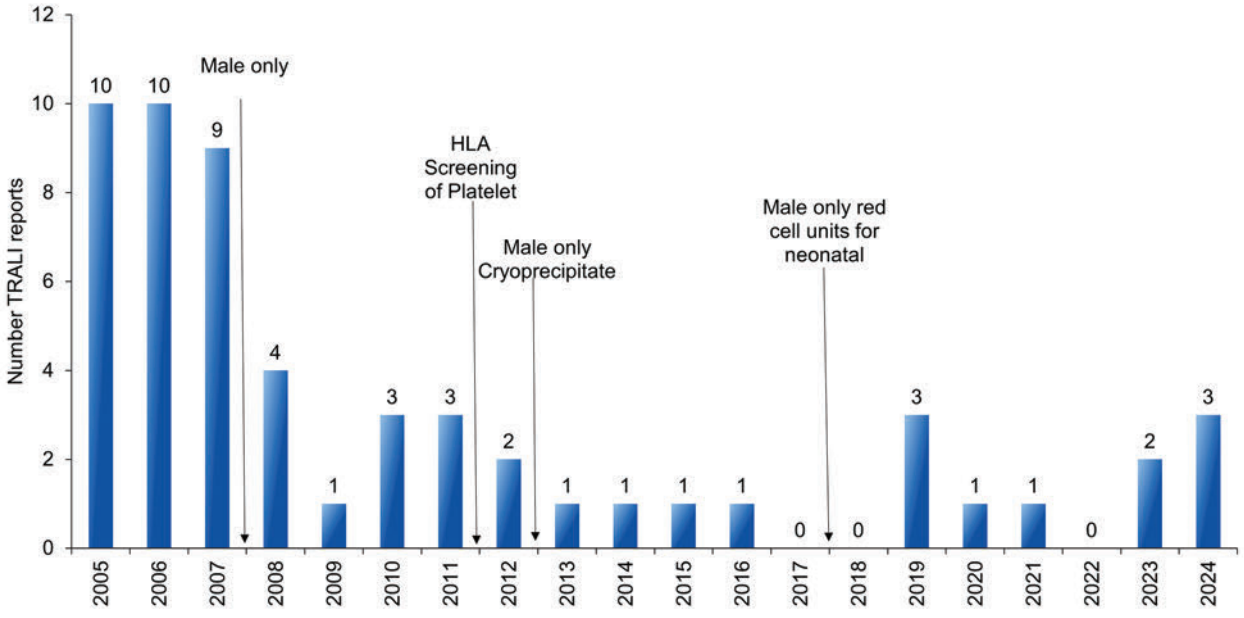


Figure 3.5.1-1: Annual TRALI reactions 2005 to 2024

3.5.2 Transfusion-Associated Circulatory Overload (TACO)

Surveillance case definition (extract from ISBT TACO definition)[9]:
Acute or worsening respiratory compromise and/or evidence of pulmonary oedema (A and/or B below) during or up to 12 hours after transfusion and presence of a total of 3 or more of the criteria below:

A. Acute or worsening respiratory compromise
B. Evidence of acute or worsening pulmonary oedema
C. Evidence for cardiovascular system changes not explained by the patient's underlying medical condition
D. Evidence of fluid overload
E. Supportive result of a relevant biomarker e.g. an increase of B type natriuretic peptide level (e.g., BNP or NT-pro BNP) above the age group-specific reference range and greater than 1.5 times the pretransfusion value.

In 2024, 25 reports of TACO were received (the same number as in 2023).

Although the reporting rate is lower than 2022, at 1.7 reports/10,000 units transfused it is the second highest rate in the last ten years (Figure 3.5.2-1).

In section 3.8 of this report, two TACO case studies are presented on two different paediatric patients.

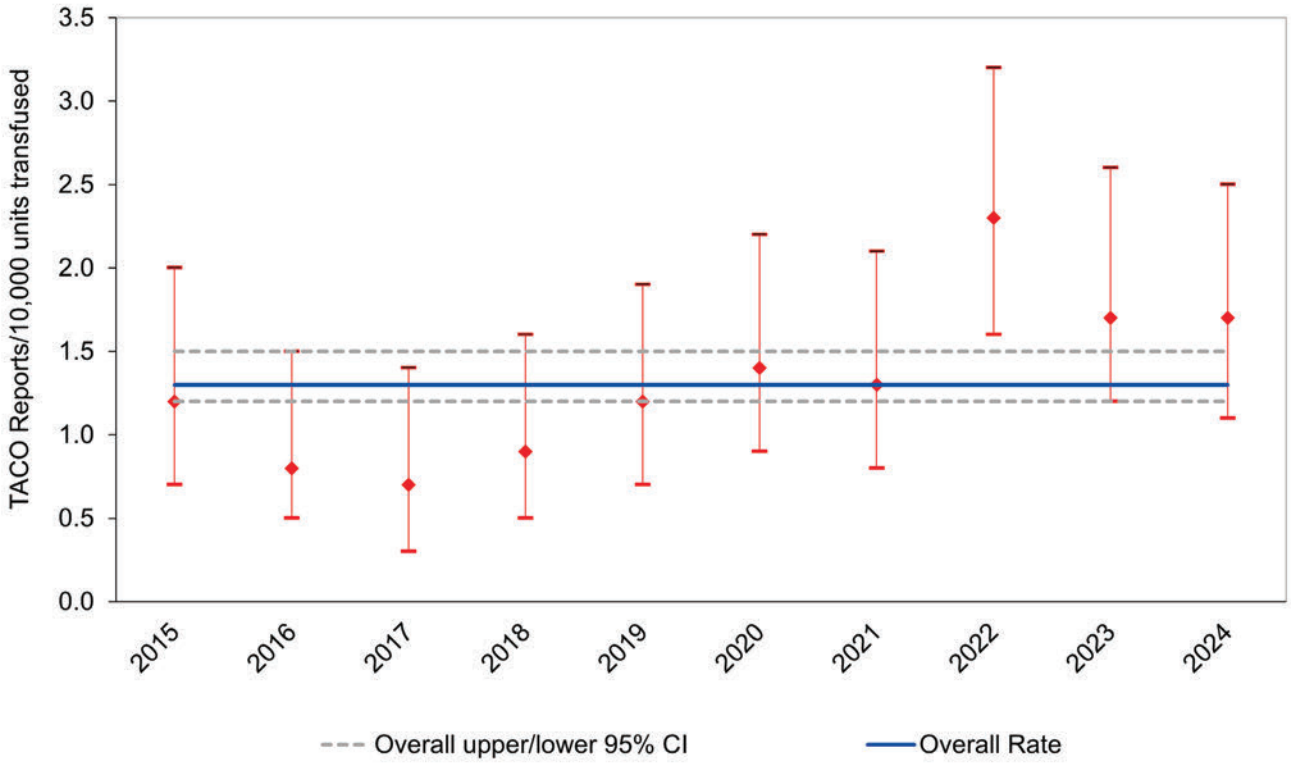


Figure 3.5.2-1: Annual rate of reported TACO reactions (with 95% CI) 2015 – 2024

[9] Andrzejewski C, Bolton-Maggs P, Grey S, Land K, Lucero H, Perez G, Popovsky M, et al. Transfusion-associated circulatory overload (TACO) definition. International Society of Blood Transfusion, International Haemovigiliance Network, AABB (formerly the American Association of Blood Banks); 2018 [updated 2019 Mar; cited 2024 Jul 07]. Available from: https://www.aabb.org/docs/default-source/default-document-library/resources/taco-2018-definition.pdf?sfvrsn=e1bcfce4_0

In 2024, eighteen of the TACO cases were severe (grade 2) and one was life-threatening (grade 3). No deaths attributed to TACO were reported (grade 4). Table 3.5.2-1 summarises the severe TACOs from the last ten years. Over the last ten years TACO accounted for 5.2% of all reactions, but almost a third of severe reactions and two-thirds of those that resulted in death.

Table 3.5.2-1: Severe TACO reactions 2015 – 2024

		Severity			
		Grade 2 (Severe)	Grade 3 (Life-Threatening)	Grade 4 (Death)	Total
All adverse reactions	Number	296	52	9	357
TACO reactions	Number	91	14	6	111
	Percentage of reactions	30.7%	26.9%	66.7%	31.1%

The signs and symptoms identified in these cases are shown in Figure 3.5.2-2.

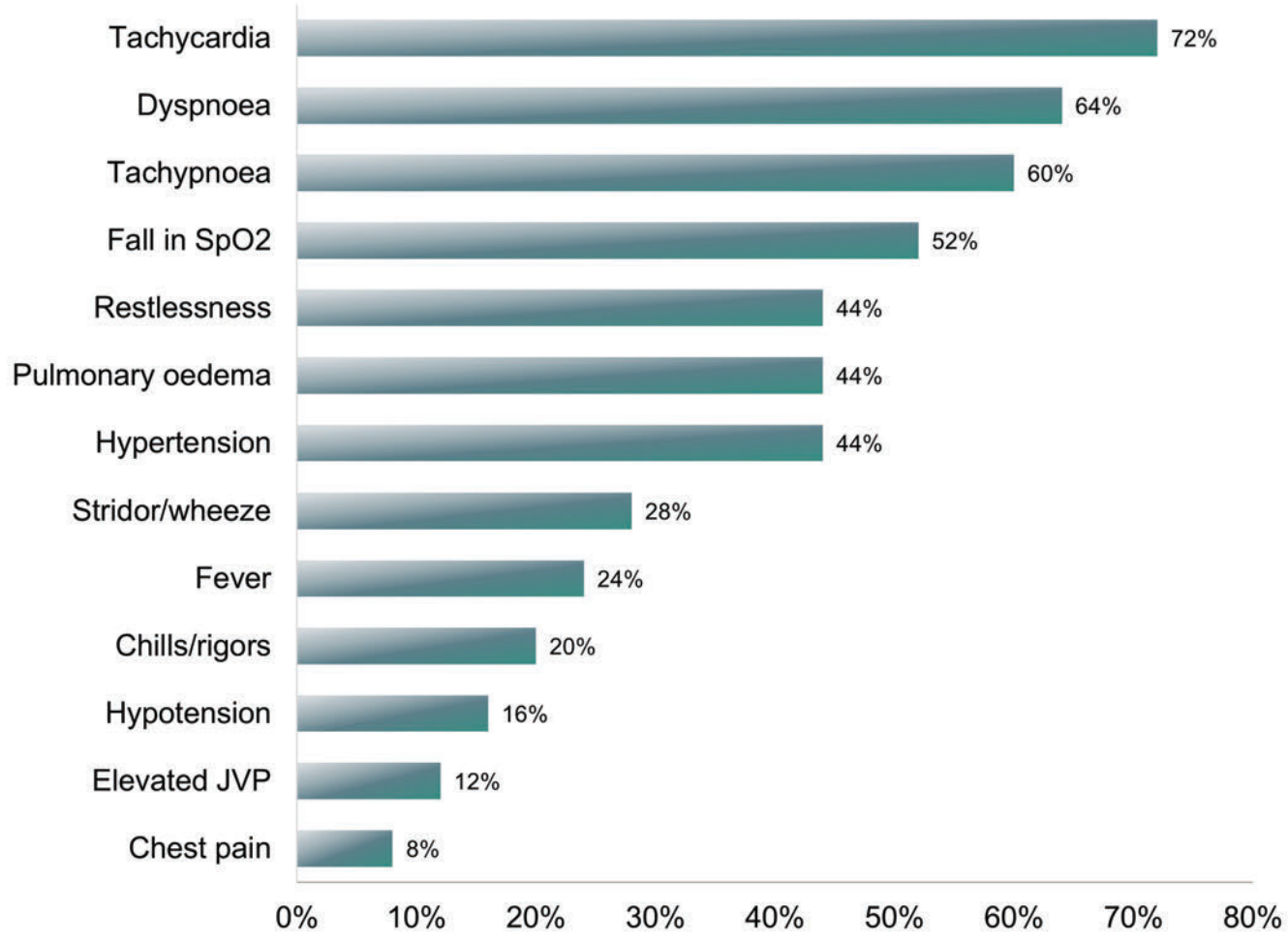


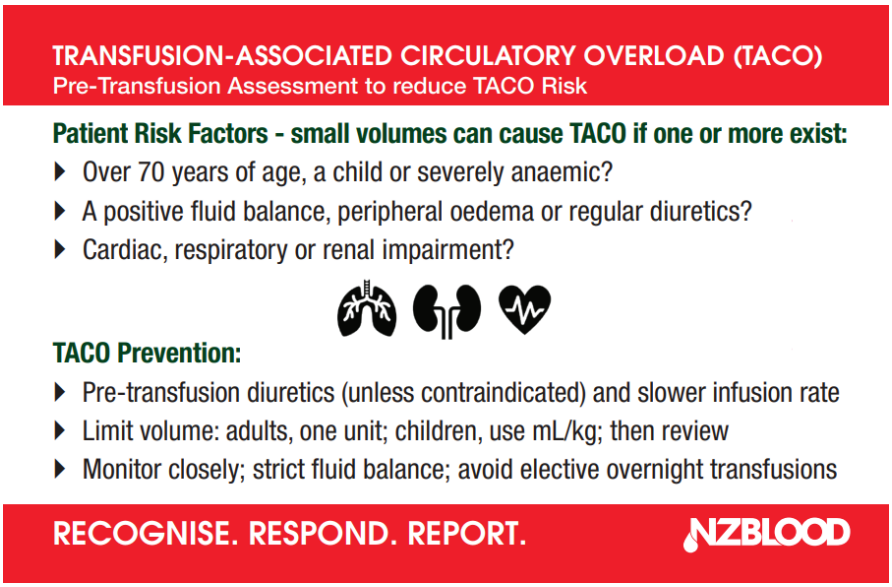
Figure 3.5.2-2: TACO signs and symptoms as a percentage of TACO cases 2024

In recent years, NZBS has undertaken initiatives to raise awareness of TACO across hospitals in New Zealand. This work, led by the Transfusion Nurse Specialists (TNS) at NZBS, has resulted in the development of two resources: a TACO lanyard card (Figure 3.5.2-3) and a TACO risk assessment tool.

The TACO lanyard card was designed as a quick-reference resource for nursing and medical staff. It highlights the main risk factors associated with TACO and outlines practical measures to reduce its occurrence. The reverse side of the card provides a summary of how to recognise, respond to, and report TACO. Feedback from clinical teams has been overwhelmingly positive, with many finding the card a valuable tool in daily practice.

The TACO risk assessment tool offers more in-depth guidance for clinical staff, supporting pre-transfusion assessment and decision-making. It serves as a practical aid to help identify patients at risk before initiating a blood transfusion.

Both resources are aimed at enhancing patient safety by promoting early recognition and prevention of TACO. NZBS plans to continue rolling out these tools to hospitals nationwide over the coming years.



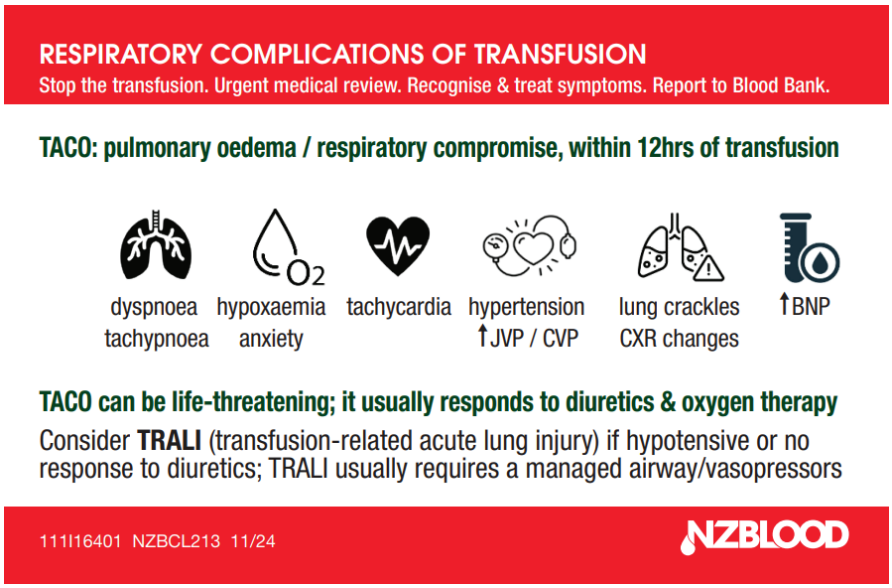


Figure 3.5.2-3 TACO lanyard card

3.5.3 Transfusion-Associated Dyspnoea (TAD)

Respiratory distress within 24 hours of transfusion that does not meet the criteria of TRALI, TACO, or allergic reaction and is not explained by the patient's underlying condition.

In 2024, 16 adverse reactions were classified as TAD. Cumulative data for the last ten years is shown in Table 3.5.3-1.

Table 3.5.3-1: Annual TAD reactions 2015 – 2024

Year	TAD Events	Total Units Transfused	Frequency	Rate / 10,000 Units Transfused (95%CI)
2015	2	132,060	1:66,030	0.2 (0.0 to 0.6)
2016	8	130,185	1:16,273	0.6 (0.3 to 1.2)
2017	14	127,765	1:9,126	1.1 (0.6 to 1.9)
2018	11	130,361	1:11,851	0.8 (0.5 to 1.5)
2019	20	135,093	1:6,755	1.5 (0.9 to 2.3)
2020	9	131,308	1:14,590	0.7 (0.3 to 1.3)
2021	17	134,440	1:7,908	1.3 (0.8 to 2.0)
2022	15	139,750	1:9,317	1.1 (0.6 to 1.8)
2023	20	143,542	1:7,177	1.4 (0.9 to 2.2)
2024	16	147,183	1:9,199	1.1 (0.7 to 1.8)
Total	**132**	**1,351,687**	**1:10,240**	**1.0 (0.8 to 1.2)**

3.6 HAEMOLYTIC AND SEROLOGIC TRANSFUSION REACTIONS

3.6.1 Acute Haemolytic Transfusion Reactions (AHTR)

A reaction in which symptoms and clinical or laboratory signs of increased red cell destruction occur at any time up to 24 hours following the transfusion of blood or a blood component.

One AHTR case was reported in 2024.

This case involved a 48-year-old female who was admitted to hospital with shortness of breath following an aortic valve replacement. The patient was found to be anaemic with a baseline haemoglobin of 71 g/L. The patient was subsequently transfused one unit of red cells and following the transfusion the patient developed apparent brown urine, fever and rigors. The patient's direct antiglobulin test was positive before the transfusion and the antibody elution showed no antibody specificity. The post-transfusion results were essentially the same as pre-transfusion results. The classification was AHTR (based mostly on the patient's signs and symptoms), severe (grade 2), with an imputability of possible.

3.6.2 Delayed Haemolytic/Serologic Transfusion Reactions (DHTR / DSTR)

A DHTR usually manifests between 24 hours and 28 days after a transfusion and clinical or laboratory features of haemolysis are present. Signs and symptoms are similar to AHTR but are usually less severe. DHTR may sometimes manifest as an inadequate rise of post-transfusion haemoglobin level or unexplained fall in haemoglobin after a transfusion. Blood group serology usually shows abnormal results.

DSTR should be considered when, after a transfusion, there is demonstration of clinically significant antibodies against red blood cells which were previously absent (as far as is known) and the DAT is positive but there are no clinical or laboratory features of haemolysis.

During 2024, two DHTR and 35 DSTR reports were received. The two reports for DHTR were for anti-Jk^{a} and anti-c. Of the DSTR reports, two involved female patients under 55 years of age who received K-positive red cell units (instead of K-negative units) and subsequently developed new anti-K antibodies (refer to Chapter 4 Error Reports for more details). Fig 3.6.2-1 details the specificities of the blood group antibodies implicated in the DHTR and DSTR events over the last nine years.

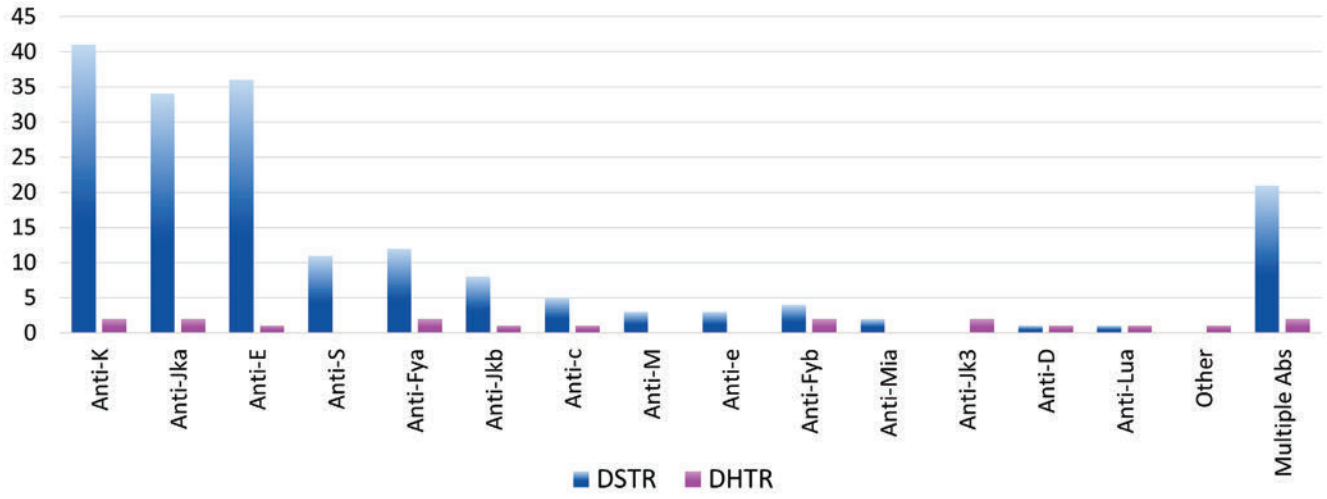


Figure 3.6.2-1: DHTR and DSTR by red cell antibody specificity 2016 – 2024

3.7 OTHER TRANSFUSION REACTIONS

3.7.1 Unclassifiable Complications of Transfusion (UCT)

Occurrence of an adverse effect or reaction temporally related to transfusion, which cannot be classified according to an already defined event, with no risk factor other than transfusion.

During 2024, there were 22 reports of adverse reactions which could not be classified into a definitive category.

A wide range of signs and symptoms can be seen in UCTs. Figure 3.7.1-1 shows the most common signs and symptoms reported since 2005.

Hyperkalaemia is infrequently seen in adverse reaction reports but two such cases were reported in 2024. See case studies on the following pages.

