

Appendix for Transfusion-transmissible infections in Australia 2025 Surveillance Report

Contents

Glossary	3
Methodological notes	5
Screening tests for transfusion-transmissible infections	8
Other supporting information	9
References	10



Glossary

This glossary provides clear definitions for technical terms used throughout the Transfusion-transmissible infections in Australia Surveillance Report. Entries are listed alphabetically.

Active syphilis

Defined by reactivity on treponemal and non-treponemal syphilis testing, with or without clinically apparent infection (i.e. excluding past treated infections and may also exclude latent syphilis). This definition is no longer in use (see 'Potentially infectious syphilis') but has been included in this report as trend data from 2013 to 2016 used this definition.

Apheresis

The collection procedure for plasma and/or platelets which separates whole blood into its components and returns remaining components to the donor, using automated separation technology.

First-time donor

A donor who has not previously donated blood or blood products in Australia.

Hepatitis B virus (HBV) positive

The person has either tested positive to HBV surface antigen, HBV DNA or to both:

Hepatitis B surface antigen (HBsAg) positive: HBsAg is an HBV protein and a positive result indicates the presence of HBV in the blood. This means the person is currently infected with HBV and can transmit the infection to others (infectious). Most adults who acquire HBV clear the virus within a few months, and their HBsAg test result will be negative after that time. Some people remain infected and continue to test positive for HBsAg. If, after six months, the person still tests positive for HBsAg, the infection is considered chronic.

Hepatitis B deoxyribonucleic acid (HBV DNA) positive: HBV DNA assays are used to monitor response to treatment, assess the likelihood of vertical transmission of HBV, and to detect the presence of occult HBV infection (i.e. infection in someone who tests HBsAg negative). If positive, it could either mean:

- The virus is multiplying in a person's body and they are highly contagious.
- In case of OBI (see below), the presence of viral DNA means that a person is possibly infectious and potentially at increased risk of liver damage.

Hepatitis C virus (HCV) positive

The person has either tested positive to antibodies to HCV, HCV RNA or both as defined below:

Antibodies to hepatitis C (anti-HCV) positive: The person has tested positive for antibodies to HCV in the blood, but the results should be interpreted carefully. A positive anti-HCV could mean the person is a chronic carrier of HCV, has been infected but has resolved infection, or is recently (acutely) infected. In blood donors, false positive results also occur. The HCV RNA test, described below, can help differentiate between current or resolved infection.

Hepatitis C ribonucleic acid (HCV RNA) positive: RNA is the genetic material of the virus, and the qualitative test determines whether the virus is present. A positive test means that the person is currently infected. A negative HCV RNA test in the presence of anti-HCV is indicative of resolved infection.

Incidence

The rate of newly acquired infection among repeat donors.

Incident donor

A positive repeat donor whose most recent previous donation was within the last 12 months and tested negative for the same TTI, excluding donors with occult hepatitis B virus infection (OBI), and HCV antibody positive/RNA negative donors deemed to be 'partial seroreverters' (see 'Seroreversion' definition).

First-time donors with NAT 'yield' test results, with the exception of donors with occult hepatitis B infection (see 'NAT Yield' and 'Occult HBV infection' definitions) are included as incident donors.



Infectious syphilis

Syphilis infection of less than two years' duration in the general population diagnostic setting.

Injecting drug use (IDU)

Corresponds to the public health definition of People Who Inject Drugs (PWID). Specifically, defined in the context of blood donation as; 'used drugs' in the past five years by injection or been injected, even once, with drugs not prescribed by a doctor or a dentist.

Lapsed donor

A repeat donor who has not donated blood in the past two years.

NAT Yield

A donor who tests positive on nucleic acid testing (DNA or RNA) but negative on serological tests.

Non-compliance

Disclosure of information post-donation that would have led to deferral from donation had it been disclosed on the donor questionnaire.

Occult HBV infection (OBI)

A form of chronic HBV infection characterised by undetectable HBsAg, low/intermittently detectable levels of HBV DNA and usually detectable anti-HBc in the blood.

Positive donor

A donor confirmed (by additional testing as necessary) to have tested positive to the relevant TTI.

Potentially infectious syphilis

This is a blood safety specific surveillance definition designed to capture donors who are at theoretical risk of transmitting syphilis by blood transfusion. Potentially infectious syphilis includes repeat donors if: they had seroconverted within the last two years (treponemal antibody test negative to positive) with a positive confirmatory result, or; had a history of syphilis treatment since their last treponemal antibody test non-reactive donation and infectious syphilis cannot be conclusively ruled out at the time of that donation, or; were previously known to have past treated syphilis and subsequently had possible reinfection (four-fold RPR titre rise). Potentially infectious syphilis includes first-time donors if screening and confirmatory tests for treponemal antibodies were positive, in addition to RPR titre >8 or clinical evidence (signs of syphilis) or recent contact with a confirmed case.