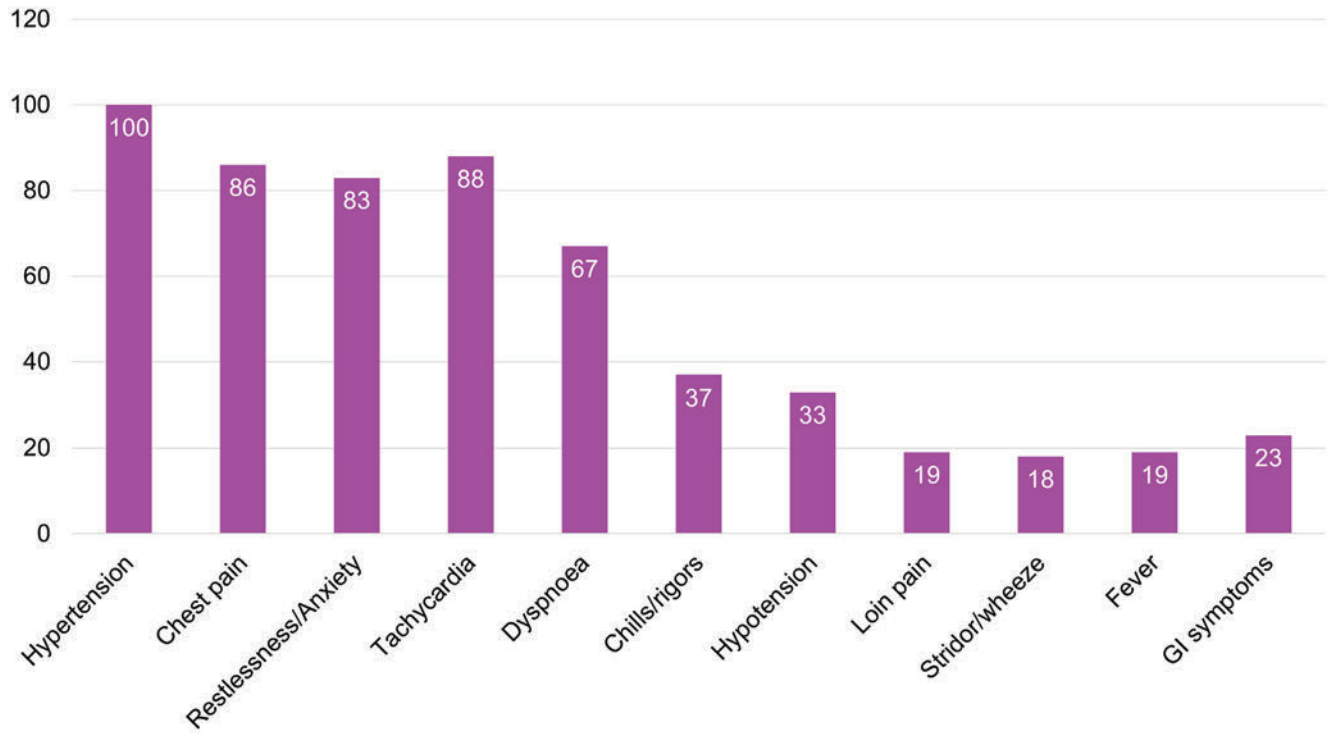


Figure 3.7.1-1: Numbers of signs and symptoms reported in UCT cases 2005 - 2024

3.7.2 Haemosiderosis

Transfusion-associated haemosiderosis is being defined as a blood ferritin level of > 1000 µg/L, with or without organ dysfunction in the setting of repeated RBC transfusions.

To date the Haemovigilance Programme in NZ has not received any reports of haemosiderosis. This is an important complication of chronic transfusion that may not be being detected in some patient groups.

CASE STUDY

Two cases of hyperkalaemia with post-partum haemorrhage

Dr Krishna Badami, Transfusion Medicine Specialist

CASE STUDY 1

A 34-year-old woman was having an elective lower segment caesarean section using spinal anaesthesia. The indication was placenta accreta. The caesarean section was complicated by a 5 L post-partum haemorrhage (PPH). However, she was successfully delivered. The PPH itself was managed using a range of measures including oxytocin, syntometrine, carboprost, tranexamic acid, activation of the massive haemorrhage protocol (MHP), and eventually, an attempted sub-total hysterectomy (and this necessitated the induction of general anaesthesia). In total, during the MHP activation, she received 13 units of RBC, 8 units of FFP, 10 units of cryoprecipitate, and a unit of platelets. During the MHP, whilst still in the operating theatre under general anaesthetic, she suffered a cardiac arrest with the ECG changing from narrow complex tachycardia to (broad complex) ventricular fibrillation (VF). Defibrillation, and cardiopulmonary resuscitation (CPR) were immediately performed. VF was followed by asystole, the CPR was continued, and she received further direct current shocks, and doses of adrenaline. A blood sample collected at 14:59 hours had shown potassium of 7.5 mmol/L (Normal range: 3.5 to 5.2 mmol/L). At the same time, the pH on an arterial blood sample was 7.26 (Normal range: 7.35 to 7.45), and the base excess, - 8.9 mmol/L (Normal range: -3 to +3 mmol/L). The ionized calcium corrected for albumin around this time was 2.35 mmol/L (Normal range: 2.2 to 2.6 mmol/L). Sodium and creatinine were also normal then and later. To treat the hyperkalemia and its consequences, she received insulin, intravenous glucose, furosemide, and calcium chloride, and, for the acidosis, an infusion of sodium bicarbonate. During the resuscitation, in theatre, there was also copious, frothy sputum from the endotracheal tube which needed aspirating. Together with evidence of significant respiratory failure (calculated P/F ratio about 188), and significant, acute hypoalbuminaemia seen after the event, there also appeared to be an element of acute respiratory distress syndrome (ARDS). Eventually, after time in the ICU, and a re-look laparotomy, the patient recovered, and was discharged home.

This case was classified as a transfusion-related hyperkalemia (the International Haemovigilance Network definition, which the NZBS follows is, “any abnormally high potassium level (>5 mmol/L or >1.5 mmol/L net increase) within an hour of transfusion”), grade 3 (life-threatening). In the absence of any other plausible explanation for the hyperkalemia, the imputability was determined to be probable. Transfusion-related hyperkalemia is a known but rare consequence of transfusions especially massive transfusions as in this case. During storage, potassium, which is normally mainly intracellular, exits the RBC because of failure of the Na-K pump.

CASE STUDY 2

A 46-year-old female was being treated for a PPH with estimated blood loss of approximately 2.5 L. Despite this, she was haemodynamically stable. In the operating theatre, she was transfused two units of RBC. These were completed around 21:55 hours. No problems were observed during the transfusion, and no ECG changes were observed during monitoring. About an hour after the completion of the transfusion, at about 23:00 hours, in the Post-Anaesthesia Care Unit, the patient suffered a cardiac arrest with the patient demonstrating agonal gasps. CPR was immediately started. Five rounds of CPR with 5 direct current shocks were administered. During the cardiac arrest, the patient was intubated early and received several doses of 1 mg adrenaline, as well as 300 mg amiodarone. A “variable broad complex arrhythmia” was observed on cardiac monitoring. An arterial blood gas sample peri-arrest showed a potassium of 7.2 mmol/L. Treatment for this was with calcium chloride 10%, insulin and dextrose, and sodium bicarbonate. Following this, the patient converted to an “odd, alternately narrow/broad complex pulseless electrical activity (PEA) rhythm before ultimately achieving ROSC” (return of spontaneous circulation).

The patient remained in sinus rhythm after this with a potassium of 4.5 mmol/L. Other causes of cardiac arrest were considered. Haemoglobin was stable without overt clinical evidence of bleeding. An embolic event - including amniotic fluid embolism – was considered but excluded as were other reversible causes. The aetiology of the hyperkalaemia is uncertain. Blood transfusion is a possible cause, but two things are highly unusual, and markedly different to what is discussed in Case 1. Firstly, the fact that this was associated with only two units of RBC being transfused. In this connection, note that there was no suggestion of haemolysis in either the transfused RBC, or in the patient. Secondly, there was an hour's delay between the transfusion and the presentation (through cardiac arrest, hyperkalaemia, etc). Therefore, other possibilities must also be kept in mind. For instance, an Addisonian crisis, likely reversible, precipitated by the critical haemorrhage. The hyperkalaemia is suggestive but, in the absence of further information, it is not possible to confirm or refute this. If this latter possibility were true, then the imputability of the case would be reduced to unlikely or excluded. Incidentally, this was a recent, relatively late thought on re-reviewing this case. It highlights the frequent challenge in haemovigilance of making diagnoses, or drawing conclusions, using limited information often remote (physically and temporally) from the patient.

3.8 REPORTS INVOLVING PAEDIATRIC PATIENTS

During 2024, there were 36 ATRs reported involving recipients under 16 years of age, 58.3% in males (Table 3.8-1). Of these children, six were aged two years or younger, while 21 children were between three and ten years old. The rate of events in paediatric patients was 39.9/10,000 units transfused.

Table 3.8-1: ATRs in paediatric patients by event type, rate, gender and severity 2024

Event Type	Number	Percentage of Events	Rate/10,000 units transfused	Gender		Severity Score		
				Female	Male	1	2	3
Allergic	19	52.8%	21.1	6	13	14	3	2
FNHTR	14	38.9%	15.5	7	7	14	0	0
TACO	2	5.6%	2.2	1	1	0	2	0
TAD	1	2.8%	1.1	1	0	1	0	0
Total	**36**	-	**39.9**	**15**	**21**	**29**	**5**	**2**

The breakdown by component is shown in Table 3.8-2.

Table 3.8-2: Frequency and rate of paediatric ATRs by component type 2024

Component	Event*	Units transfused	Frequency	Rate/10,000 units transfused (95% CI)
Platelets	18	2,542	1:141	70.8 (44.0 to 112.5)
Red cells	16	5,073	1:317	31.5 (19.0 to 51.6)
Plasma	2	978	1:489	20.4 (0.5 to 79.4)
Cryoprecipitate	1	272	1:272	36.8 (0 to 226.7)

** Some reactions are associated with the transfusion of more than one component type.*

CASE STUDY

Two cases of TACO in paediatric patients

Dr Deepak Sadani, Transfusion Medicine Specialist

CASE STUDY 1

An 18-month-old female child was admitted to the paediatric ward with lower respiratory tract infection (LRTI) and anaemia of unknown origin. On examination her heart rate was at 150 bpm, respiratory rate was 58 breaths/min, saturation measured peripherally was at 94% on 1 L oxygen via nasal prongs, which was primarily related to the infection. Blood pressure was 80/45 mmHg. She was alert, clinging to her mother, appeared pale with no jaundice. Capillary refill time was <2 seconds centrally and 3 seconds peripherally, moist mucous membranes, normal skin turgor. Additionally, no bruises or rashes were seen and there were no other signs of bleeding. She was noted to be warm and well perfused, have good volume radial pulse, mild to moderate increased work of breathing with subcostal recessions. No tracheal tug. Heart sounds were normal with no murmurs heard. Examination of her chest revealed some occasional crepitations on the left side, no wheeze with good air entry bilaterally. Abdominal examination was soft, non-tender, nil hepatosplenomegaly, no masses. A few cervical lymph nodes were palpable bilaterally. Throat examination revealed the tonsils unable to be visualised but nil surrounding erythema. Her weight was 9.48 kg, height 83.5 cm, head circumference 46.4 cm.

The child had a past medical history of:

- Transient erythroblastopenia of childhood - No sources of bleeding. No vascular malformations.
- Normal pregnancy and delivery at term. Breastfed from birth, normal introduction of solids, eats a variety of foods including meat, eggs, dark green vegetables. Eats all sorts of beans and nuts (not fava beans) for a long time before this anaemia developed.
- No relevant family history. Has two older sisters and one older brother, all well. Has a maternal cousin with phenylketonuria.

The patient was started on intravenous antibiotics and antipyretics. She was considered stable, though unwell. CRP was trending down from 85 >>> 63 mg/L. Haemoglobin that day was 61 g/L. Bearing in mind the compromised oxygen supply with a lower oxygen supply to tissues being impacted by the low haemoglobin value, the treating doctor decided to transfuse a single unit of red cells. This was started at 11:25 hours and finished at 15:25 hours, totalling 216 mL at ~5 mL/kg/hr over 4 hours. Post transfusion, the patient received one dose of intravenous diuretic furosemide (at 1 mg/kg).

At about 05:30 hours the next day, the child was noted to be unwell with an increased respiratory rate (42 to 52 breaths/min), increased heart rate (120 to 142 beats/minute), low blood pressure (102/69 to 71/43 mmHg), with an increased oxygen requirement and a temperature rise of 0.9 °C. Oxygen requirements increased to 1 L (from 0.5 L). A further dose of intravenous furosemide (10 mg) was given for post-transfusion diuresis. Post transfusion, haemoglobin increased to 102 g/L. Respiratory distress associated with underlying LRTI/sepsis remained. It was noted in the adverse event report that the exacerbation in her clinical condition after red cells lessened post furosemide diuresis.

No fluid balance chart records were available, no BNP was measured, and no post-transfusion weight was recorded.

The chest X-ray showed:
Pre-transfusion – Widespread patch opacities present throughout both the lungs. No evidence of pleural fluid. Heart size – normal.
Post-transfusion – marked patchy opacities present throughout both the lungs, little more marked than previously, no pleural fluid seen. Heart size mildly enlarged.

A diagnosis of TACO was made, based on improvement in clinical condition post diuresis induced by furosemide and the X-ray changes. The imputability was possible and severity was serious (grade 2).

CASE STUDY 2

An 11-year-old male child with a primary diagnosis of haemophagocytic lymphohistiocytosis (HLH) was admitted with LRTI/pneumonia and acute kidney injury. The child had a past medical history of end stage kidney disease (ESKD) secondary to congenital renal dysplasia, and he had undergone a renal transplant eight years earlier.

Upon admission the child was febrile, complained of generalised abdominal pain, sore throat and had a wet cough. The child had been unwell with diarrhoea and vomiting for more than one week prior to admission. Rhinovirus and enterovirus were detected on throat swab examination. A full blood count on the morning showed haemoglobin levels to be low (at 73 g/L) and a single unit of red cells was started at 22:20 hours.

After transfusion of only 25 mL of red cells at 23:10, the child was noted to have tachypnoea (respiratory rate dropped from 38 to 48 breaths/min), with an increased oxygen requirement (SpO_2 95% on 5 L of oxygen to 90% on 10 L of oxygen). The patient's temperature had increased 0.8 °C (to 38 °C) and developed chills and rigors. Intravenous furosemide was administered and a strict fluid balance implemented.

The chest X-ray showed:
Pre-transfusion – Inflammatory changes with a small area of consolidation in the lower lobes likely reflects bronchopneumonia.
Post-transfusion – Progressive pneumonic changes with increasing consolidation throughout both lungs, particularly in the upper lobes and left lower lobe.

BNP on laboratory tests was noted to have gone up from 651 µg/L pre-transfusion to 806 µg/L post-transfusion. The child was transferred to the Paediatric Intensive Care Unit for further monitoring and care.

A diagnosis of TACO was made based on the above findings. The imputability was possible and severity was serious (grade 2).

Discussion

There are several similarities between the two cases – both being admitted unwell with lower respiratory tract infections. Both the children had a low haemoglobin level at baseline, which was multifactorial in origin, with no active bleeding at the time of the transfusion. While they were being treated for their underlying conditions, one intervention that was thought to help with improving their immediate situation was a correction of the low haemoglobin levels. Access to blood products is exceedingly simple in hospitals, especially within intensive care units. There is an overwhelming impression from the prescriber's point of view that they are trying to help a difficult situation and that there is little harm from transfusing blood. This is based on decisions taken by junior doctors in after hours, whose limited experience does not help with determining what is in the patient's best interests and what adverse events can occur due to blood transfusion. This can lead to excessive faith in the benefit of transfusing a blood component. However, in both these situations a perceived improvement in situation was marred by an increasingly well recognised complication of blood transfusion – TACO.

Very few cases of paediatric reports of transfusion adverse reactions are reported to haemovigilance systems. This may be attributed to reduced awareness of certain transfusion complications in children – particularly those frequently seen and reported in adults, alongside the lack of clear definitions for rarer complications, and difficulties in diagnosing certain complications in complex paediatric patients.

3.9 RARE ADVERSE TRANSFUSION REACTIONS

3.9.1 Post-Transfusion Purpura (PTP)

Thrombocytopenia arising 5 - 12 days following a transfusion of cellular blood components with findings of antibodies in the patient directed against Human Platelet Antigen (HPA) system.

There was one case of Post-Transfusion Purpura (PTP) in 2024.

A 62-year-old female, with multiple myeloma had, a month earlier, received an autologous stem cell transplant. She was admitted to hospital with a low platelet count (7 x 10^9/L). She had had neutropenic fevers and was refractory to platelet transfusions. She was transfused four units of pooled platelets over three consecutive days, and a unit of RBC on the fourth day. Following these, the platelet count fluctuated (7, 3, 5 and 35 x 10^9/L). Thirteen days after the RBC transfusion the patient's platelet count dropped back to 2 x 10^9/L. The next day, the patient was transfused a unit of (standard) pooled platelets, and another of washed apheresis platelets. The reason for the latter is unclear. The following day, her platelet count was 1 x 10^9/L. She was given intravenous immunoglobulin (IVIg) for two consecutive days, and her platelet count rose from 1 to 12 to 47 x 10^9/L. Genotyping showed that she was HPA 1b/1b homozygous. Antibodies against HPA-1, and HLA, were identified. However, she never received any matched platelet transfusions as her platelet count seemed to have recovered. The case was classified as PTP, grade 2 (severe), of probable imputability. The following points about this interesting patient are noteworthy:

1. For a start, in contrast to most cases of PTP, the patient was profoundly thrombocytopenic (and platelet trans fusion refractory) at presentation.[10]
2. In contrast to most cases of PTP described, the patient had apparently no bleeding.[10]
3. There is the possibility that this may have been immune platelet transfusion refractoriness rather than PTP.
4. Although the evidence is not very convincing, IVIg may sometimes work in patients who are immune platelet transfusion refractory.[11]
5. The early platelet count response (baseline, 7, then 3, then 5 and then 35 x 10^9/L) might be explainable by initial poor response to the platelet transfusions, followed by a much better response - possibly to an unexpected matched or partly-matched platelet unit.
6. HLA typing results (for DRB3*0101) were not available for this patient. Incidentally, patients with PTP associated with anti-HPA-1a (as also with mothers of babies affected by neonatal alloimmune thrombocytopenia or NAIT due to anti-HPA-1a) are invariably positive.
7. Anti-HPA-1a can also be associated with platelet refractoriness.

While PTP is possible, for the reasons discussed above, this is not a clear-cut case. Nonetheless, the diagnosis of PTP (which is, incidentally, a very rare condition) is difficult. The gold standard, hardly ever achievable, would be through the demonstration of the paradoxical destruction of autologous antigen-negative (e.g. HPA-1a-negative) platelets by an antibody to an HPA alloantigen (e.g. HPA-1a).

3.9.2 Transfusion-Associated Graft-Versus-Host Disease (TA-GVHD)

TA-GVHD is a clinical syndrome characterised by symptoms of fever, rash, liver dysfunction, diarrhoea, pancytopenia and findings of characteristic histological appearances on biopsy occurring 1-6 weeks following transfusion with no other apparent cause. The diagnosis of TA-GVHD is further supported by the presence of chimerism.

No cases of TA-GVHD were reported in 2024 and none have been reported since the National Haemovigilance Programme began in 2005.

[10] Hinojosa O, Ammari O, Albusoul L, Kuriakose P, Otrock ZK. Post-Transfusion Purpura: A literature review. Blood. 2023;142 (Suppl 1):1294. doi:10.1182/blood-2023-187525.

[11] Zeigler ZR, Shadduck RK, Rosenfeld CS, Winkelstein A, Przepiorka D, Kiss JE, Duquesnoy RJ, Marrari M. Intravenous gamma globulin decreases platelet-associated IgG and improves transfusion responses in platelet refractory states. Am J Hematol. 1991;38(1):15–23. doi:10.1002/ajh.2830380104.

3.10 TRANSFUSION-TRANSMITTED INFECTION (TTI)

3.10.1 Transfusion-transmitted bacterial infections

One transfusion transmitted bacterial infection was reported in 2024.

A 51-year-old male, with diffuse large B-cell lymphoma, presented to hospital with thrombocytopenia (platelet count 10 x 10^9/L). The patient received one unit of split apheresis platelets. During the transfusion the patient developed hypotension (blood pressure dropped from 98/60 mmHg to 80/60 mmHg), tachycardia (heart rate increased from 98 bpm to 107 bpm), fevers (temperature rose from 35.7 °C to 37.7 °C), rigors chills and restlessness. Blood cultures were taken from the patient's peripherally inserted central catheter (PICC) line and peripheral line during the reaction; gram negative bacilli (Klebsiella pneumoniae) were grown. The same organism grew in the platelet bag. The pre-release bacterial culture performed on all platelet units by NZBS was negative in both aerobic and anaerobic bottles. The other split from the same donation had been discarded so was not available for testing. Both donor and phlebotomist denied any gastric-type illness prior to the transfusion. It was not possible to determine how the unit became contaminated. The patient was administered loratadine PO 10 mg, paracetamol PO 1 g, hydrocortisone IV 100 mg, 1 L fluid and cefepime IV 2 g. The patient was admitted to the intensive care unit (ICU) due to refractory hypotension not responsive to fluid boluses. He required vasopressor support and spent 48 hours in the ICU. This case was classified as TTI, grade 3 (life-threatening), with an imputability of probable.

3.10.2 Donor infectious disease screening

In New Zealand, all blood donations are screened for HBsAg, HBV DNA, anti-HCV, HCV RNA, anti-HIV-1/2, HIV RNA and syphilis antibodies. All new donors are also tested for anti-HTLV-I/II. Additional testing is performed on selected donations, e.g., CMV IgG antibody for fetal and neonatal transfusions, Trypanosoma cruzi (Chagas Disease) and malarial antibody tests in donors who may pose a risk due to residence and/or travel to affected areas.

During 2024, 105,313 donors were tested. Of these, 72.4% were repeat donors and 27.6% were first-time donors (previously untested). A total of 227,865 donations were tested during the year.

Numbers and rates of confirmed positive infectious markers for 2024 are shown in Table 3.10.2-1.

Table 3.10.2-1: Donors with confirmed positive infectious markers 2024

		HBV	HBV Occult	HCV	HIV	Syphilis	HTLV I/II
Number of donors tested	First-time tested donors (n=29,052)	7	5	17	1	8	1
	Repeat donors (n=76,261)	0	15	1	1	27	-
	Total donors (n=105,313)	7	20	18	2	35	1
Rate per 10,000 donors	First-time tested donors	2.4	1.7	5.9	0.3	2.8	0.3
	Repeat donors	0	2.0	0.1	0.1	3.5	-
	All donors	0.7	1.9	1.7	0.2	3.3	0.1

Figure 3.10.2-1 shows numbers and trends of confirmed positive infectious markers in donors since 2005.

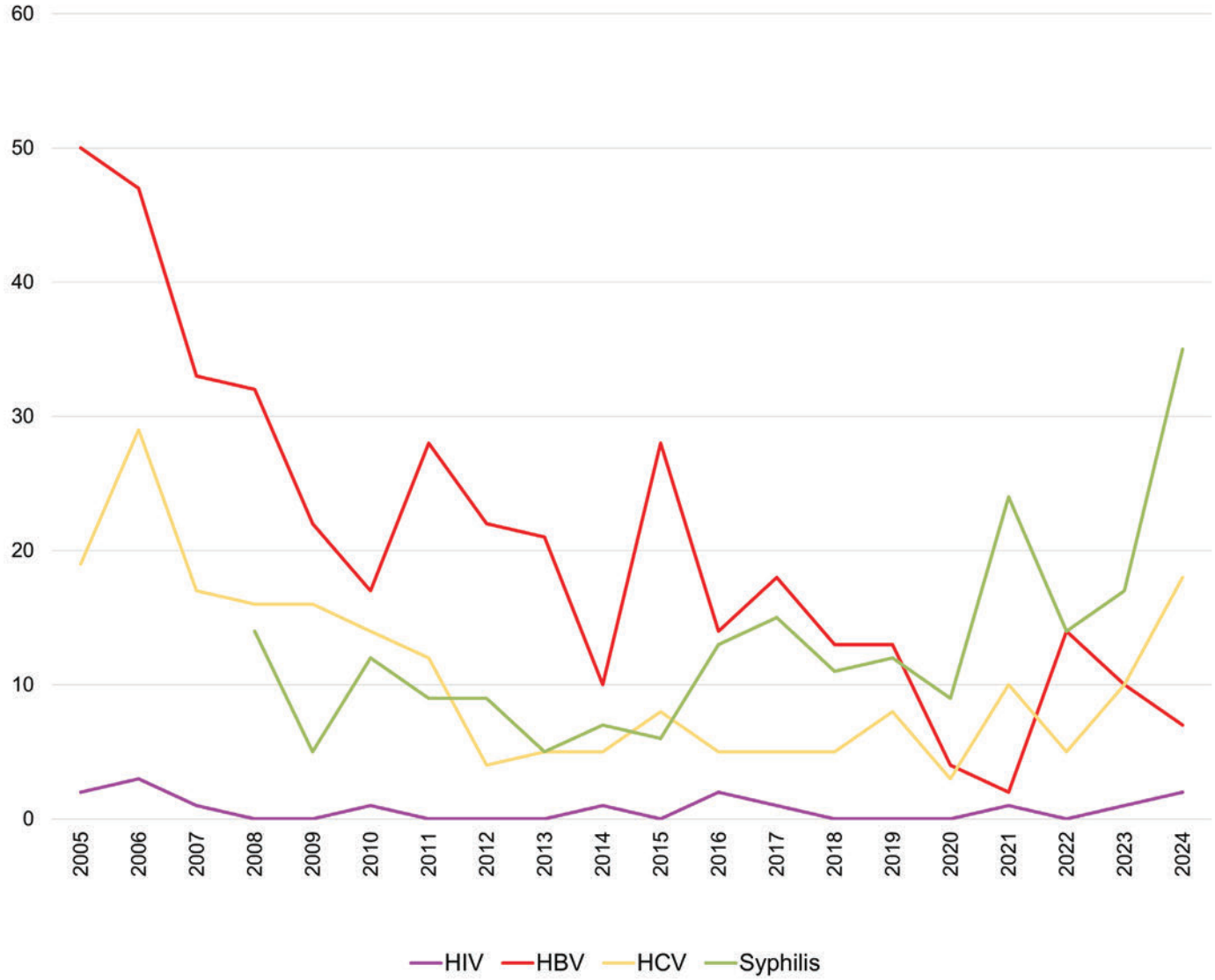


Figure 3.10.2-1: Annual number of donors with confirmed positive infectious markers 2005-2024

The overall numbers for 2024 are similar to those seen over the last decade with two exceptions.

The first exception is the number of donors with confirmed syphilis, which is now at its highest since 1998 (Figure 3.10.2-2). This increasing prevalence of syphilis is also being seen in other countries.[12] This follows a trend of increased numbers over the last four years. The rate is higher in first-time donors. This is expected as this is a group who have probably not been checked for syphilis before. The rate in repeat donors is not as high but is the most frequent confirmed infection in repeat donors.

[12] Conti G, Notari EP, Dodd RY, Kessler D, Custer B, Reik R, Lanteri MC, Hailu B, Yang H, Stramer SL; U.S. Transfusion-Transmissible Infections Monitoring System (TTIMS). Syphilis seroprevalence and incidence in US blood donors from 2020 to 2022. Transfusion. 2024 Feb;64(2):325–33. doi:10.1111/trf.17707.

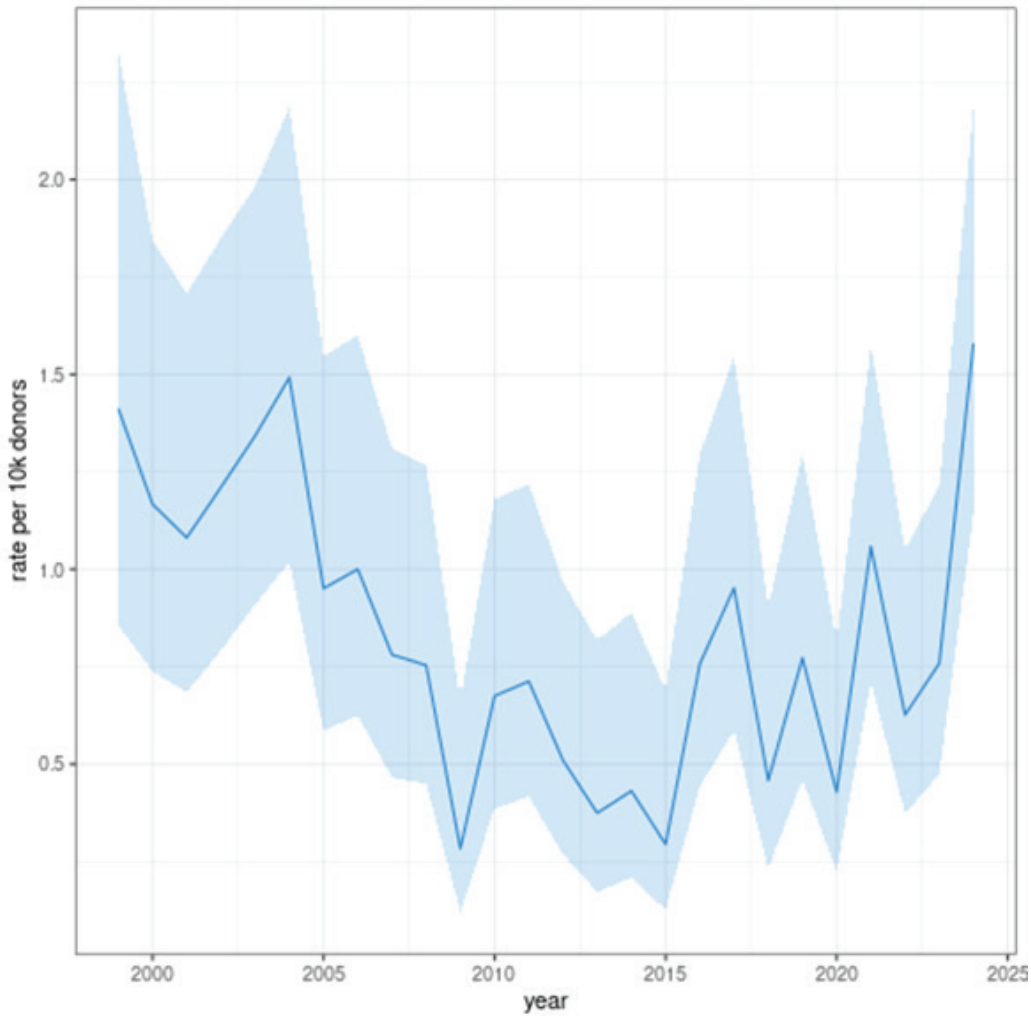


Figure 3.10.2-2: Rate per 10,000 donors with confirmed syphilis 2005-2024, with 95% confidence intervals

The second exception is an increase in first-time donors with confirmed hepatitis C antibodies. There are two possible factors at play here:

1. Post-Covid, we are seeing older donors coming through as first-time donors. This can be seen with an average age of first-time donors moving from an average of 28 (range: 26-31) between 2005 and 2020 to an average of 35 (range: 30-40) since the start of 2021.

2. In February 2024, we made the single biggest change to donor selection in many years, namely allowing donors who had a previous geographic deferral for vCJD to donate. This has seen many donors who are older donating for the first-time with an overall average age of first-time donors 40 and 39 for the last two years respectively.

It is difficult to tease out the two points above as we do not ask donors if they were previously deferred under the vCJD geographic deferral. However, we can see a surge in new and older donors in 2024 with the lifting of the vCJD geographic risk deferral.

This change, together with the rise in first-time donors with hepatitis C antibodies, suggests we are finding donors who acquired hepatitis C many years ago, possibly through injecting drug use that was less safe in the latter half of the last century than it is now. There may also be a small number of donors who acquired hepatitis C through a blood transfusion before donor screening began in 1992. These individuals may have been treated but not told they will always be ineligible for blood donation. The change may also be linked to changes in the deferral policy around non-medical use of injected drugs. This was previously a permanent deferral whereas it is now a five-year deferral.

It is important to note that we have not seen a significant increase in first-time donors who are reactive for hepatitis C RNA, i.e. have an actual infection. In other words, most of the hepatitis C antibody positive donors are previously treated/cleared donors.

3.10.3 Residual risk of viral infections

The risk of viral transfusion-transmitted infection remains of significant concern, both to recipients and prescribers. The risks remain very small though need to be monitored and reported on.

There are several steps to protecting recipients from viral infections, starting with the donor questionnaire and interview, serological analysis of the donation, tests for nucleic acids (RNA and DNA) of the viruses and, finally, for some viruses, processing steps such as leucodepletion. Fractionated plasma products go through further viral inactivation steps as part of the risk mitigation of pooled plasma.

NZBS and its predecessor regional blood services have not had a single confirmed transmission of HIV or HCV in New Zealand since testing was introduced in 1986 and 1992, respectively. Since nucleic acid testing was introduced in late 2006, there have similarly been no confirmed transmissions of HBV, although a small number of probable cases, arising from occult hepatitis B in the donors, have been reported.

In the absence of any observed transmissions, the risk to recipients is now modelled using donors' donation frequency and the incidence of infections in donors. The residual risk to donors is derived from the calculated frequency of window period donations. This assumes that window period donations represent the dominant source of risk. While this is highly likely for HIV and HCV, it is much less likely for hepatitis B where infection from occult carriers is, in our clinical experience, the more likely cause. The data below do not reflect the risks due to occult hepatitis B.

For repeat donors, the standard model calculates the risk from the incidence of new infections between donations in repeat donors, together with the window period of the virus, to derive a risk that a donation is in the window period.[13]

For first-time donors, 4.5% of donations, we have used a model developed in Australia that derives the risk based on the window period of the infection and the time taken for the infection to be diagnosed.[14] Although this model is not as robust in its assumptions as the repeat donor model, its impact is offset by the relative scarcity of first-time donors.

The data from first time and repeat donors was then analysed using the two models in a Monte Carlo simulation to take account of the degree of imprecision around the various parameters in the calculations, generating prediction intervals (similar to confidence intervals). The risks generated by the modelling are shown below (Table 3.10.3-1).

Table 3.10.3-1: Residual risk estimates for New Zealand donations, with 95% prediction intervals

Infection	Mean risk	95% Prediction interval
HIV	1 in 13.0 million	1 in 3.2 to 41.1 million
HCV	1 in 10.2 million	1 in 5.3 to 17.5 million
HBV	1 in 1.2 million	1 in 0.7 to 2.2 million

As mentioned, the risk above for hepatitis B does not take into account the risk posed by occult hepatitis B. This is a condition where a suboptimal immune response allows minute levels of hepatitis B into circulation, at or below the level of detection of the hepatitis B nucleic acid test. Counteracting this phenomenon, though, is the relatively high level of hepatitis B vaccination amongst recipients. So, unlike for HIV and hepatitis C, the true risk to recipients is therefore a balance between the incidence of occult hepatitis B and recipient immunity (immunocompromised recipients being at higher risk compared to those who are immunocompetent).

[13] Schreiber GB, Busch MP, Kleinman SH, Korelitz JJ. The Risk of Transfusion-Transmitted Viral Infections. N Engl J Med. 1996; 334(26):1685–90.
[14] Seed CR, Kiely P, Keller AJ. Residual risk of transfusion transmitted human immunodeficiency virus, hepatitis B virus, hepatitis C virus and human T lymphotrophic virus. Intern Med J. 2005 Oct; 35(10):592–8.

3.10.4 Lookback

All cases of potential transfusion transmitted infections are investigated by NZBS. Lookback may be donor-triggered or recipient-triggered.

In 2024, seven lookback cases were carried out: six donor-triggered lookbacks and one recipient-triggered lookback.

Donor-triggered lookback

- *A donor, who has previously tested negative for NZBS mandatory infectious marker screening, is repeat reactive on the current donation and confirmed positive for an infection. All previous donations in the preceding 24 months are traced. Clinicians of living recipients are notified and asked to undertake appropriate testing on the recipient. For occult hepatitis B infections (OBI) lookback extends back as far as donor records allow.*
- *A donor or healthcare provider notifies NZBS that a donor has developed signs or symptoms of an infection after a donation indicating that his/her donation may have been infectious.*

In 2024, all six donor-triggered lookbacks were for occult hepatitis B. All cases had living recipients, so lookback was undertaken on all these recipients.

There were a total of 59 living recipients for the six cases. Hepatitis B results are usually obtained by writing to the patient's general practitioner and requesting that the patient be tested. Some results are obtained from medical records. The overall success rate for recipient results received was 67%. There were no confirmed transmissions of hepatitis B found. A summary of the lookbacks is shown in Table 3.10.4-1.

Table 3.10.4-1: Summary of donor-triggered lookback conducted in 2024

Living recipients implicated	59
Recipients not traceable	1
Result obtained before lookback	1
GP letters sent	57
Results received from GPs	16
Results obtained from medical records	22
Total results obtained	38
Proportion of results obtained	67%
Confirmed transmissions	0

Recipient-triggered lookback

NZBS is informed that a recipient of blood components or products has developed a reactive laboratory test result and/or disease symptoms indicating that a blood component or product may have been infectious for HBV, HCV, HIV, HTLV, a bacterial infection or any other infection that may be transmitted through blood transfusion. Archived samples of these donations are re-tested and confirmatory testing is carried out. Implicated donors are traced and asked to provide samples for retesting if they have not donated or have not been retested since their implicated donation.

One recipient triggered lookback was performed in 2024, for hepatitis C. There were four donors implicated with this one case, and all of these donors were negative for hepatitis C.

3.10.5 Bacterial testing of platelet components

NZBS performs pre-release sampling for bacterial culture on all platelet components. This provides NZBS with an indication of bacterial contamination rates in its donations. NZBS samples platelet components on day 2 (at least 36 hours after collection), inoculates 8 mL into each of the aerobic and anaerobic culture bottles and incubates to day 7.

Initial positives are further tested to confirm the result and identify the organism. The following AABB definitions[15] are used for the classification of test results:

Initial positive	• Positive or abnormal (out of range) initial test
True positive	• Positive on both the initial test and a confirmatory test. • Positive on the initial test, the unit was transfused and either of the following occurs: - The remaining available sample of the unit is positive by confirmatory test - The recipient has post-transfusion sepsis verified by positive culture.
False positive	• Positive on the initial test, negative on a confirmatory test. • Positive on the initial test and both of the following occur: - The remaining available sample of the unit is negative by confirmatory test - The recipient has no clinical or microbiological evidence of post-transfusion sepsis.
Indeterminate	• Positive on the initial test and either no confirmatory test was performed or the confirmatory test results could not be interpreted. • Other combinations of component and recipient results in situations where the component has been transfused.

A total of 16,457 platelet pools and apheresis platelet donations were tested in 2024 (Table 3.10.5-1). 39 units were initial positive and, of these, 25 were confirmed as true positive (0.15% of the total number tested).

Table 3.10.5-1: Platelet bacterial culture summary 2024

Result	Number of units*	Percentage of number tested
Number tested	16,457	
Non-reactive	16,418	99.76%
Initial positive	39	0.24%
False positive	3	0.02%
Indeterminate	11	0.07%
True positive	**25**	**0.15%**

[15] AABB (formerly known as the American Association of Blood Banks). Association Bulletin #04-07 - Actions following an initial positive test for possible bacterial contamination of a platelet unit; 2014 [updated Jun 2022; cited 2024 Jul 07]. Available from: https://www.aabb.org/docs/default-source/default-document-library/resources/association-bulletins/ab04-07.pdf

The EDQM Guide indicates that contamination rates in single donor platelets are generally reported to be at or below 0.2% in surveillance studies.[16] NZBS bacterial contamination rates for a mixture of single donor platelets and pooled platelets have remained below 0.2% since 100% testing of platelet units began in 2015 (Figure 3.10.5-1).

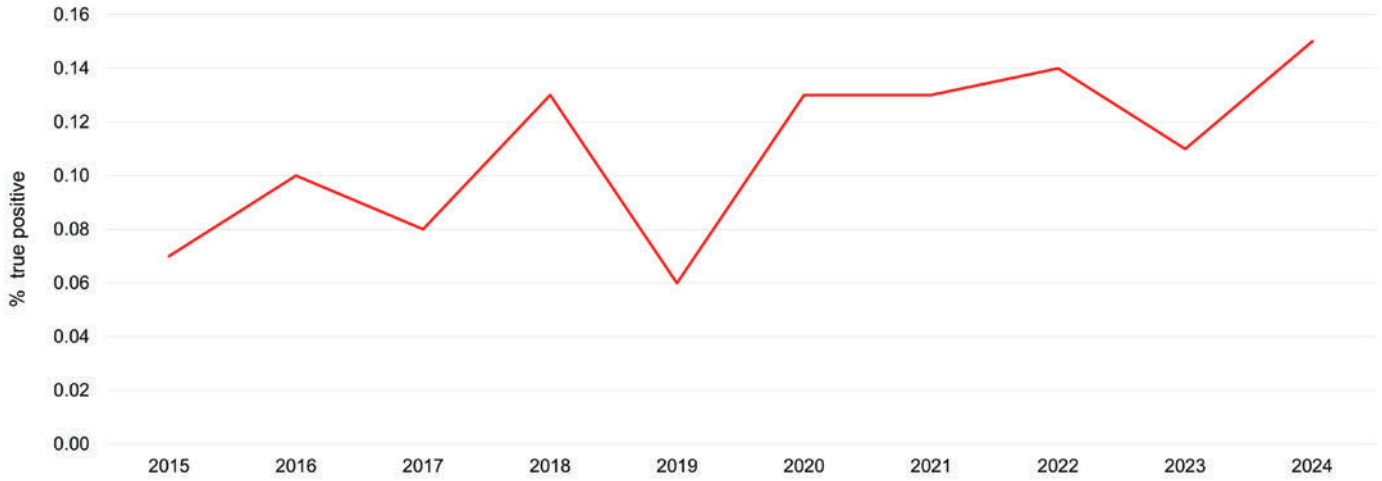


Figure 3.10.5-1: Confirmed positive bacterial culture rates 2015 – 2024

All but one of the true positive units were platelet pools and the apheresis unit was not transfused. Eleven of the true positive units were transfused (Table 3.10.5-2). NZBS medical staff routinely follow up with the clinical teams of the recipients. No sepsis was reported in any of the patients.

Table 3.10.5-2: Bacterial species identified in confirmed positive cases 2024

Species	Number	
	Total	Transfused
Cutibacterium sp	20	10
Streptococcus sp	3	0
Staphylococcus sp	1	0
Multiple species	1	1
Total	**25**	**11**

NZBS takes steps to reduce the risk of bacterial contamination of components. These include a standardised and validated skin disinfection process and diverting the first 30 mL of blood drawn into a sample diversion pouch for filling tubes for testing. However, contamination from skin flora can never be eliminated.

[16] European Directorate for the Quality Medicines & Healthcare of the Council of Europe (EDQM). Guide to the preparation, use and quality assurance of blood components. 21st ed. Strasbourg (France): Council of Europe; 2023.

CHAPTER 04

ERROR REPORTS

04 ERROR REPORTS

This chapter covers a range of errors and near misses relating to blood components, fractionated products and blood samples.

The total number of errors and near misses reported in 2024 was 81, compared with 101 in 2023 (Table 4-1). It is likely that errors and near misses are still widely under-recognised and under-reported. The data in this chapter reflects only what has been reported to NZBS. We continue to stress the importance of reporting and investigating all errors.

More than half of the events relate to wrong blood in tube (WBIT) and most (52/81) occurred in hospitals with NZBS blood banks.

Most errors and near misses reported originated in clinical areas (69/81). The majority of the errors and near misses that occurred in clinical areas were detected and reported by blood banks.

Table 4-1: Error and near miss summary with primary error location 2024*

Error	Clinical error	Blood Bank error	Total
Incorrect blood component transfused (IBCT)	8	4	12
Incorrect fractionated product administered (IFPA)	1	1	2
Anti-D errors and near misses	5	3	8
Storage and handling errors	4	1	5
Avoidable, delayed, under/over-transfusion	3	2	5
Near misses	2	1	3
Wrong Blood in Tube (WBIT)	46	-	46
TOTAL	**69**	**12**	**81**

** Excluding sample and form labelling errors – see section 4.6.*

Further details on the above errors and near misses are provided in the following sections.

4.1 INCORRECT COMPONENT/PRODUCT ADMINISTERED

Transfusion of a blood component or product that was intended for another patient, or one that did not meet the patient's requirements.

4.1.1 Incorrect blood component transfused (IBCT)

During 2024, there were 12 IBCT events reported (12 in 2023). The IBCT events for 2024 are detailed in Table 4.1.1-1.

Table 4.1.1-1: IBCT events 2024

IBCT type	Error description	Error location	Number
WCT Wrong component transfused • *Transfusion to wrong patient;* • *transfusion of wrong component; or* • *transfusion of wrong group.*	**Wrong patient**		
	Blood transfused to wrong patient.	Blood Bank	1
	Wrong component		
	Wrong component transfused.	Clinical	1
SRNM Special requirements not met *Unintentional transfusion of blood that did not meet the specific requirements for the patient.*	Phenotyped blood not transfused when required.	Clinical	1
		Blood Bank	1
	K Pos red cells transfused to a female <55 years and new anti-K subsequently detected. *(See section 4.5 for full details on K Neg policy)*	Blood Bank	2
	Irradiated blood indicated but non-irradiated blood transfused. *(See "Irradiated blood protocols" section below)*	Clinical	6
TOTAL			**12**

No ABO incompatible transfusions were reported in 2024.

Irradiated blood protocols

In last year's Haemovigilance Annual Report we discussed the problem of ensuring that patients receive irradiated blood when their purine analogue medications are dispensed in the community. Community dispensing does not allow the national blood bank computer system, eTraceline, to be updated with the appropriate irradiation protocol for a patient's future transfusions.

Since the last report NZBS has conducted an internal audit. During the audit, the medical records of 1,391 patients who were receiving purine analogues were reviewed, to determine if any patients had inadvertently received non-irradiated blood during and following purine analogue treatment.

During the audit, it was found that 17 patients had received 60 units of non-irradiated RBCs between September 2022 and December 2024.[17] None of the patients developed TA-GVHD.

The Ministry of Health is now providing NZBS with monthly updates on all the patients receiving purine analogues. This information is being used to apply irradiation protocols in eTraceline and ensure relevant patients receive irradiated blood during any future transfusions.

A similar issue was reported by one hospital in 2024, where the haematology computer system was failing to flag some irradiated blood requirements. This resulted in a failure to send the appropriate notification to the Blood Bank to add a protocol to the patient record.

The Haematology Department reported that on discovering this failure, an audit was conducted of 170 patients and 31 did not have irradiation protocols in eTraceline. The Blood Bank promptly added protocols to these patients and to another five patients who Blood Bank was subsequently notified of. The Blood Bank then examined each patient record and found that six patients had received non-irradiated blood. No TA-GVHD was reported in any of these patients.

To address the problem, the Blood Bank has implemented a local process to send a report to the Haematology Unit stating a protocol has been added to the patient record in eTraceline. This is visible to the Haematologist in the hospital computer system when booking the patient for a Hematopoietic Progenitor Cell (HPC) collection and before purine analogue treatment is started. This process helps reduce the risk of patients inadvertently receiving non-irradiated blood. This process may be useful for other Blood Banks to implement in collaboration with their respective hospital Haematology Units.

4.1.2 Incorrect fractionated product administered

In 2024 there were two reports of incorrect fractionated product (other than RhD immunoglobulin) being administered. This was a much lower number of errors than that seen in 2023 (11) and may indicate that blood banks are more accustomed to the new products and have implemented appropriate checks.

One of the errors was related to Privigen® NZ and the other to Hizentra® NZ. In both cases the incorrect product was issued by the Blood Bank, but bedside checking failed to detect the error.

[17] Ng CZ, Mosen L, Corkery C, Smith M, Duarte G. Transfusion-associated graft-versus-host disease and purine analogues: What are we missing? Vox Sang. 2025. doi:10.1111/vox.70047

4.2 ANTI-D ERRORS AND NEAR MISSES

Six errors and two near misses involving RhD immunoglobulin were reported in 2024. Five errors and one near miss were reported in 2023.

Table 4.2-1: Anti-D errors 2024

Error	Number
Anti-D administered to woman with immune anti-D	2
Anti-D administered to the mother of an RhD negative baby	2
Anti-D not administered when indicated	1
Anti-D administered to the wrong patient	1
Near miss	2
TOTAL	**8**

Instances of Anti-D not being administered when indicated are likely under-reported. Nevertheless, a study published by Badami, KG et al discusses the decline in red cell alloimmunisation prevalence in Canterbury, New Zealand, since 2006.[18] The paper concluded that this is likely due to changes in transfusion management, population mix (an increase in ethnicities that are predominantly RhD positive) and declining fertility.

In light of the Anti-D errors, NZBS has requested MAK-SYSTEM, the eTraceline vendor, to introduce a check to prevent Anti-D being issued to RhD positive women. NZBS has been advised this change will be included in the next patch release due August 2025.

[18] Badami KG, Hull S, Vanhecke C. Effects of change in transfusion practice, population mix and fertility on red blood cell alloantibody prevalence. Vox Sang. 2025;120(6):615-624. doi: 10.1111/vox.70022. Epub 2025 Mar 27. PMID: 40147875.

4.3 OTHER ERRORS

4.3.1 Storage and handling errors

Administration of the correct blood component or product to the intended patient, where handling or storage errors may have affected component or product safety.

Storage and handling errors include administration of expired components or products and errors in the administration process. Five errors were reported in 2024 (Table 4.3.1-1). Four were reported in 2023.

Table 4.3.1-1: Storage and handling errors 2024

Error	Location	Number
No blood filter used with giving set	Clinical	1
Red cells stored at room temperature transfused	Blood Bank	1
Red cell unit transfused at wrong rate	Clinical	1
Privigen® NZ infusion rate error	Clinical	2
TOTAL		**5**

4.3.2 Avoidable, delayed and under/over-transfusion

Avoidable transfusions: Where administration of a suitable blood component or product is intended, but the decision leading to the administration is flawed.

Avoidable delays: Where an avoidable delay in provision of blood components or products affected patient care.

Under/over-transfusion: A dose inappropriate for the patient's needs, excluding those cases which result in TACO.

A total of five events were reported in these three categories in 2024 (Table 4.3.2-1). Four events were reported in 2023.

Table 4.3.2-1: Avoidable, delayed and under/over-transfusions 2024

Error		Location	Number
Avoidable transfusion	Inappropriate transfusion in non-anaemic patient.	Clinical	1
Delayed transfusion	Delay in providing blood to theatre for actively bleeding patient.	Blood Bank	1
	Delayed administration of HyperHEP B® to a child of a Hepatitis B positive mother.	Blood Bank	1
Over-transfusion	Double dose of Hepatitis B immunoglobulin given to a baby.	Blood Bank	1
Under-transfusion	Insufficient Prothrombinex® requested for patient.	Clinical	1
TOTAL			**5**

4.4 NEAR MISS EVENTS

A deviation from standard procedures or policies that is discovered before administration commences and that could have led to a wrong transfusion or a reaction in a recipient if administration had occurred.

During 2024, there were three near miss events reported (ten in 2023). These events are summarised in Table 4.4-1. Near misses related to wrong blood in tube are addressed separately in section 4.4.1.

Table 4.4-1: Near miss events by error type and location 2024

Process step	Near Miss Description	Location	Number
Issuing	Wrong patient. Blood Bank issued red cells to a patient that was for a different patient with the same surname. Bedside checks detected the error before the blood was given.	Blood Bank	1
Requesting	Wrong patient. RiaSTAP® was requested for the wrong patient because the incorrect patient label was applied to the request form.	Clinical	1
Requesting	Wrong patient. Albumex® 4 was requested for the incorrect patient. Error detected before infusion.	Clinical	1

4.4.1 Wrong Blood in Tube (WBIT) Events.

- *Blood is taken from the wrong patient and is labelled with the intended patient's details (miscollected).*
- *Blood is taken from the intended patient but labelled with another patient's details (mislabelled).*

During 2024, 46 WBIT events were reported (54 in 2023). Figure 4.4.1-1 shows an overview of the 46 WBITs classified four different ways: category of reporting blood bank, current/historical, sample type and detection method.

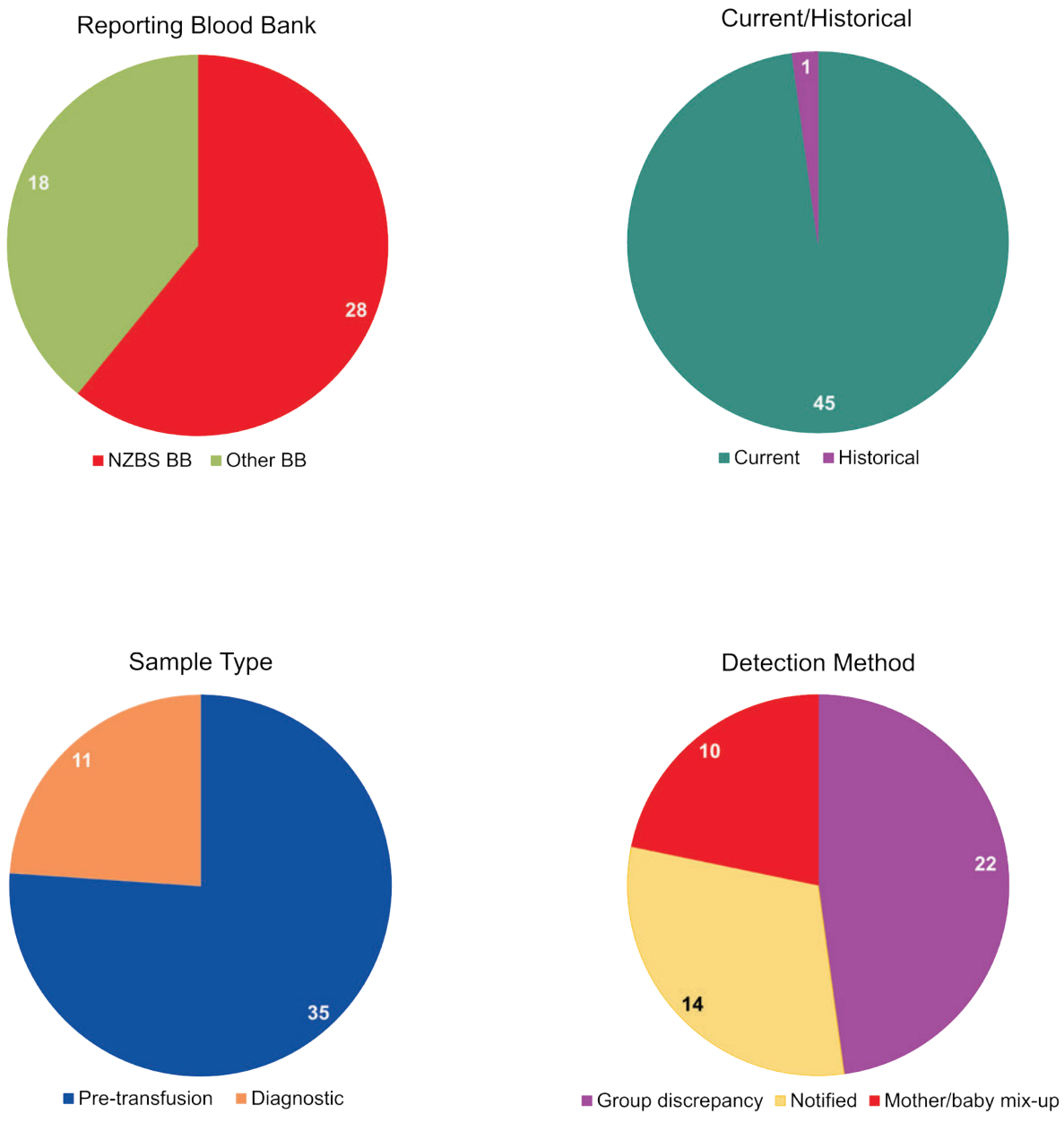


Figure 4.4.1-1: WBIT overview 2024

Most WBITs are reported by NZBS blood banks. Prior to 2020 very few WBITs were reported by other blood banks. Since 2020, other blood banks have been encouraged to report WBITs, and in 2023 NZBS issued a specific WBIT form to encourage better reporting from these blood banks. Since 2020 we have seen a steady increase in the number of WBITs reported by non-NZBS blood banks – see Figure 4.4.1-2. In 2024, the 18 WBITs from other blood banks were reported by North Shore, Middlemore, Rotorua, Taranaki, Hutt and Wairau Hospitals. We continue to encourage all blood banks to report WBITs to NZBS.

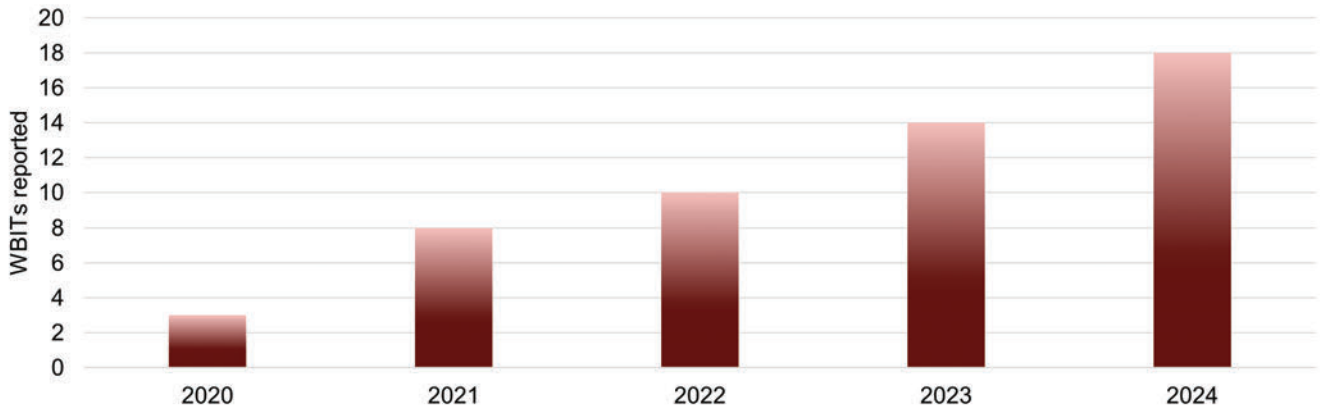


Figure 4.4.1-2: WBITs reported by non-NZBS blood banks 2020 – 2024

Table 4.4.1-1 provides a closer look at which blood banks are reporting WBITs and a breakdown by detection method.

Table 4.4.1-1: WBITs by reporting blood bank and detection method 2024

Reporting Site	Group discrepancy	Notified by ward	Mother/baby mix-ups *	TOTAL
Auckland	7	4	-	11
Waikato	1	-	1	2
Palmerston North	1	-	-	1
Wellington	-	3	2	5
Christchurch	2	3	1	6
Dunedin	4	-	-	4
North Shore	4	-	-	4
Middlemore	1	1	5	7
Rotorua	1	-	-	1
Taranaki	-	1	-	1
Hutt	-	2	1	3
Wairau	1	-	-	1
TOTAL	**22**	**14**	**10**	**46**

* These were previously reported as cord blood errors (usually cord blood labelled with maternal details). This category has been renamed to reflect that it includes any WBIT where there is a mix-up between mother and baby identification.

Figure 4.4.1-3 shows that over the last ten years the annual number of current WBITs detected by group discrepancy has minimally changed. However, 2024 saw the highest number of mother and baby mix-ups since these errors began being reported in 2020. Half of these errors occurred at Middlemore Hospital. Of the ten mother/baby mix-ups, eight were cord blood samples labelled with maternal details and two were maternal samples labelled with baby's details.

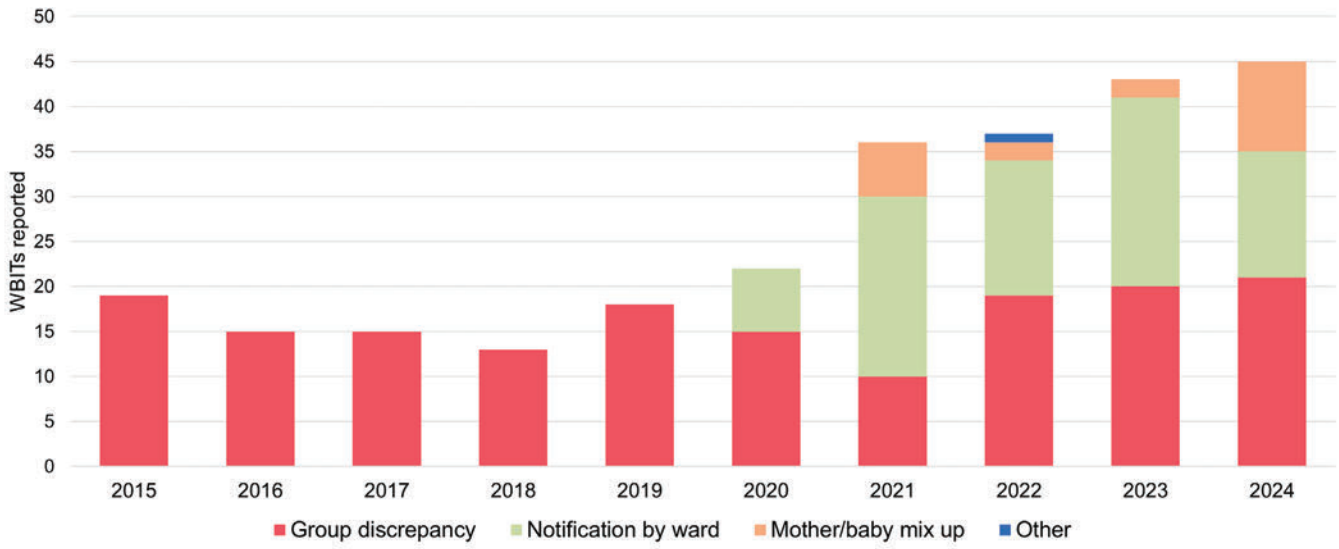


Figure 4.4.1-3: Current WBITs by detection method 2015 – 2024

Errors at sample collection

In 2024 information on the role of the sample collector was received for 44 out of 45 current WBITs, see Table 4.4.1-2. Historical WBITs are omitted as it is not always possible to identify the collector.

Table 4.4.1-2: Current WBITs by hospital and role of sample collector 2024

Site	Nurse	Midwife	Doctor	Phlebotomist	Other	Unkown
Auckland	5	2	1	2	1	-
Waikato	-	1	-	1	-	-
Palmerston North	-	-	-	1	-	-
Wellington	1	2	-	-	2	-
Christchurch	1	1	-	2	1	1
Dunedin	-	1	1	1	1	-
North Shore	2	1	-	-	-	-
Middlemore	-	6	-	1	-	-
Rotorua	-	1	-	-	-	-
Taranaki	1	-	-	-	-	-
Hutt	1	2	-	-	-	-
Wairau	-	-	-	1	-	-
TOTAL	**11**	**17**	**2**	**9**	**5**	**1**

Midwives collected 17 of the WBITs in 2024. This is the highest number since this data was first reported in 2021 and is also reflected in the high number of mother/baby mix-ups shown in Figure 4.4.1-3. These findings are consistent with findings in the UK 2023 Annual SHOT Report where midwives collected 282/986 WBIT samples and 52/986 WBITs were due to mother/cord blood mix-ups.[19]

Where possible, Transfusion Nurse Specialists or blood banks attempt to interview sample collectors and obtain information about the errors made during the identification and sample labelling process. This useful information was obtained on 20 samples in 2024 and Table 4.4.1-3 shows some of the typical errors made during the sample collection process. The number of WBITs involving patients not wearing wrist bands highlights the importance of having robust identification processes in such situations, particularly when the patient has dementia.

Table 4.4.1-3: Common sample collection errors 2024

Type of collection error	Number
Sample not labelled at bedside	8
Tube label not checked against wrist band	14
Patient wearing a wrist band	8
Patient not wearing a wrist band	6
Locations of patients without wrist bands:	
• Antenatal	2
• Maternity	1
• Rest home (patient with dementia)	2
• Home visit	1

NHI linking errors

Linking patients to the incorrect NHI number continues to be a serious problem that can lead to a WBIT sample being collected. There were nine WBITs caused by NHI linking errors in 2024.

One linking error involved two women with the surname *Kaur*, the same first name and a similar date of birth. This is the third year in a row that we have reported an NHI linking error involving the surname *Kaur.* This is possibly a reflection of the growing Sikh community in New Zealand. In 2024, the most frequently registered surname for babies in New Zealand was *Singh* (680 babies), closely followed by *Kaur* (630 babies). The name *Smith* followed third with just 300 registrations.[20] We continue to urge hospitals to have robust procedures for linking patients to the correct NHI at admission.

Other causes of linking errors seen in 2024 include a twin mix-up, misidentification of unconscious trauma patients and a patient intentionally admitting themselves under another person's identity.

[19] Narayan, S. et al., 2024. The 2023 Annual SHOT Report, Manchester: Serious Hazards of Transfusion (SHOT) Steering Group.
[20] Van Velden, B. Releases: Most common registered family names in 2024 [Internet]. Wellington (NZ): New Zealand Government; 2025 [cited 2025 Jul 07]. Available from: https://www.beehive.govt.nz/release/most-common-registered-family-names-2024

Analysis of current WBIT data

The following tables show frequencies of current WBITs. Those current WBITs not detected by group discrepancy are shown in Table 4.4.1-4. This includes mother/baby mix-ups and those reported by the ward/collector.

Table 4.4.1-4: Frequency of current WBITs not detected by group discrepancy 2024

Site	WBITs	Samples tested	WBIT frequency	WBIT rate per 10,000 samples (95% CI)
Auckland	4	66,830	1:16,708	0.6 (0.2 to 1.6)
Waikato	1	28,966	1:28,966	0.3 (0 to 2.2)
Palmerston North	-	12,507	-	-
Wellington	5	33,978	1:6,796	1.5 (0.5 to 3.6)
Christchurch	4	36,103	1:9,026	1.1 (0.3 to 3.0)
Dunedin	-	12,454	-	-
Middlemore	6	38,857	1:6,476	1.5 (0.6 to 3.5)
Taranaki	1	12,419	1:12,419	0.8 (0 to 5.0)
Hutt Valley	3	8,029	1:2,676	3.7 (0.7 to 11.5)

Table 4.4.1-5 shows WBITs detected by blood group discrepancy. For these, corrected frequencies and rates are calculated. The corrected values use a correction factor based on New Zealand blood group frequencies to account for the proportion of samples for which there is no historical blood group on record and the chance that two patients have the same blood group.

Table 4.4.1-5: Frequency of current WBITs detected by group discrepancy 2024

Site	Detected WBITs	Historical groups	WBIT frequency*	WBIT rate per 10,000 samples* (95% CI)
Auckland	7	48,712	1:4,918	2.0 (1.0 to 3.8)
Waikato	1	20,039	1:14,162	0.7 (0 to 3.5)
Palmerston North	1	9,331	1:6,594	1.5 (0 to 7.4)
Wellington	-	24,500	-	-
Christchurch	2	23,827	1:8,419	1.2 (0.2 to 3.8)
Dunedin	4	8,994	1:1,589	6.3 (2.4 to 14.4)
North Shore	4	20,554	1:3,631	2.8 (1.1 to 6.3)
Middlemore	1	28,995	1:20,491	0.5 (0 to 2.4)
Rotorua	1	3,892	1:2,751	3.6 (0 to 17.7)
Wairau	1	1,536	1:1,086	9.2 (0 to 44.9)

** Corrected to account for silent WBITs (correction factor = 1.415).*

The corrected frequencies can be used to calculate the predicted number of 'silent WBITs', i.e. those not detected because the blood groups of the two patients were the same or there was no blood group history on record. The numbers of detected current WBITs and predicted silent WBITs over the last ten years, at NZBS sites only, are shown in Figure 4.4.1-4. The relative proportion of silent WBITs has decreased since 2020 because of the inclusion of other detection methods. Nevertheless, silent WBITs remain a significant concern because they may lead to fatal transfusion reactions.

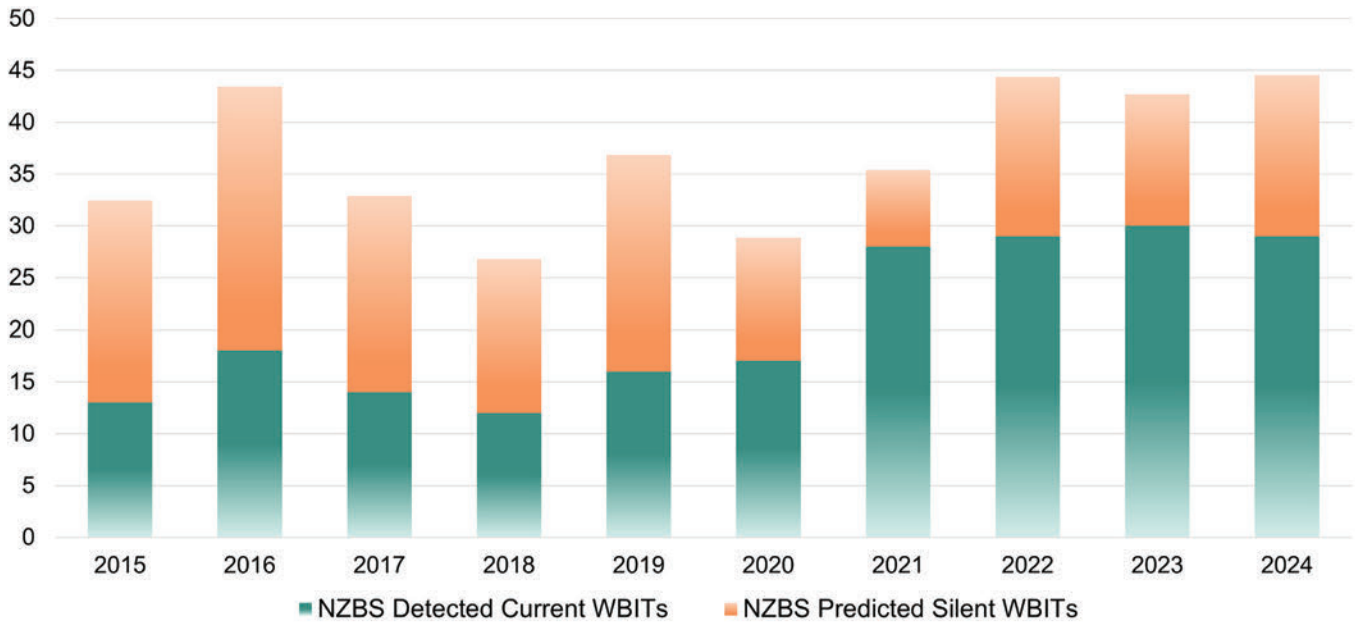


Figure 4.4.1-4: Numbers of detected current WBITs and predicted silent WBITs at NZBS sites 2015 – 2024*
** Non-blood group discrepant WBITs have only been reported since 2020*

4.5 K NEGATIVE POLICY

In 2021 NZBS introduced a policy to transfuse females of child-bearing age, defined as females under 55 years of age, with K negative red cell components.

In 2024, NZBS reviewed its definition of 'child-bearing age' against international practice. As a result, the upper age limit for females of child-bearing age was changed to 50 years. The change was effective from 18 December 2024.

The soft protocol in eTraceline was amended to read "*F <50yrs: K- red cells required unless patient K+*". This protocol is automatically added to the eTraceline patient file of every female under the age of 50 years and removed when the woman turns 50. The protocol has no consequences but will display at the point of issue to prompt the issuer to select K negative units if relevant.

Since the policy was introduced, the national compliance rate has been 97% or higher. It is pleasing to see the compliance of some individual blood banks has improved, leading to further small improvements in the national average compliance rate since 2022, as shown in Table 4.5-1 below. 2025 will see the first full year of data for women under 50 years of age.

Table 4.5-1: K negative policy compliance 2022 – 2024

Year	National average compliance rate	Number of blood banks <95% compliant	Lowest compliance rate
2022	97.0%	5	78%
2023	98.4%	5	89%
2024	98.9%	1	94%

During 2024, there were two reported events where a K Negative woman <55 years of age was transfused with K positive red cells and subsequently developed an anti-K antibody (see IBCT section 4.1.1).

Table 4.5-2 shows percentage compliance for each blood bank for 2024.

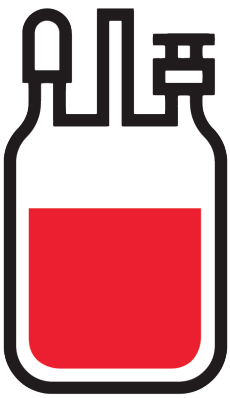


Table 4.5-2: Compliance with K negative policy by blood bank 2024

Blood Bank	Red cell units issued to females <55 years	Number of compliant red cell units	% Compliant
Auckland	4,543	4,505	99.2%
Christchurch	2,156	2,131	98.8%
Dargaville	3	3	100%
Dunedin	529	518	97.9%
Dunstan	13	13	100%
Gisborne	194	193	99.5%
Greymouth	59	59	100%
Hastings	473	465	98.3%
Hutt Valley	431	420	97.4%
Kaitaia	43	43	100%
Kawakawa	34	34	100%
Masterton	68	68	100%
Middlemore	2,799	2,774	99.1%
Nelson	155	152	98.1%
North Shore	981	974	99.3%
Oamaru	3	3	100%
Palmerston North	676	667	98.7%
Rotorua	344	339	98.5%
Southland	235	235	100%
Taranaki	221	220	99.5%
Taumarunui	4	4	100%
Taupo	54	54	100%
Tauranga	527	515	97.7%
Thames	37	37	100%
Timaru	100	94	94.0%
Tokoroa	3	3	100%
Waikato	1,701	1,695	99.6%
Wairau	184	177	96.2%
Waitakere	325	322	99.1%
Whanganui	202	200	99.0%
Wellington	1,818	1,794	98.7%
Whakatane	142	141	99.3%
Whangarei	429	426	99.3%
NATIONAL	**19,486**	**19,278**	**98.9%**

4.6 REQUEST FORM AND SAMPLE LABELLING ERRORS

In November 2022 NZBS introduced a new policy called Positive Patient Identification (PPID). This policy introduced tighter acceptance criteria for sample labelling; NZBS no longer allows for corrections to be made to non-compliant samples, except under extenuating circumstances authorised by a NZBS Transfusion Medicine Specialist.

While it was acknowledged that the new policy would lead to higher sample rejection rates, the intention of the policy was to reduce risk associated with improperly labelled samples.

The total number of samples registered in New Zealand in 2024 was 364,993. There were sample and/or request form labelling errors associated with 19,898 samples, i.e. a national rate of 54.5 errors per 1,000 samples.

Figure 4.6-1 shows how the error rate has increased since the introduction of PPID.

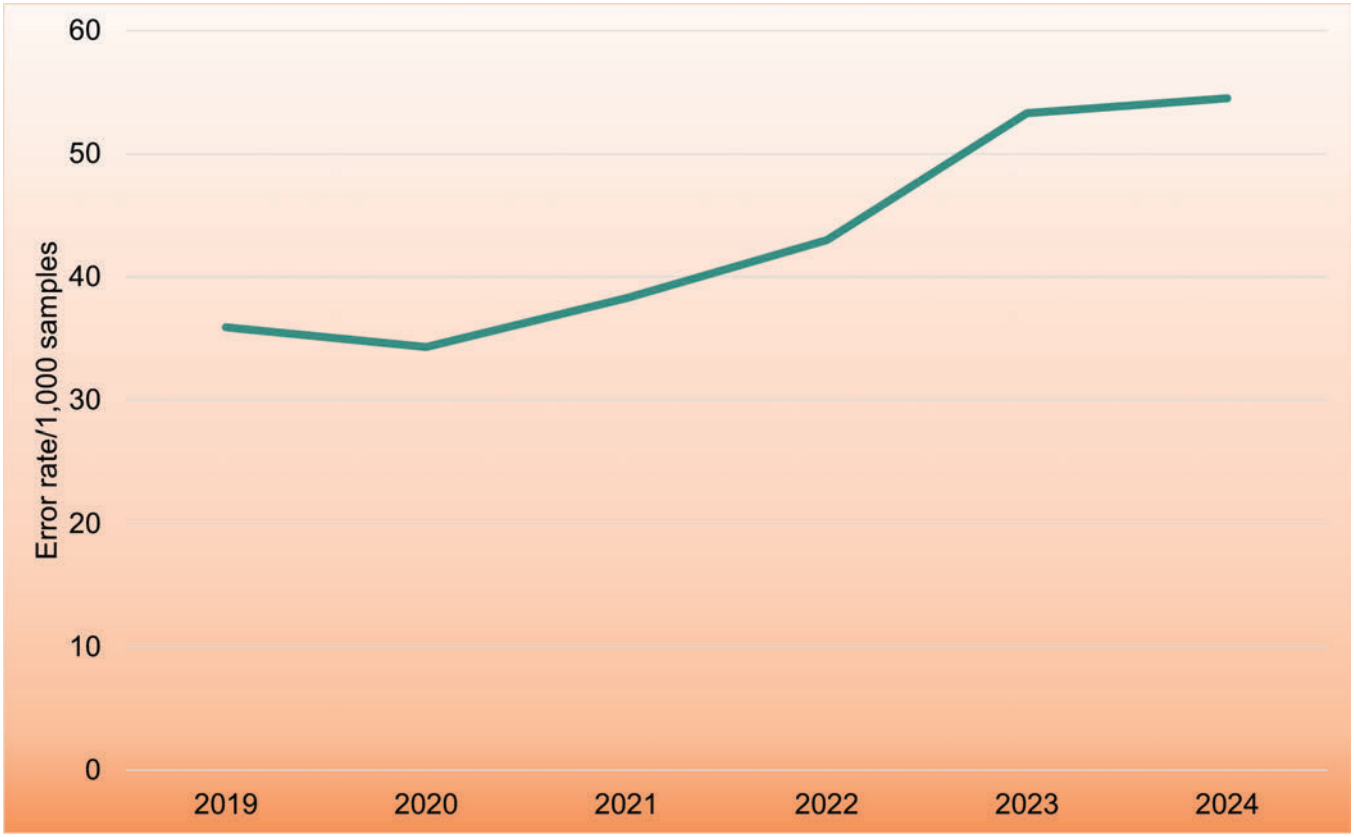


Figure 4.6-1: National request form and sample labelling error rate 2019 – 2024
(PPID introduced Nov 2022)

In September 2023, changes were made to the way status comments were recorded in eTraceline. Status comments describe the type of error on the sample and/or form label. Some status comments were retired and new comments were added.

Figure 4.6-2 shows sample and request form labelling error rates for new and existing status comments in 2024. Rates of the retired status comments are no longer reported.

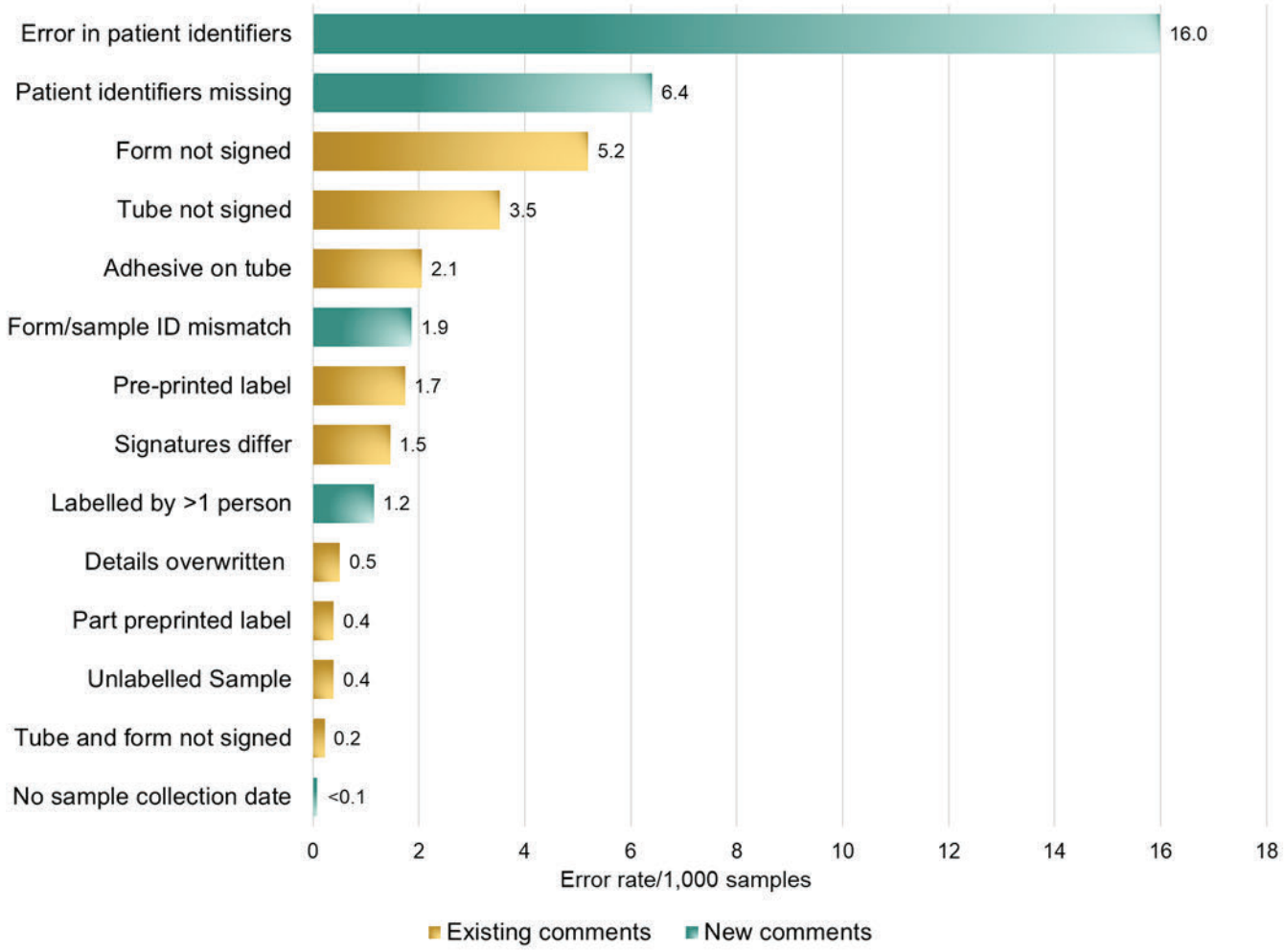


Figure 4.6-2: Request form and sample labelling error rate by eTraceline sample status 2024

Table 4.6-1 shows error rates by blood bank. The blood banks have been divided into three arbitrary groups, based on numbers of samples registered, and sorted by error rate within each group. It should be noted that labelling errors occur at the collection point and each blood bank may receive samples from more than one facility.

Table 4.6-1: Request form and sample labelling errors by blood bank 2024

Size	Blood Bank	Errors	Total samples	Error frequency	Error rate/1,000 samples (95% CI)
Large (>10,000 samples)	Taranaki	382	12,419	1:33	30.8 (27.9 to 33.9)
	NorthShore	1,071	29,405	1:27	36.4 (34.3 to 38.6)
	Hawkes Bay	697	16,727	1:24	41.7 (38.7 to 44.8)
	Wellington	1,567	33,978	1:22	46.1 (43.9 to 48.4)
	Whangarei	467	10,379	1:22	45.0 (41.2 to 49.2)
	Auckland	3,636	66,830	1:18	54.4 (52.7 to 56.2)
	Middlemore	2,128	38,857	1:18	54.8 (52.5 to 57.1)
	Tauranga	724	12,325	1:17	58.7 (54.7 to 63.0)
	Waikato	1,948	28,966	1:15	67.3 (64.4 to 70.2)
	Palmerston North	814	12,507	1:15	65.1 (60.9 to 69.5)
	Dunedin	904	12,454	1:14	72.6 (68.2 to 77.3)
	Christchurch	2,917	36,103	1:12	80.8 (78.0 to 83.7)
Medium (2,000-10,000 samples)	Auckland Ref Lab	25	2,409	1:96	10.4 (7.0 to 15.3)
	Gisborne	58	4,351	1:75	13.3 (10.3 to 17.2)
	Wairau	71	2,138	1:30	33.2 (26.4 to 41.7)
	Timaru	83	2,213	1:27	37.5 (30.3 to 46.3)
	Waitakere	309	7,206	1:23	42.9 (38.4 to 47.8)
	Nelson	272	4,983	1:18	54.6 (48.6 to 61.3)
	Masterton	153	2,794	1:18	54.8 (46.9 to 63.8)
	Hutt Valley	462	8,029	1:17	57.5 (52.7 to 62.9)
	Southland	358	5,580	1:16	64.2 (58.0 to 70.9)
	Rotorua	340	5,315	1:16	64.0 (57.7 to 70.9)
	Whanganui	174	2,643	1:15	65.8 (57.0 to 76.0)
	Whakatane	168	2,398	1:14	70.1 (60.5 to 81.0)
Small (<2,000 samples)	Kawakawa	13	492	1:38	26.4 (15.1 to 45.1)
	Kaitaia	11	304	1:28	36.2 (19.6 to 64.4)
	Greymouth	59	1,531	1:26	38.5 (29.9 to 49.5)
	Taupo	21	506	1:24	41.5 (27.0 to 62.9)
	Dunstan	14	284	1:20	49.3 (28.9 to 81.7)
	Thames	43	735	1:17	58.5 (43.6 to 78.0)
	Oamaru	9	65	1:7	138.5 (72.3 to 244.9)
	Tokoroa	0	37	-	-
	Taumarunui	0	16	-	-
	Te Kuiti	0	14	-	-
	NATIONAL	**19,898**	**364,993**	**1:18**	**54.5 (53.8 to 55.3)**

CHAPTER 05

PHARMACOVIGILANCE

05 PHARMACOVIGILANCE

New Zealand is not self-sufficient in producing fractionated plasma products; the demand for fractionated products exceeds New Zealand's plasma supply. Thus, NZBS is increasingly relying on commercial immunoglobulin products which are sourced from international plasma. From January to December 2024, NZBS has seen the percentage of immunoglobulins produced from international plasma increase from 17.8% to 22.9%. In contrast, the percentage of immunoglobulins produced from New Zealand plasma has reduced from 82.2% to 77.1% during 2024.

There are certain plasma products which are made solely from New Zealand plasma, while others are produced from international plasma. The following plasma products are made exclusively from New Zealand plasma donations: Privigen® NZ, Hizentra® NZ, Alburex® 5 NZ, Alburex® 20 NZ, Beriplex® NZ, Biostate, Normal immunoglobulin – VF, Hepatitis B immunoglobulin, Tetanus immunoglobulin, and Zoster immunoglobulin.

During 2024 NZBS continued the introduction of new domestic plasma products across New Zealand. This change was necessary as the NZBS plasma product manufacturer, CSL Behring, changed its manufacturing process.

Five products are currently being phased out (from mid-2023 to the end of 2025), and they are being replaced by five new products. Table 5-1 summarises this product migration.

Table 5-1: Migration of fractionated plasma products

Previously available products	Newly available products
Intragam® P (6% intravenous immunoglobulin)	Privigen® NZ (10% intravenous immunoglobulin)
Evogam® (16% subcutaneous immunoglobulin)	Hizentra® NZ (20% subcutaneous immunoglobulin)
Albumex® 4 (4% albumin)	Alburex® 5 NZ (5% albumin)
Albumex® 20 (20% albumin)	Alburex® 20 NZ (20% albumin)
Prothrombinex® VF (prothrombin complex concentrate containing clotting factors II, IX and X)	Beriplex® NZ (prothrombin complex containing clotting factors II, VII, IX and X)

5.1 IMMUNOGLOBULINS

The first of the new CSL Behring products to be introduced to New Zealand were the immunoglobulins: Privigen® NZ and Hizentra® NZ. The Grifols product, Gamunex® 10% (intravenous immunoglobulin) was introduced at the same time for those patients who could not tolerate Privigen® NZ or had previously had a documented adverse reaction to Privigen®.

Figure 5.1-1 shows how the proportions of immunoglobulins issued have changed since 2023 with introduction of the new products.

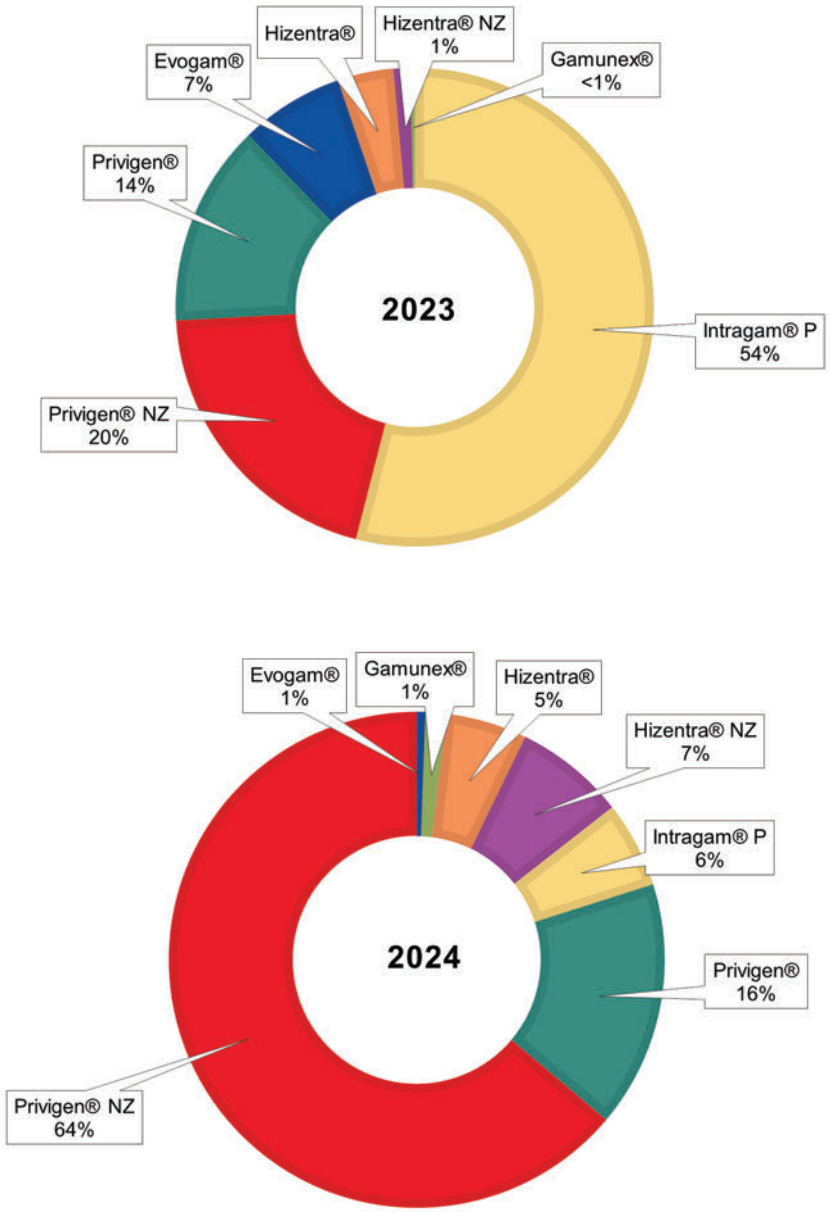


Figure 5.1-1: Immunoglobulin products as a percentage of all immunoglobulin issued in years 2023 and 2024

In 2024, immunoglobulins were prescribed and issued for more than 50 medical conditions. The ten conditions for which they were most frequently prescribed are shown in Fig 5.1-2. This pattern is similar to that seen in 2022 and 2023. During the process of migrating patients to the new immunoglobulin products, Privigen® was used in patients with acute short-term conditions, and therefore in an increased proportion of patients with acute inflammatory conditions, for example Kawasaki disease, Guillain-Barré syndrome or immune thrombocytopenic purpura.

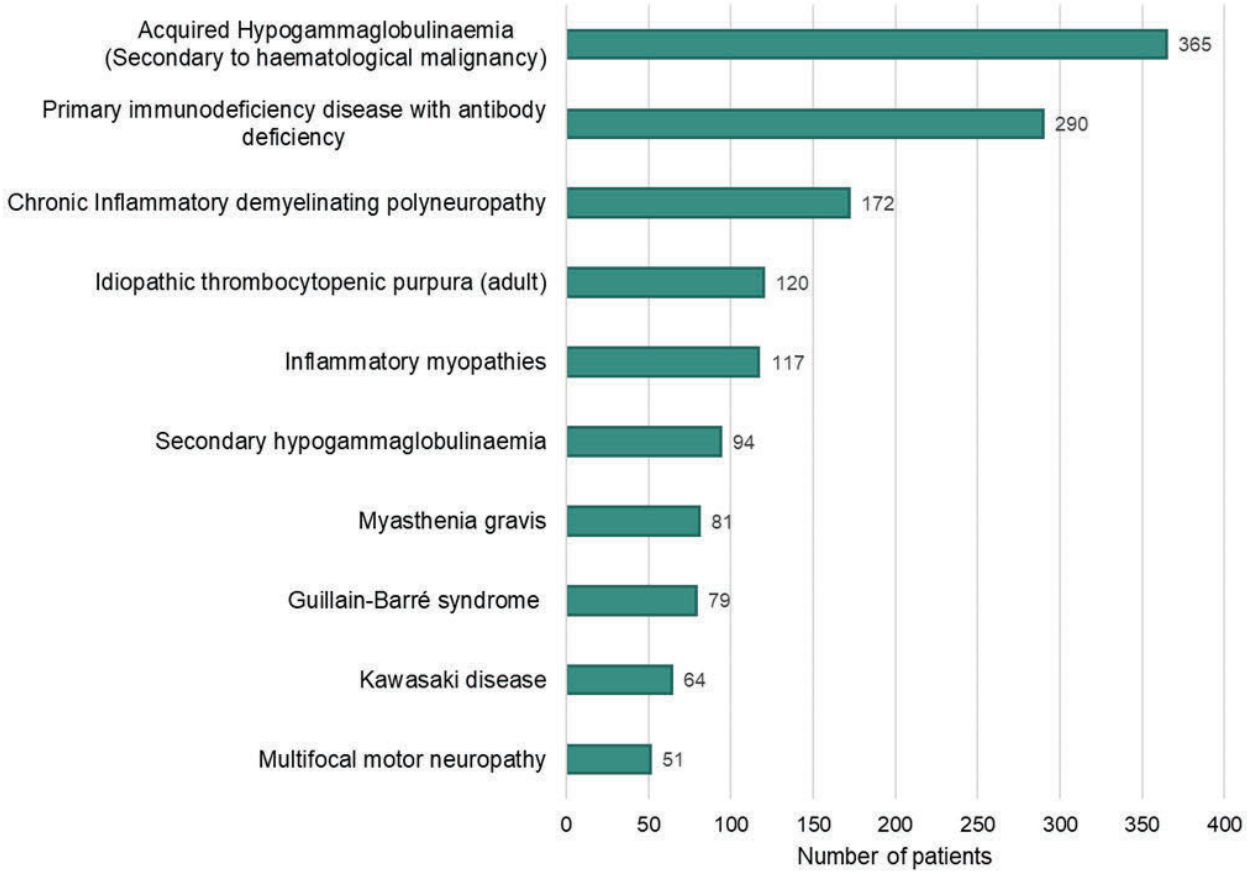


Figure 5.1-2: Ten conditions for which immunoglobulin was most commonly prescribed in 2024

5.2 ADVERSE EVENTS

During 2024, the NZBS Pharmacovigilance Programme saw an increase in numbers of immunoglobulin adverse event reports compared with 2022 and 2023. Table 5.2-1 summarises the numbers and types of adverse event reports for last three years.

Table 5.2-1: Adverse event report summary: 2022 to 2024

	2022	2023	2024
Total adverse event reports received	58	106	116
1. Total adverse reaction reports	49	89	99
• Reactions to immunoglobulin	48	79	94
• Reactions to other products	1	10	5
2. Total error and near miss reports*	9	17	17
• Immunoglobulin	0	8	4
• Anti-D	9	6	8
• Albumex®	0	3	1
• Prothrombinex®	0	0	1
• HyperHEP B®	0	0	2
• RiaSTAP®	0	0	1

**Errors and near misses are discussed further in Chapter 4 of this report.*

As per Table 5.2-1, in 2022 (preceding the introduction of new immunoglobulin products) NZBS received a total of 58 adverse event reports for fractionated products: 49 adverse reaction reports and nine error and near miss reports.

In 2024, during the transition to the new immunoglobulin products, a total of 116 adverse event reports were received: 99 adverse reaction reports and 17 error and near miss reports. Like previous years, most reactions were to immunoglobulin products (n=94, 95%).

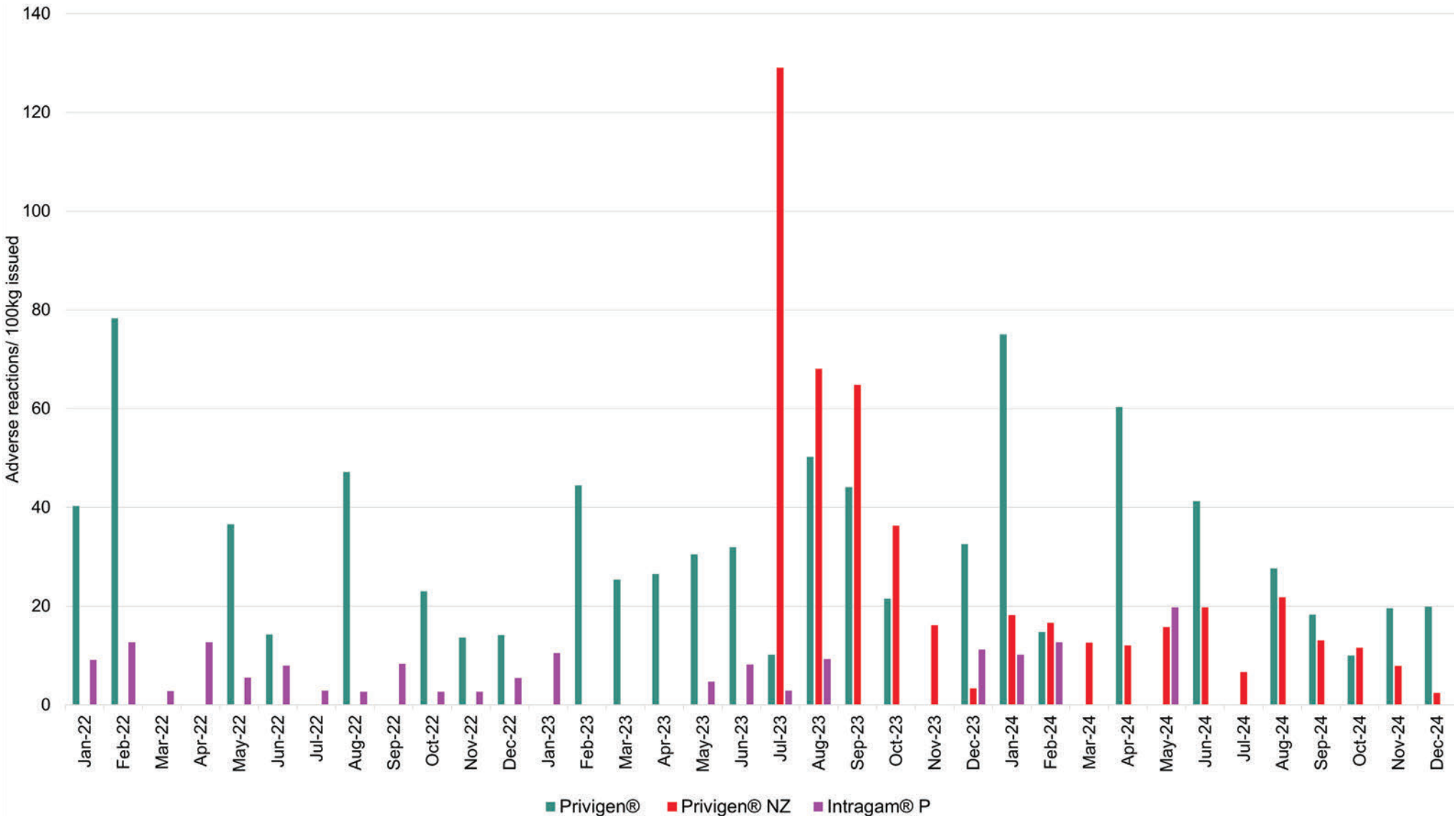


Figure 5.2-1: Adverse reaction rates per 100kg issued, for Privigen®, Privigen® NZ and Intragam® P from 2022 to 2024

Figure 5.2-1 shows the difference in adverse reaction rates for the three intravenous immunoglobulin products issued by NZBS from 2022 to 2024. Note that data for Privigen® NZ is only available from July 2023, as this is when Privigen® NZ was introduced. As seen in Figure 5.2-1, during the introduction of Privigen® NZ, there were higher adverse reaction reporting rates identified compared with those seen for Privigen® and Intragam® P, intravenous immunoglobulins already in use within New Zealand at the time. From mid-2023 to the end of 2024, NZBS has seen these adverse reaction reporting rates for Privigen® NZ reduce. The reason for the initial higher adverse reaction reporting rates during the early period is not yet clear. Prior to introducing Privigen® NZ, communication was provided by NZBS to healthcare professionals and patient advocacy groups encouraging them to report all adverse events. This may have led to heightened awareness about adverse event reporting and may have contributed, at least in part, to the increased number of adverse reactions reported. There may have also been under-reporting for immunoglobulin products already in use. In addition, the change in manufacturing process may have played a role in the change in adverse reaction rates. Additionally, adverse reactions may be more frequent in patients receiving immunoglobulins for the first time[21,22] and when changing intravenous immunoglobulin preparations.[23,24]

Also of note, there were five episodes of aseptic meningitis reported amongst immunoglobulin users during 2024. The Privigen® and Privigen® NZ Medsafe datasheets were updated in October 2024 to include a warning related to aseptic meningitis.[21, 22]

Adverse reaction reports associated with nine fractionated plasma products were received during 2024 (Table 5.2-2).

Table 5.2-2: Adverse reaction reports received by product 2024

Product	Total amount of product issued	Adverse reactions reported
Intragam® P	40 kg	3
Privigen®	113 kg	25
Privigen® NZ	448 kg	58
Gamunex®	9.5 kg	1
Hizentra®	37 kg	3
Hizentra® NZ	51 kg	4
Albumex® 4	7,135 L	3
Albumex® 20	1,026 L	1
Prothrombinex®-VF	3.7 x 10^6 IU	1
TOTAL		**99**

[21] Privigen®: New Zealand Data Sheet [Internet]. Wellington, NZ: Medsafe; 2011 May 12 [updated 2024 October 31; cited 2025 May 26]. Available from: https://www.medsafe.govt.nz/profs/datasheet/p/privigeninj.pdf

[22] Privigen® NZ: New Zealand Data Sheet [Internet]. Wellington, NZ: Medsafe; 2023 March 9 [updated 2024 October 31; cited 2025 May 26]. Available from: https://www.medsafe.govt.nz/profs/datasheet/p/privigeninf.pdf

[23] Ameratunga R, Sinclair J, Kolbe J. Increased risk of adverse events when changing intravenous immunoglobulin preparations. Clinical & Experimental Immunology. 2004 Apr;136(1):111-3.

[24] Côté J, Chaloult-Lavoie M, Poulin É, Hayes LA, Singbo MN, Ouellet P, Pelland-Marcotte MC. Incidence of adverse events related to intravenous immunoglobulin therapy in children. Transfusion. 2025 Jan;65(1):88-99.

Table 5.2-3 shows that most reactions were allergic and febrile events associated with immunoglobulin therapy. Of the eight pain reactions reported, five were associated with Privigen® NZ – four of these five reactions involved back pain.

Table 5.2-3: Adverse reaction types by product 2024 (all causalities)

Product	Allergic	Febrile	Pain	Haedache	Aseptic meningitis	Hypertension	Hypotension	Thromboembolic	Haemolytic	Volume overload	Other*
Intragam® P	1	1	-	-	-	-	-	-	-	-	1
Privigen®	6	7	2	1	3	-	2	1	-	1	2
Privigen® NZ	20	20	5	1	-	1	1	1	1	-	6
Hizentra®	1	-	-	-	1	-	-	1	-	-	-
Hizentra® NZ	-	-	-	-	1	-	-	-	-	-	3
Albumex® 4	1	1	1	-	-	-	-	-	-	-	-
Albumex® 20	-	-	-	-	-	-	1	-	-	-	-
Prothrombinex®-VF	1	-	-	-	-	-	-	-	-	-	-
Total	**30**	**29**	**8**	**2**	**5**	**1**	**4**	**3**	**1**	**1**	**12**

Note: There may be more than one reaction type per report

** For example: Shortness of breath, dizziness, chest tightness and pain, loss of balance, haematuria, elevated liver enzymes, extravasation*

CASE STUDY

Retinal vein occlusion

Dr Krishna Badami, Transfusion Medicine Specialist

A 72-year-old female had been on long-term replacement treatment with various immunoglobulin preparations, for secondary hypogammaglobulinaemia, with multiple episodes of bronchiectasis. She also had type 1 diabetes mellitus and was on an insulin pump (satisfactory glycaemic control although previously sub-optimal), and on regular retinal screening which had shown mild non-proliferative diabetic retinopathy. These were her chief problems and the ones most relevant to the adverse event she had with the immunoglobulin treatment.

In addition, she also suffered from a wide array of medical and related problems including xerostomia, chronic rhinosinusitis, gastroesophageal reflux, breast cancer at age 37 years requiring bilateral mastectomy and breast implants (complicated by bilateral lymphoedema), previous supraventricular tachycardia (on flecainide), hypertension, possible coronary spasm in 2001 (normal coronary angiogram and echocardiogram, and angina symptoms relieved with bisoprolol), daytime hypersomnolence (sleep studies in 2012 and 2013 showed no significant obstructive sleep apnoea), history of polymyalgia rheumatica (treated with steroids), stress fractures in her feet, polycystic ovary syndrome with high BMI, depression, eczema, pancreatic insufficiency, recurrent vaginal thrush, previous vitamin B6 and B12 deficiency, a faint monoclonal band on serum electrophoresis in December 2017 (which was considered unlikely to be the cause of her immunodeficiency), unspecified 'neck problems', bilateral cataract procedures, chronic itching, multiple drug allergies (she was on a long list of regular medications), a range of social stressors, and family history of malignancy.

In April 2024, she noticed "vision changes" ("my eye vision wasn't clear, it was as if I had lost pixels in my eye"). She visited her optometrist who apparently said that her retina was "swollen" and referred her to an ophthalmologist. In early May 2024, the ophthalmologist noted, "visual acuity: Right 6/6 unaided; Left 6/9 unaided", and diagnosed a "left incipient central retinal vein occlusion which is currently non-ischemic with secondary cystoid macular oedema". He noted further that she had "a background of mild non-proliferative diabetic retinopathy in both eyes." He started her on a course of Avastin® (Bevacizumab, a monoclonal antibody against vascular endothelial growth factor-A, VEGF-A) intravitreal injections.

At the time of this event (in April 2024, and since about February 2024), she was on Hizentra® (20% immunoglobulin, mainly IgG for subcutaneous use – 28 grams per month in weekly divided doses) having previously been on two different intravenous immunoglobulin preparations - Privigen® NZ (for about four months until February 2024), and Intragam® P prior to that.

Therefore, this was classified as a thromboembolic episode possibly related to treatment with immunoglobulin although other factors – the diabetes, and her age – could also have contributed. As far as we are aware, she had no past or family history of venous thromboembolism (VTE). VTE (as also arterial events) have been often described with IVIg with postulated pathogenetic mechanisms involving, at least, hyperviscosity, and the presence of activated procoagulant factors such as XIa. Although subcutaneous immunoglobulin preparations might be expected to be less likely to cause VTE (because of slower absorption), reports of VTE with subcutaneous immunoglobulin preparations also exist but they are fewer. After having been off the Hizentra® for some weeks after the event, she resumed immunoglobulin treatment - with Privigen® NZ.

Causality
Excluded
Unlikely
Possible
Likely
Certain

Severity
Non-serious
Serious – *cases that are life-threatening or result in death, disability or prolonged hospitalisation.*

Of the 99 adverse reactions, 96 were assessed as having a causality of possible, likely or certain and 12 of these were serious reactions. Table 5.2-4 shows this information by product.

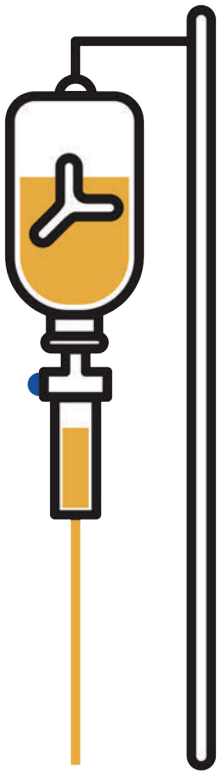
Table 5.2-4: Serious case numbers for reports with causality possible, likely or certain 2024

Product	Causality - possible, likely or certain	Serious
Intragam® P	3	-
Privigen®	25	4
Privigen® NZ	56	5
Hizentra®	3	2
Hizentra® NZ	4	-
Albumex® 4	3	-
Albumex® 20	1	1
Prothrombinex®-VF	1	-
TOTAL	**96**	**12**

No adverse reaction reports were received for the following human plasma derived products issued during 2024:

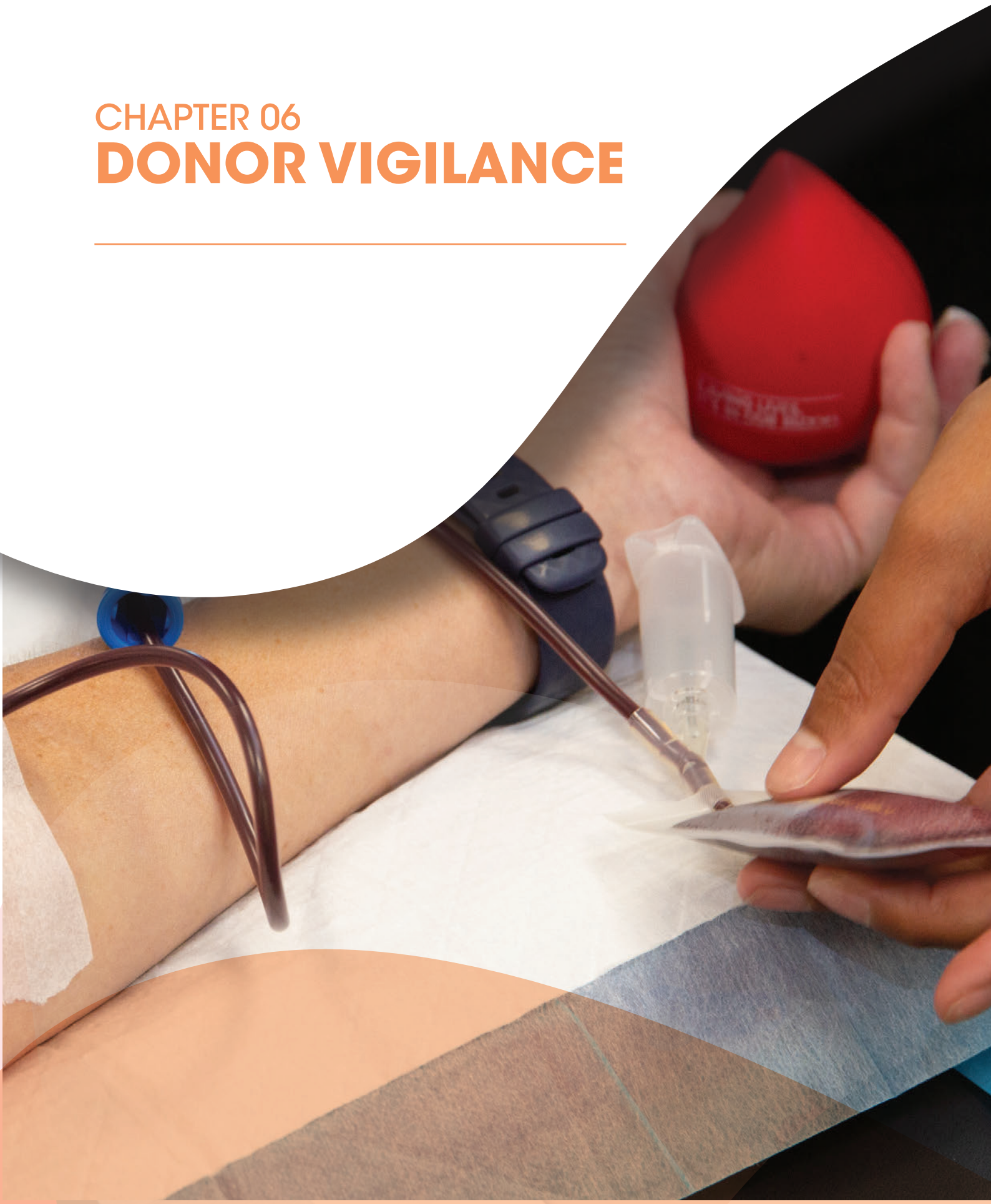
Immunoglobulins	Haemostasis products*
Evogam®	Biostate®
Gamunex® 10%	FEIBA NF®
Normal Immunoglobulin-VF	Fibrogammin® (FXIII)
Hepatitis B Immunoglobulin-VF	Koate-DVI® (FVIII)
HyperHEP® B	Thrombotrol®-VF (ATIII)
Rhophylac®	**Other**
Tetanus Immunoglobulin-VF	Alburex® 5
Zoster Immunoglobulin-VF	Alburex® 20
Berirab® P (Rabies Immunoglobulin)	BERINERT® (C1 Esterase inhibitor)
	Zemaira® (alpha$_1$-proteinase inhibitor)

** NZBS also issues some recombinant haemostasis products. Adverse events associated with these products would normally be reported directly to the New Zealand Centre for Adverse Reactions Monitoring (CARM).*



CHAPTER 06

DONOR VIGILANCE



06 DONOR VIGILANCE

The annual numbers of blood donations by donation type over the last ten years are shown in Figures 6-1 and 6-2. The number of whole blood and platelet donations has remained steady for the last five years. The rate of growth in plasma donations seen between 2019 and 2021 has not been sustained.

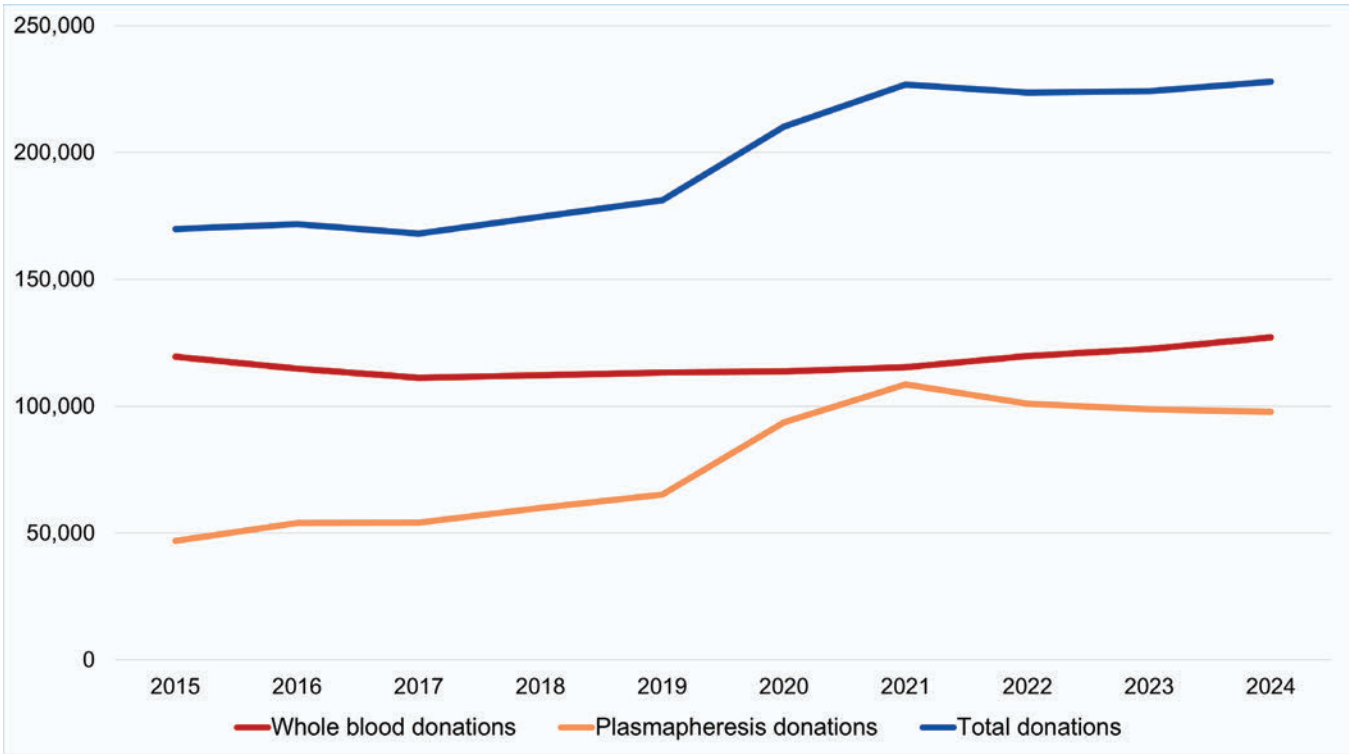


Figure 6-1: Annual number of whole blood and plasmpheresis donations 2015 – 2024

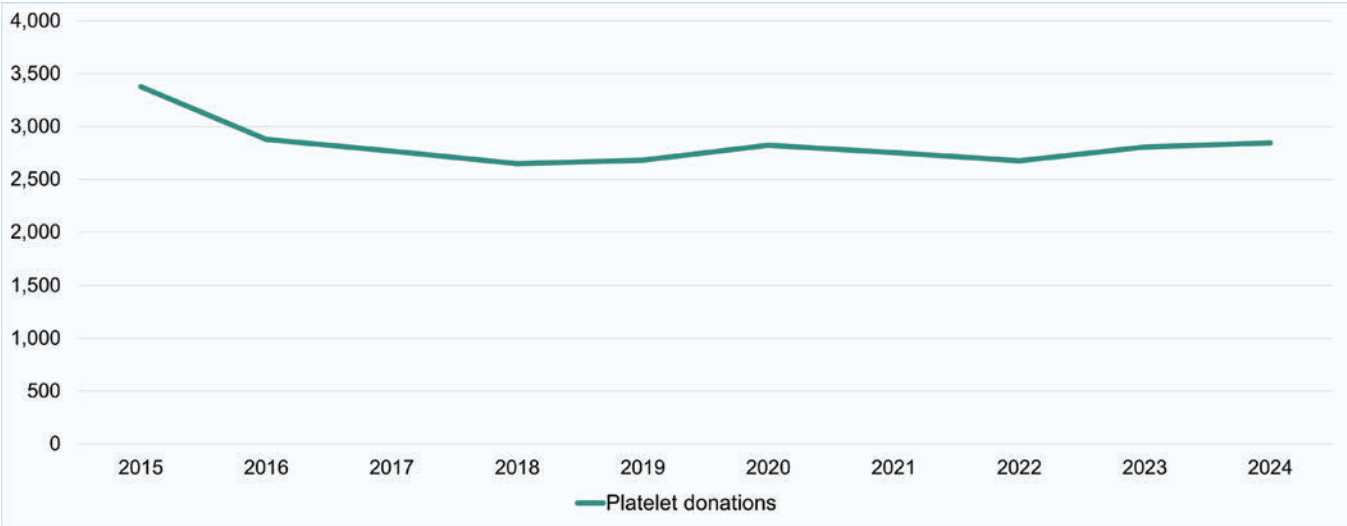


Figure 6-2: Annual number of plateletpheresis donations 2015 – 2024

A total of 227,865 whole blood, plasma and platelet donations were collected in 2024. Donor adverse event (DAE) reports were received in relation to 8,132 donations from 7,509 donors. These values relate to whole blood, plasma and platelet donations. There were also 54 adverse events reported in relation to Haematopoietic Progenitor Cell (HPC) collections, two events in relation to granulocyte collections and 91 for therapeutic venesection for discard.

Table 6-1 shows the rate of donations with adverse events for 2024 and Figure 6-3 shows rates over the last ten years.

Table 6-1: Adverse event rates by donation type 2024

Donation type	Donations with adverse events	Total donations	Frequency	Rate / 1,000 donations (95% CI)
Whole Blood	4,014	127,142	1:32	31.6 (30.6 to 32.5)
Plasmapheresis	3,979	97,878	1:25	40.7 (39.4 to 41.9)
Plateletpheresis	139	2,845	1:20	48.9 (41.5 to 57.4)
Total	**8,132**	**227,865**	**1:28**	**35.7 (34.9 to 36.5)**

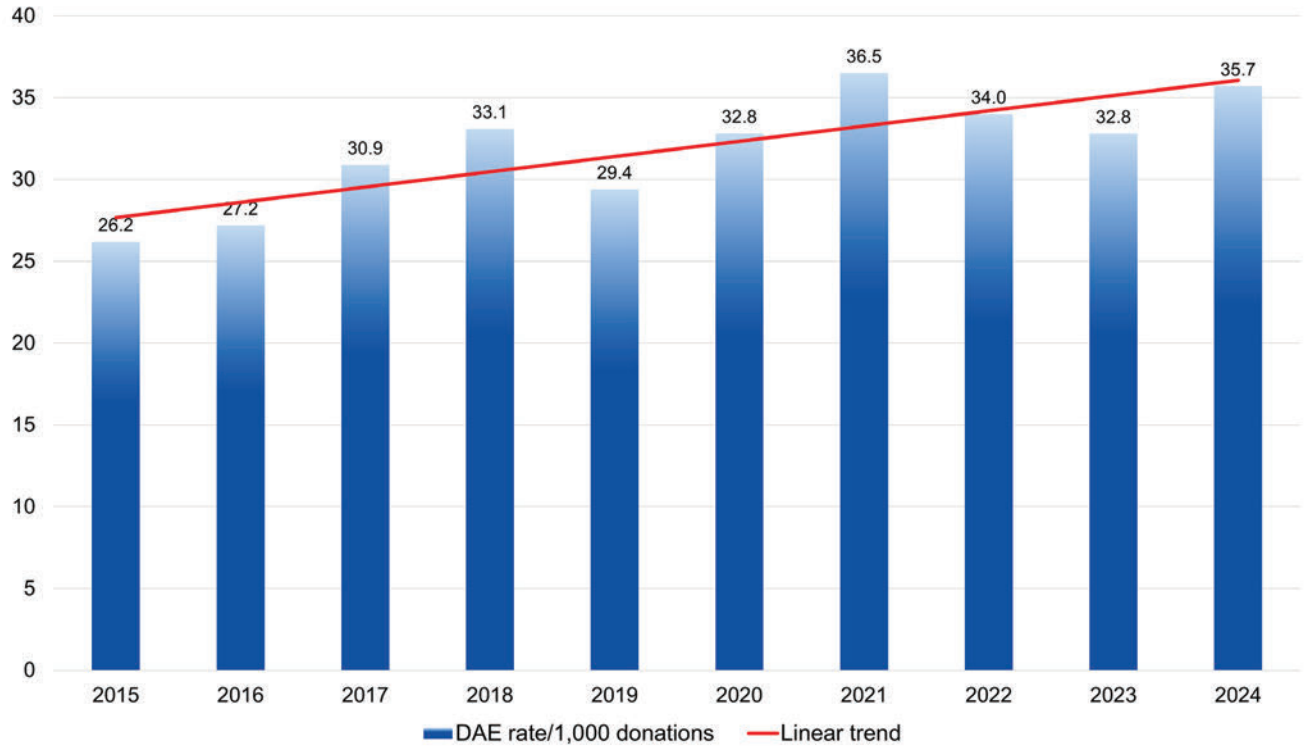


Figure 6-3: Donor adverse event (DAE) rate/1,000 donations 2015 – 2024

NZBS uses the following ISBT categories for complications related to blood donation[25]

A. Complications with local symptoms:

A1. Blood outside vessel

- Haematoma
- Re-bleeding
- Arterial puncture

A2. Pain

- Nerve injury/irritation
- Other painful arm

A3. Localised infection/inflammation

- Thrombophlebitis
- Cellulitis

A4. Other major vessel injury

B. Vasovagal reactions

C. Complications related to apheresis

- Citrate reaction
- Haemolysis
- Air embolism

D. Allergic reactions

- Local allergy
- Generalised allergic reaction (anaphylaxis)

E. Other serious complications

- Major cardiovascular event

F. Other complications

- Includes 'Red Cells Not Returned' (RCNR) for technical reasons

[25] Working Group on Donor Vigilance of the International Society of Blood Transfusion Working Party on Haemovigilance, The International Haemovigilance Network, The AABB Donor Haemovigilance Working Group. Standard for surveillance of complications related to blood donation; 2008. [updated 2014 Dec 11; cited 2025 Jun 09]. Available from: http://www.aabb.org/research/hemovigilance/Documents/Donor-Standard-Definitions.pdf

Table 6-2 presents the numbers and reporting rate of each type of donor adverse event in 2024. Vasovagal reactions and haematomas were the most frequently reported events. This is consistent with data from previous years.

Table 6-2: Numbers and rates of adverse events by reaction type* 2024

ISBT Category	Event type	Number of events	Percentage of total events	Rate per 1,000 donations (95% CI)
A1	Haematoma	3,103	38.16%	13.618 (13.150 to 14.102)
A1	Re-bleeding	31	0.38%	0.136 (0.095 to 0.194)
A1	Arterial Puncture	8	0.10%	0.035 (0.016 to 0.071)
A2	Nerve irritation / injury	103	1.27%	0.452 (0.372 to 0.549)
A2	Other painful arm	158	1.94%	0.693 (0.593 to 0.811)
A3	Thrombophlebitis	2	0.02%	0.009 (0 to 0.034)
A3	Cellulitis	2	0.02%	0.009 (0 to 0.034)
A4	Other major vessel injury	0	-	-
B	Vasovagal reaction	4,453	54.76%	19.542 (18.982 to 20.119)
C	Citrate reaction	395	4.86%	1.733 (1.571 to 1.913)
C	Haemolysis	0	-	-
C	Air embolism	1	0.01%	0.004 (0 to 0.028)
D	Allergic reaction - localised	14	0.17%	0.061 (0.036 to 0.104)
D	Allergic reaction - generalised	0	-	-
D	Anaphylaxis	0	-	-
E	Other serious complications**	2	0.02%	0.009 (0 to 0.034)
F	Other complications***	341	3.19%	1.497 (1.346 to 1.664)
	Total	**8,613**		

* *Some reports contain more than one event type, hence the number of event types is higher than the number of reports. Events relate to whole blood, plasma and platelet collections only.*

** *Two cases of acute cardiac symptoms.*

*** *313/341 (91.8%) of events classified as 'F. Other Complications' relate to RCNR for technical reasons only.*

As part of ongoing efforts to enhance donor safety and reduce phlebotomy-related injuries, NZBS has implemented several clinical quality improvement initiatives. A key national intervention has been the introduction of the Orange Dot system, an initiative observed within Australian Red Cross Lifeblood. The Orange Dot is a simple, yet effective visual cue placed on a donor's arm to indicate that a single needle manipulation has occurred. This signals to staff that no further needle adjustments should be made, aligning with best practice guidelines that recommend no more than one needle manipulation. The initiative was rolled out nationwide in March 2025 and has received positive feedback from both staff and donors. Ongoing data analysis is underway to assess its impact on phlebotomy-related injury rates.

In parallel, a vein grading project has been piloted in one region, aiming to standardise the assessment of vein quality prior to phlebotomy. This structured approach supports matching the complexity of the vein with the appropriate phlebotomy skillset, helping to optimise donor outcomes and reduce the risk of complications. The pilot has provided valuable insights into the feasibility and clinical utility of structured vein assessments, with early feedback suggesting potential for broader implementation.

Together, these initiatives reflect NZBS's commitment to continuous improvement in donor care.

NZBS uses the ISBT/IHN/AABB endorsed tool for scoring severity of donor adverse events.[26] The scores are based on extent and duration of the injury and whether outside medical care or hospital admission is required.

Most donor adverse events in 2024 (95.9%) were mild. Table 6-3 lists events by severity (grade 1 = mild; grade 3 = severe). The most common grade 3 events are haematomas, vasovagal reactions with loss of consciousness and nerve irritation/ injury.

Table 6-3: Donor adverse events by severity* 2024

Cat	Event type	Total	Grade 1	Grade 2	Grade 3
A1	Haematoma	3,103	2,915	178	10
A1	Re-bleeding	31	30	1	0
A1	Arterial puncture	8	8	0	0
A2	Other painful arm	158	149	7	2
A2	Nerve irritation / injury	103	74	22	7
A3	Cellulitis	2	0	1	1
A3	Thrombophlebitis	2	0	1	1
A4	Other major vessel injury	0	0	0	0
B	Vasovagal - No loss of consciousness	3,929	3,868	60	1
B	Vasovagal - Loss of consciousness	524	479	37	8
C	Citrate reaction	395	388	7	0
C	Air embolism	1	1	0	0
C	Haemolysis	0	0	0	0
D	Local allergic reaction	14	13	1	0
D	Anaphylaxis	0	0	0	0
E	Other serious complications	2	0	0	2
F	Other complications	341	333	7	1
	TOTAL	**8,613**	**8,258**	**322**	**33**

** Some reports contain more than one event type, hence the number of event types is higher than the number of reports. Events relate to whole blood, plasma and platelet collections only.*

[26] Townsend M, Kamel H, van Buren N, Wiersum-Osselton J, Rosa-Bray M, Gottschall J, et al. Development and validation of donor adverse reaction severity grading tool: enhancing objective grade assignment to donor adverse events. Transfus. 2020;60:1231-1242.

Figure 6-4 shows that vasovagal reactions are more common in whole blood donors than apheresis donors, while haematomas are more common in apheresis donors. This pattern is similar to that seen in previous years.

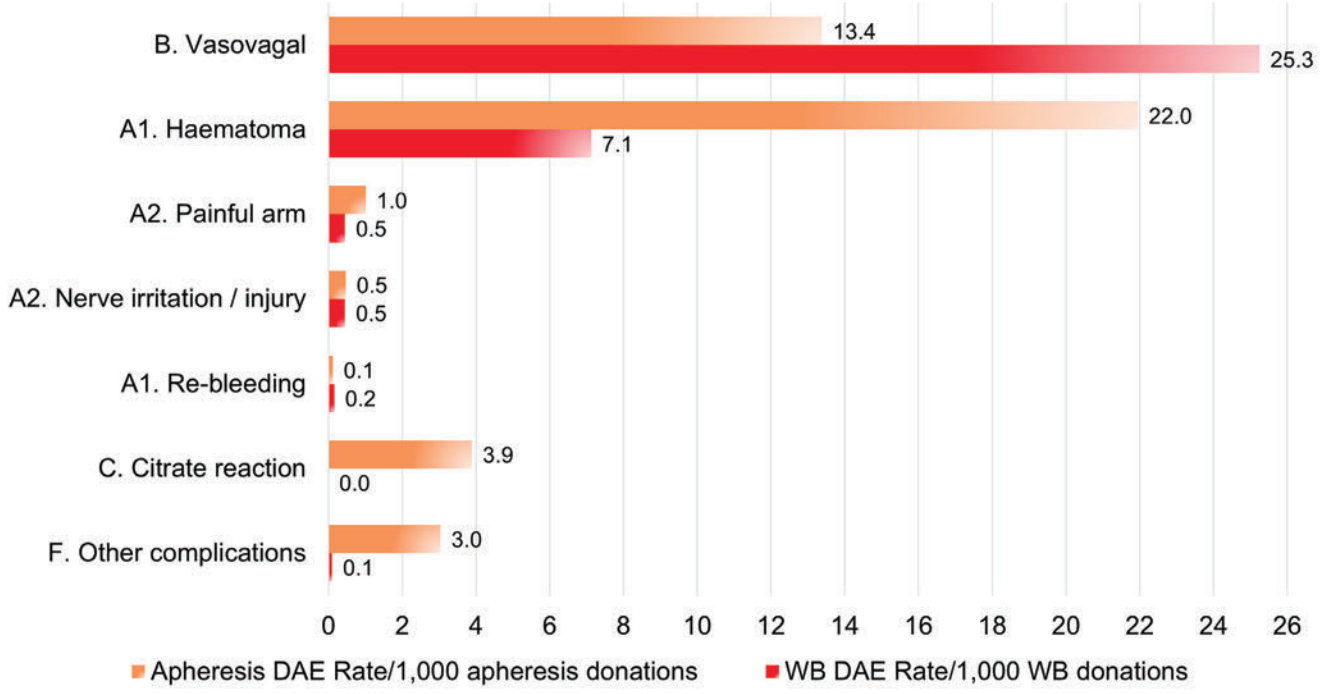


Figure 6-4: Adverse events with frequency >0.1/1,000 donations 2024

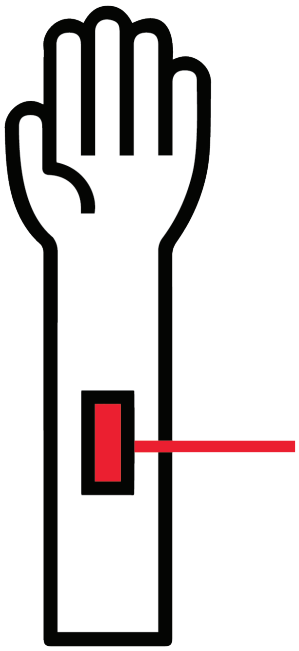


Figure 6-5 shows that while the rate of haematomas in 2024 was similar in first-time and repeat donors, vasovagal reactions occurred nearly four times more frequently in first-time donors than in repeat donors. Figure 6-6 shows how these rates have been decreasing since 2022.

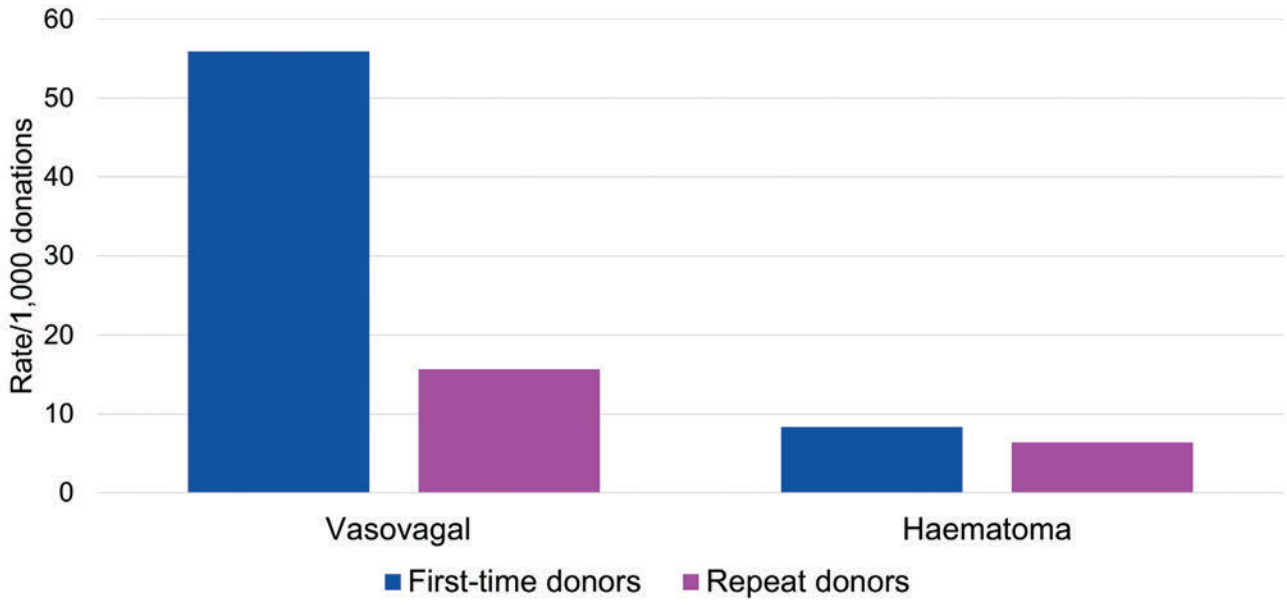


Figure 6-5: Adverse events with frequency >0.1/1,000 donations 2024

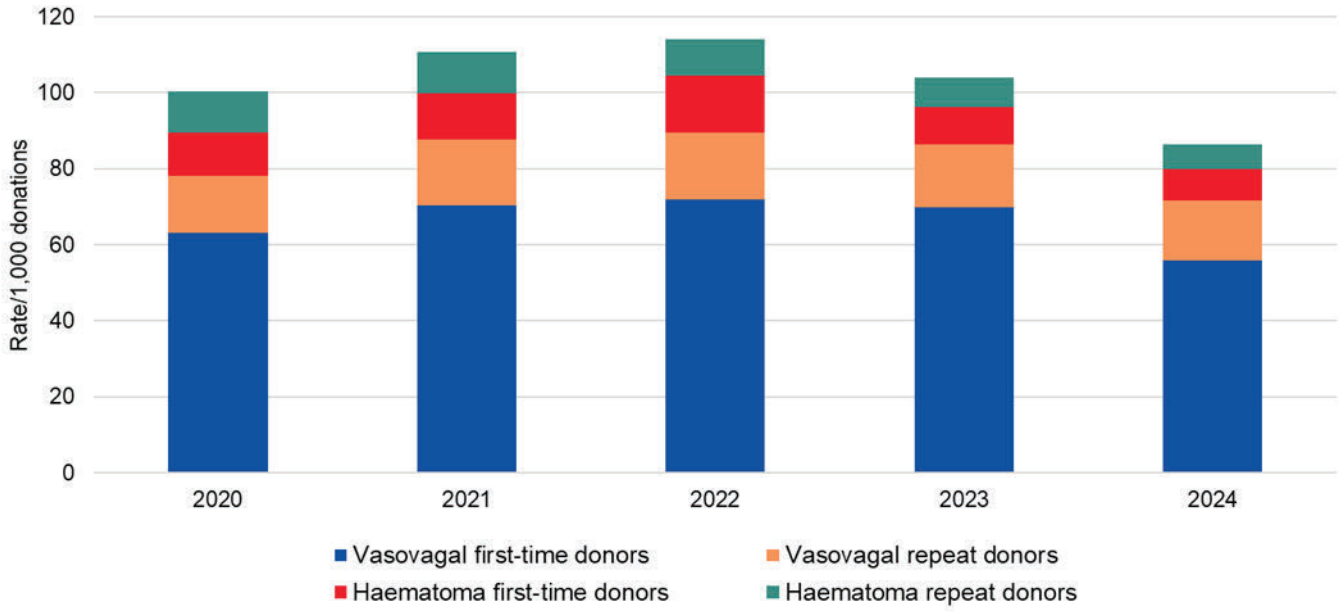
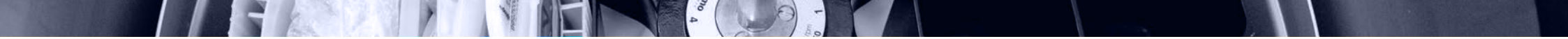


Figure 6-6: Haematoma and vasovagal rates in first-time and repeat donors from 2020 – 2024

CHAPTER 07

DATA SUPPLEMENT



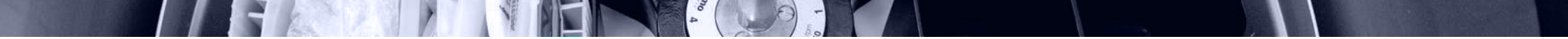
DATA SUPPLEMENT

This supplement contains additional data for some sections of the Haemovigilance Annual Report 2024. Where the data relates to Figures in the main report, this has been indicated in italics in the Table title.

2. HAEMOVIGILANCE OVERVIEW

Supplementary Table 2-1: Blood components transfused and adverse transfusion reaction reports received 2015 – 2024 *(Refer Fig 2-1)*

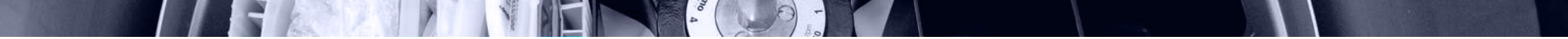
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Total components transfused	132,060	130,185	127,765	130,361	135,093	131,308	134,440	139,750	143,542	147,183
Annual change of total components transfused (%)	-2.3%	-1.4%	-1.9%	2.0%	3.6%	-2.8%	2.4%	3.9%	2.7%	2.5%
Total ATR reports	449	391	408	436	519	574	549	519	581	596
Annual change of total ATR reports (%)	2.0%	-12.9%	4.3%	6.9%	19.0%	10.6%	-4.4%	-5.5%	11.9%	2.6%
Number of ATR reports per 10,000 components transfused	34	30	32	33	38	44	41	37	40	40
Number of individual patients	412	369	362	394	452	518	493	460	536	540



2.2 BLOOD COMPONENTS TRANSFUSED

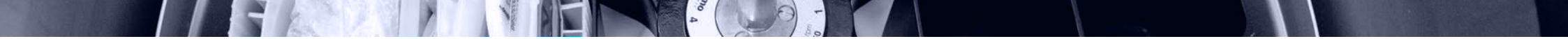
Supplementary Table 2.2-1: Number of blood components transfused annually 2015 – 2024 *(Refer Figs 2.2-1 and 2.2-2)*

Blood Component	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Red Cells	99,915	98,535	95,979	95,438	98,614	97,874	100,791	104,508	106,650	109,296
Red Cells-Neo	1,260	1,327	1,466	1,412	1,361	1,378	1,603	1,383	1,464	1,545
Total Red Cells	**101,175**	**99,862**	**97,445**	**96,850**	**99,975**	**99,252**	**102,394**	**105,891**	**108,114**	**110,841**
Platelets	11,912	12,790	13,115	13,914	14,387	13,316	14,117	13,926	15,452	15,803
Platelets-Neo	621	624	685	601	650	510	691	594	543	510
Total Platelets	**12,533**	**13,414**	**13,800**	**14,515**	**15,037**	**13,826**	**14,808**	**14,520**	**15,995**	**16,313**
Fresh Frozen Plasma	13,172	11,821	12,141	13,542	13,954	12,212	10,797	12,949	12,264	11,965
Fresh Frozen Plasma-Neo	162	161	131	196	125	214	262	276	261	356
Total Fresh Frozen Plasma	**13,334**	**11,982**	**12,272**	**13,738**	**14,079**	**12,426**	**11,059**	**13,225**	**12,525**	**12,321**
Cryoprecipitate	4,482	4,463	4,147	5,279	5,968	5,804	6,179	6,114	6,908	7,708
Cryodepleted Plasma	536	464	101	175	34	0	0	0	0	0
Total Components	**132,060**	**130,185**	**127,765**	**130,557**	**135,093**	**131,308**	**134,440**	**139,750**	**143,542**	**147,183**



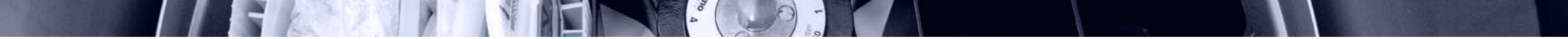
Supplementary Table 2.2-2: Components transfused per 1,000 population 2015 – 2024 *(Refer Figs 2.2-3 and 2.2-5)*

Component	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Red Cells	21.9	21.2	20.2	19.8	20.1	19.5	20.0	20.7	20.7	20.8
Platelets	2.7	2.8	2.9	3.0	3.0	2.7	2.9	2.8	3.1	3.1
Fresh Frozen Plasma	2.9	2.5	2.5	2.8	2.8	2.4	2.2	2.6	2.4	2.3
Cryoprecipitate	1.0	0.9	0.9	1.1	1.2	1.1	1.2	1.2	1.3	1.4
Cryodepleted Plasma	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
All Components	28.7	27.6	26.5	26.6	27.1	25.8	26.2	27.3	27.5	27.6
Population (millions)	**4.6**	**4.7**	**4.8**	**4.9**	**5.0**	**5.1**	**5.1**	**5.1**	**5.2**	**5.3**



Supplementary Table 2.2-3: Components transfused by Te Whatu Ora District 2024

Te Whatu Ora District	Red cells	FFP	Cryo	Platelets	Total
Auckland	21,013	4,705	2,733	6,905	35,356
Bay of Plenty	4,617	300	139	204	5,260
Canterbury	13,876	1,194	601	1,950	17,621
Capital, Coast & Hutt Valley	12,440	1,626	1,334	2,674	18,074
Counties Manukau	10,964	1,061	801	453	13,279
Hawkes Bay	3,736	315	80	158	4,289
Lakes	1,841	85	35	95	2,056
MidCentral	4,170	162	113	782	5,227
Nelson Marlborough	3,729	103	36	129	3,997
Northland	3,376	293	90	363	4,122
South Canterbury	1,055	59	24	22	1,160
Southern	5,671	755	438	734	7,598
Tairawhiti	1,752	75	47	60	1,934
Taranaki	1,056	66	37	43	1,202
Waikato	12,142	1,280	958	1,354	15,734
Wairarapa	237	13	113	60	423
Waitemata	7,477	195	111	290	8,073
West Coast	416	11	2	7	436
Whanganui	1,273	23	16	30	1,342
Grand Total	**110,841**	**12,321**	**7,708**	**16,313**	**147,183**

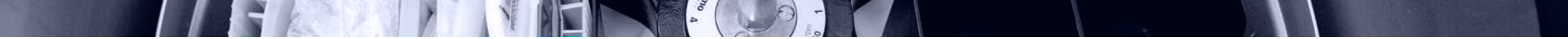


2.3 RECIPIENTS OF BLOOD COMPONENTS

Supplementary Table 2.3-2: Annual numbers of recipients of components by year* 2015 to 2024 *(Refer Figs 2.3-1 and 2.3-2)*

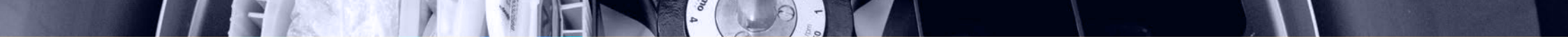
Component	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Red cells	23,437	22,620	22,884	22,534	23,056	23,509	24,621	25,279	26,502	27,266
	-3.7%	*-3.5%*	*1.2%*	*-1.5%*	*2.3%*	*2.0%*	*4.7%*	*2.7%*	*4.8%*	*2.9%*
Fresh Frozen Plasma	3,198	2,551	2,399	2,487	2,418	2,208	2,249	2,450	2,530	2,525
	10.4%	*-20.2%*	*-6.0%*	*3.7%*	*-2.8%*	*-8.7%*	*1.9%*	*8.9%*	*3.3%*	*-0.2%*
Platelets	2,764	3,154	3,104	3,187	3,279	3,198	3,257	3,367	3,541	3,738
	-13.4%	*14.1%*	*-1.6%*	*2.7%*	*2.9%*	*-2.5%*	*1.8%*	*3.4%*	*5.2%*	*5.6%*
Cryoprecipitate	1,155	1,195	1,158	1,301	1,455	1,401	1,480	1,528	1,767	1,245
	-2.3%	*3.5%*	*-3.1%*	*12.3%*	*11.8%*	*-3.7%*	*5.6%*	*3.2%*	*15.6%*	*-29.5%*

** percentage change from previous year in italics*



Supplementary Table 2.3-3: Age group distribution of male and female recipients 2017 to 2024 *(Refer Figs 2.3-3 and 2.3-4)*

Male recipients (count)										
Age group (yrs)	**0 - 4**	**5 - 14**	**15 - 24**	**25 - 34**	**35 - 44**	**45 - 54**	**55 - 64**	**65 - 74**	**75 - 84**	**85+**
Red cells	3,504	1,092	1,840	2,393	2,867	5,173	10,337	16,675	17,517	10,465
FFP	813	185	475	530	630	1,125	2,100	2,723	2,081	556
Platelets	1,280	449	482	498	677	1,465	3,086	4,059	2,497	514
Male recipients (percentage)										
Age group (yrs)	**0 - 4**	**5 - 14**	**15 - 24**	**25 - 34**	**35 - 44**	**45 - 54**	**55 - 64**	**65 - 74**	**75 - 84**	**85+**
Red cells	4.9%	1.5%	2.6%	3.3%	4.0%	7.2%	14.4%	23.2%	24.4%	14.6%
FFP	7.2%	1.6%	4.2%	4.7%	5.6%	10.0%	18.7%	24.3%	18.6%	5.0%
Platelets	8.5%	3.0%	3.2%	3.3%	4.5%	9.8%	20.6%	27.0%	16.6%	3.4%
Female recipients (count)										
Age group (yrs)	**0 - 4**	**5 - 14**	**15 - 24**	**25 - 34**	**35 - 44**	**45 - 54**	**55 - 64**	**65 - 74**	**75 - 84**	**85+**
Red cells	2,613	1,266	5,468	12,441	9,496	8,144	9,873	14,688	16,879	13,421
FFP	630	186	381	894	803	732	1,107	1,395	1,123	352
Platelets	953	378	357	559	664	985	1,686	2,040	1,239	317
Female recipients (percentage)										
Age group (yrs)	**0 - 4**	**5 - 14**	**15 - 24**	**25 - 34**	**35 - 44**	**45 - 54**	**55 - 64**	**65 - 74**	**75 - 84**	**85+**
Red cells	2.8%	1.3%	5.8%	13.2%	10.1%	8.6%	10.5%	15.6%	17.9%	14.2%
FFP	8.3%	2.4%	5.0%	11.8%	10.6%	9.6%	14.6%	18.3%	14.8%	4.6%
Platelets	10.4%	4.1%	3.9%	6.1%	7.2%	10.7%	18.4%	22.2%	13.5%	3.5%



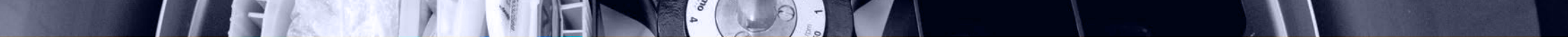
3. ADVERSE TRANSFUSION REACTION REPORTS

3.1.1 Imputability

Supplementary Table 3.1.1-1: Adverse transfusion reactions by imputability 2015-2024 *(Refer Fig 3.1.1-1)*

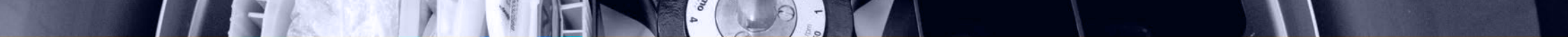
	2015	2016	2017	2018	2019	2020*	2021	2022	2023	2024
Total reactions	460	404	429	448	532	574	549	519	581	596
Possible, probable, certain	363	326	302	320	398	385	335	327	412	423
Excluded or unlikely	97	78	127	128	134	189	214	192	169	173
Percent excluded/unlikely	21.1%	19.3%	29.6%	28.6%	25.2%	32.0%	39.0%	37.0%	29.1%	29.0%

** transfusion-related errors have been removed from 2020 onwards*



Supplementary Table 3.1.1-2: Adverse transfusion reactions by event type and imputability 2024 *(Refer Fig 3.1.1-2)*

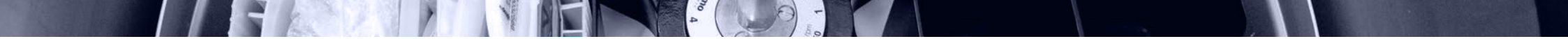
Reaction type	Excluded	Unlikely	Possible	Probable	Certain	Total	Imputability > 2
FNHTR	60	81	168	21	0	330	189
Allergic	0	1	34	51	15	101	100
TACO	4	1	8	14	3	30	25
TRALI	0	0	2	1	0	3	3
TAD	3	2	16	0	0	21	16
TAH	0	1	18	6	0	25	24
AHTR	0	0	1	0	0	1	1
DHTR	0	0	0	2	0	2	2
DSTR	7	0	0	2	33	42	35
TTI	0	1	0	1	0	2	1
PTP	0	0	0	1	0	1	1
UCT	6	6	18	3	1	34	22
HPC events	0	0	2	2	0	4	4
Total	**80**	**93**	**267**	**104**	**52**	**596**	**423**



3.1.6 Reporting by Te Whatu Ora District

Supplementary Table 3.1.6-1: Adverse transfusion reaction reports by Te Whatu Ora District (imputability >2) 2024 *(refer Fig 3.1.6-3)*

Size	Te Whatu Ora District	ATRs	Units Transfused	Frequency	Rate / 10,000 units transfused (95%CI)
Large (>10,000 units transfused)	Capital, Coast & Hutt Valley	60	18,074	1:301	33.2 (25.7 to 42.8)
	Counties Manukau	36	13,279	1:369	27.1 (19.5 to 37.6)
	Canterbury	46	17,621	1:383	26.1 (19.5 to 34.9)
	Auckland	91	35,356	1:389	25.7 (20.9 to 31.6)
	Waikato	35	15,734	1:450	22.2 (15.9 to 31.0)
Medium (3,000-10,000 units transfused)	MidCentral	27	5,227	1:194	51.7 (35.2 to 75.4)
	Southern	35	7,598	1:217	46.1 (32.9 to 64.2)
	Nelson Marlborough	13	3,997	1:307	32.5 (18.4 to 56.2)
	Northland	13	4,122	1:317	31.5 (17.8 to 54.5)
	Bay of Plenty	16	5,260	1:329	30.4 (18.3 to 49.8)
	Waitemata	20	8,073	1:404	24.8 (15.8 to 38.5)
	Hawkes Bay	6	4,289	1:715	14.0 (5.6 to 31.3)
Small (<3,000 units transfused)	Wairarapa	4	423	1:106	94.6 (27.8 to 249.7)
	Taranaki	7	1,202	1:172	58.2 (25.6 to 122.3)
	Lakes	9	2,056	1:228	43.8 (21.7 to 84.4)
	Whanganui	4	1,342	1:336	29.8 (8.6 to 79.4)
	South Canterbury	1	1,160	1:1,160	8.6 (0 to 53.8)
	West Coast	0	436	-	-
	Tairawhiti	0	1,934	-	-
	Total	**423**	**147,183**	**1:348**	**28.7 (26.1 to 31.6)**



3.2 FEBRILE NON-HAEMOLYTIC TRANSFUSION REACTIONS

Supplementary Table 3.2-2: Distribution of FNHTR symptoms 2010-2024

Signs/Symptoms	Number of reports	Percentage
Chills/rigors	1,372	32.6%
Fever	639	15.2%
Tachycardia	497	11.8%
Hypertension	480	11.4%
Restlessness	307	7.3%
Dyspnoea	260	6.2%
Tachypnoea	145	3.4%
Nausea/vomiting	144	3.4%
Hypoxaemia	97	2.3%
Chest pain	89	2.1%
Hypotension	79	1.9%
Stridor/wheeze	70	1.7%
Urticaria	30	0.7%

3.5 PULMONARY COMPLICATIONS

3.5.1 Transfusion-Related Acute Lung Injury (TRALI)

Supplementary Table 3.5.1-2: Distribution of symptoms reported in 56 cases* 2005-2024

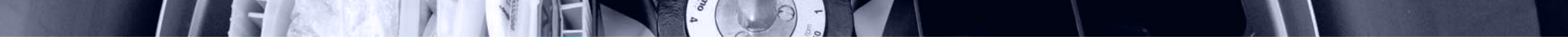
Signs/Symptoms	Number of reports	Percentage
Dyspnoea	38	67.9%
Hypoxaemia	30	53.6%
Hypotension	16	28.6%
Tachycardia	16	28.6%
Restlessness	12	21.4%
Stridor/wheeze	10	17.9%
Hypertension	6	10.7%

** Multiple symptoms per case*

3.5.2 Transfusion-Associated Circulatory Overload (TACO)

Supplementary Table 3.5.2-2: Annual TACO events 2013 – 2024 *(Refer Fig 3.5.2-1)*

Year	Number of events	Units Transfused	Frequency	Rate/10,000 Units Transfused (95%CI)
2013	16	136,995	1:8,562	1.2 (0.7 to 1.9)
2014	12	135,135	1:11,261	0.9 (0.5 to 1.6)
2015	16	132,060	1:8,254	1.2 (0.7 to 2.0)
2016	11	130,185	1:11,835	0.8 (0.5 to 1.5)
2017	9	127,765	1:14,196	0.7 (0.3 to 1.4)
2018	12	130,361	1:10,863	0.9 (0.5 to 1.6)
2019	16	135,093	1:8,443	1.2 (0.7 to 1.9)
2020	18	131,308	1:7,295	1.4 (0.9 to 2.2)
2021	18	134,440	1:7,469	1.3 (0.8 to 2.1)
2022	32	139,750	1:4,367	2.3 (1.6 to 3.2)
2023	25	143,542	1:5,742	1.7 (1.2 to 2.6)
2024	25	147,183	1:5,887	1.7 (1.1 to 2.5)
Total	**237**	**1,773,485**	**1:7,483**	**1.3 (1.2 to 1.5)**



5. PHARMACOVIGILANCE

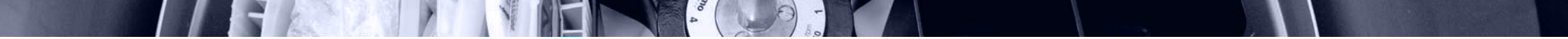
Supplementary Table 5.2-5: Adverse events by fractionated product: 2007 – 2024

Product	Number of Reports	Percentage	Product available in 2024
Intragam® P	340	40.3%	Yes
Privigen®	156	18.5%	Yes
Privigen® NZ	105	12.4%	Yes
RhD Immunoglobulin-VF	77	9.1%	Yes
Albumex® 4	48	5.7%	Yes
Albumex® 20	36	4.3%	Yes
Prothrombinex® -VF	27	3.2%	Yes
Evogam®	13	1.5%	Yes
Biostate®	10	1.2%	Yes
Hizentra® NZ	7	0.8%	Yes
Hizentra®	7	0.8%	Yes
Intragam® P & Privigen®	4	0.5%	Yes
MonoFIX -VF	2	0.2%	No
Tetanus Immunoglobulin-VF	2	0.2%	Yes
Rhophylac®	1	0.1%	Yes
Berinert®	1	0.1%	Yes
Evogam® & Intragam® P	1	0.1%	Yes
FEIBA NF	1	0.1%	Yes
Hepatitis B Immunoglobulin-VF	1	0.1%	Yes
NextGen 16% Immunoglobulin	1	0.1%	No
Normal Immunoglobulin-VF	1	0.1%	Yes
RiaSTAP®	1	0.1%	Yes
Zoster Immunoglobulin - VF	1	0.1%	Yes
Gamunex®	1	0.1%	Yes
	844		

6. DONOR VIGILANCE

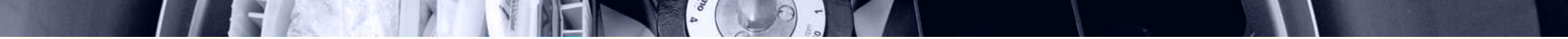
Supplementary Table 6-4: Annual number of blood donations by donation type 2005 – 2024 *(Refer Fig 6-1 and Fig 6-2)*

	Whole Blood		Plasmapheresis		Plateletpheresis		Total	
Year	Donors	WB Donations	Donors	Plasma Donations	Donors	Platelet Donations	Donors	Total Donations
2005	95,382	156,684	1,227	6,479	979	5,098	97,588	168,261
2006	91,929	151,934	2,647	12,880	957	5,148	95,533	169,962
2007	88,584	150,308	4,064	23,514	957	5,493	93,605	179,315
2008	90,364	152,760	4,190	26,985	1,009	5,998	95,563	185,743
2009	89,159	151,689	3,012	18,106	1,143	6,578	93,314	176,373
2010	89,623	153,044	3,407	18,243	1,136	6,499	94,166	177,786
2011	86,986	147,093	4,723	28,886	1,119	6,491	92,828	182,470
2012	83,040	139,845	5,037	30,179	1,138	6,527	89,215	176,551
2013	75,069	125,684	5,078	29,585	830	4,942	80,977	160,211
2014	72,754	120,668	5,910	38,099	595	3,570	79,259	162,337
2015	71,511	119,554	7,586	46,983	555	3,377	79,652	169,914
2016	69,857	114,779	8,789	54,059	425	2,878	79,071	171,716
2017	66,871	111,188	9,121	54,125	415	2,766	76,407	168,079
2018	67,407	112,162	10,243	59,895	436	2,648	78,086	174,705
2019	68,297	113,329	11,785	65,192	448	2,682	80,530	181,203
2020	68,832	113,699	17,267	93,669	611	2,823	80,801	210,191
2021	68,926	115,315	20,687	108,669	553	2,754	85,501	226,738
2022	70,301	119,854	21,043	101,036	523	2,677	87,381	223,567
2023	73,602	122,515	21,673	98,806	531	2,806	91,477	224,127
2024	80,809	127,142	23,356	97,878	554	2,845	98,254	227,865



Supplementary Table 6-5: Donation related adverse events by donation type 2024 *(Refer Fig 6-4)*

	WHOLE BLOOD (122,142 Donations)				APHERESIS (100,723 donations)			
Event type	**No of events**	**% of events**	**Frequency**	**Rate/1,000 donations (95% CI)**	**No of events**	**% of events**	**Frequency**	**Rate/1,000 donations (95% CI)**
B. Vasovagal reaction	3,093	73.29%	1:41	25.25 (23.49 to 25.19)	1,360	37.93%	1:74	13.38 (12.81 to 14.23)
A1. Haematoma	873	20.69%	1:146	7.13 (6.43 to 7.34)	2,230	62.19%	1:45	21.95 (21.25 to 23.07)
A2. Painful arm	55	1.30%	1:2,312	0.45 (0.33 to 0.56)	103	2.87%	1:978	1.01 (0.84 to 1.24)
A2. Nerve irritation/Injury	55	1.30%	1:2,312	0.45 (0.33 to 0.56)	48	1.34%	1:2,098	0.47 (0.36 to 0.63)
A1. Re-bleeding	19	0.45%	1:6,692	0.16 (0.09 to 0.24)	12	0.33%	1:8,394	0.12 (0.07 to 0.21)
F. Other complications	12	0.28%	1:10,595	0.10 (0.05 to 0.17)	329	9.17%	1:306	3.24 (2.93 to 3.64)
D. Local Allergic reaction	6	0.14%	1:21,190	0.05 (0.02 to 0.11)	8	0.22%	1:12,590	0.08 (0.04 to 0.16)
A1. Arterial puncture	7	0.17%	1:18,163	0.06 (0.02 to 0.12)	1	0.03%	1:100,723	0.01 (0 to 0.06)
A3. Cellulitis	2	0.05%	1:63,571	0.02 (0 to 0.06)	0	-	-	-
A3. Thrombophlebitis	1	0.02%	1:127,142	0.01 (0 to 0.05)	1	0.03%	1:100,723	0.01 (0 to 0.06)
E. Other serious complications	0	-	-	-	2	0.06%	1:50,362	0.02 (0 to 0.08)
A4. Other major vessel injury	0	-	-	-	0	-	-	-
C. Citrate Reaction					395	11.02%	1:255	3.89 (3.55 to 4.33)
C. Air embolism					1	0.03%	1:100,723	0.01 (0 to 0.06)
C. Haemolysis					0	-	-	-



Supplementary Table 6-6: Haematoma and vasovagal rates in first-time and repeat whole blood donors 2024 *(Refer Fig 6-5 and Fig 6-6)*

	First-time donors (n=27,319 donations)		Repeat donors (n=99,823 donations)	
Event type	**No of events**	**Rate/1,000 donations**	**No of events**	**Rate/1,000 donations**
B. Vasovagal	1,528	55.9	1,565	15.7
A1. Haematoma	229	8.4	637	6.4

Supplementary Table 6-7: Whole blood adverse event reports by donor age group 2024

Year	No of reports	No of donations	Frequency	Rate/1,000 donations (95% CI)
16 - 19	694	6,660	1:10	104.2 (97.1 to 111.8)
20 - 24	500	7,110	1:14	70.3 (64.6 to 76.5)
25 - 29	432	8,614	1:20	50.2 (45.7 to 55.0)
30 - 34	423	11,090	1:26	38.1 (34.7 to 41.9)
35 - 39	360	11,845	1:33	30.4 (27.4 to 33.6)
40 - 44	255	11,911	1:47	21.4 (19.0 to 24.2)
45 - 49	266	12,141	1:46	21.9 (19.4 to 24.7)
50 - 54	259	14,242	1:55	18.2 (16.1 to 20.5)
55 - 59	308	14,237	1:46	21.6 (19.4 to 24.2)
≥60	517	29,292	1:57	17.6 (16.2 to 19.2)
All	**4,014**	**127,142**	**1:32**	**31.6 (30.6 to 32.5)**

Supplementary Table 6-8: Rates of vasovagal events, in first-time and repeat whole blood donors, by age group and gender 2024

		First-time donors (n=27,319)		Repeat donors (n=99,823)	
Age group (years)	Gender	Frequency	Rate/1,000 donations (95% CI)	Frequency	Rate/1,000 donations (95% CI)
16 – 19	Female	1:8	129.5 (116.8 to 143.3)	1:9	113.8 (96.2 to 134.0)
	Male	1:14	71.2 (61.3 to 82.6)	1:22	46.1 (33.8 to 62.5)
20 – 24	Female	1:9	112.5 (95.7 to 131.8)	1:17	59.1 (51.4 to 67.7)
	Male	1:15	67.2 (51.3 to 87.4)	1:31	32.3 (25.2 to 41.3)
25 – 29	Female	1:10	97.8 (82.5 to 115.6)	1:35	28.5 (23.7 to 34.2)
	Male	1:14	69.1 (54.6 to 87.1)	1:40	25.0 (19.5 to 31.9)
30 – 34	Female	1:16	61.9 (50.6 to 75.5)	1:37	26.8 (22.4 to 32.0)
	Male	1:19	52.0 (41.3 to 65.3)	1:58	17.2 (13.6 to 21.8)
35 – 39	Female	1:18	56.1 (44.5 to 70.5)	1:49	20.5 (16.8 to 24.9)
	Male	1:23	43.8 (33.7 to 56.6)	1:89	11.2 (8.5 to 14.7)
40 – 44	Female	1:30	33.3 (24.3 to 45.5)	1:58	17.2 (14.0 to 21.1)
	Male	1:36	27.8 (19.2 to 39.7)	1:149	6.7 (4.7 to 9.6)
45 – 49	Female	1:25	40.4 (30.8 to 52.9)	1:68	14.7 (11.8 to 18.2)
	Male	1:35	28.6 (19.4 to 41.8)	1:171	5.8 (4.0 to 8.6)
50 – 54	Female	1:30	32.9 (25.4 to 42.4)	1:92	10.9 (8.6 to 13.8)
	Male	1:56	17.7 (11.0 to 28.0)	1:212	4.7 (3.1 to 7.0)
55 – 59	Female	1:23	42.7 (34.0 to 53.5)	1:74	13.6 (11.0 to 16.7)
	Male	1:67	15.0 (8.9 to 24.8)	1:205	4.9 (3.3 to 7.2)
≥60	Female	1:28	36.3 (28.7 to 45.6)	1:80	12.5 (10.7 to 14.5)
	Male	1:96	10.4 (6.2 to 17.2)	1:321	3.1 (2.3 to 4.3)
Total	Female	1:15	66.6 (62.8 to 70.7)	1:48	20.9 (19.8 to 22.2)
	Male	1:24	42.2 (38.7 to 46.0)	1:107	9.4 (8.5 to 10.3)
Overall		**1:18**	**55.9 (53.2 to 58.7)**	**1:64**	**15.7 (14.9 to 16.5)**