Prevalence

Prevalence is defined as the number of positive donations per 100 000 donations; it is calculated separately for all donors, first-time donors, and repeat donors.

Putative risk factor

A potential route of infection for positive donors reported at the post-donation interview.

Repeat donor

A donor who has donated in Australia on at least one occasion prior to the current donation.

Seroconversion

The time period during which a specific antibody develops and becomes detectable in the blood. Following seroconversion, a person tests positive for the antibody using tests that are based on the presence of antibodies.

Seroreversion

The progressive loss of antibody in a previously seropositive individual to the point the antibody is consistently undetectable ('seroreverter') or only intermittently detectable ('partial seroreverter').

Transfusion-transmissible infection (TTI)

Any infection that can be transmitted to a recipient via transfused blood components. In the context of this report this refers to TTIs for which Lifeblood undertakes testing, i.e. HIV, hepatitis C, hepatitis B, HTLV and syphilis.

Window period (WP)

The duration of the period from infection to the time point of first detection in the blood. The window period varies depending on the infection and the test used.



Methodological notes

This section provides supporting information and clear descriptions of the methodologies used for calculations throughout the *Transfusion-transmissible infections in Australia Surveillance Report*. Entries are listed alphabetically.

Age-specific rate

Age-specific rate is defined as the proportion of blood donors in a particular age group who test positive, usually expressed per 100 000 donors in the specified age group. Age-specific rate was calculated as follows:

$$\text{Age-specific rate of HBV among donors aged 20-29 years} = \left(\frac{\text{Number of HBV-positive donors aged 20-29 years}}{\text{Total number of donors aged 20-29 years}} \right) \times 100\,000$$

Donor-years of observation

Data on the interval between each donation by all donors who donated at least twice in the reporting year were obtained. For all donors with negative tests for transfusion-transmissible viral infections, donor-years of observation were calculated as the sum of all inter-donation intervals. For repeat donors who only made one negative donation in the reporting year, the average DYO per repeat negative donor was applied to calculate their individual inter-donation interval. For repeat positive donors, donor-years of observation were calculated as the sum of all inter-donation intervals between the first negative and the positive donation of incident donors. An average DYO per incident donor was then calculated and adjusted for all repeat positive donors.

Exposure categories

A single most important risk factor for each positive donor was identified using the primary risk factor data from the Lifeblood risk factor database. The key exposure categories for positive donors were classified as follows:

- | | |
|--|---|
| 1. Injecting drug use (IDU) | 9. Exposure in health care setting (both occupational and non-occupational) |
| 2. Country of birth (COB)/Ethnicity | 10. Household contact/Family history |
| 3. Partners with known risks or known to be positive | 11. Other blood to blood contact |
| 4. Partners with unspecified risks | 12. Others |
| 5. Engaged in sex work | 13. No risk factors identified |
| 6. Male-to-male sexual activity | 14. Not reported |
| 7. Blood or tissue recipient | |
| 8. Tattoo or body piercing | |

For a consistent comparison of the prevalence of major exposure categories between blood donors and the general population, *partners with any risks or known to be positive, engaged in sex work and male-to-male sexual activity* were combined to create a broader risk category named *sexual contact*. Thus, from the above thirteen key categories, the following exposure groups were established to match the main exposure groups in general population for each of the transfusion-transmissible infections.

The key exposure categories modified for comparison with general population were as follows:

- | | |
|--|------------------------------------|
| 1. Injecting drug use (IDU) | 5. Tattoo or body piercing |
| 2. Country of birth (COB)/Ethnicity | 6. Exposure in health care setting |
| 3. Sexual contact | 7. Household contact |
| a. Partners with any risks or known to be positive/Partners with unspecified risks | 8. Other blood to blood contact |
| b. Engaged in sex work | 9. Others |
| c. Male-to-male sexual activity | 10. No risk factors identified |
| 4. Blood or tissue recipient | 11. Not reported |



Incidence

Incidence of TTI is defined as a rate per 100 000 donor-years of observation. It was calculated as follows:

$$\text{Incidence per 100 000 donor-years of observation} = \left(\frac{\text{Number of incident donors}}{\text{Total donor-years of observation, i.e. total DYO for repeat positive donors plus total DYO for repeat negative donors}} \right) \times 100\,000$$

Incidence rate of any TTI over the nine-year period, 2016-2024, was calculated as follows:

$$\text{Incidence per 100 000 donor-years of observation} = \left(\frac{\text{Total number of incident donors in 2016-2024}}{\text{Average of 2016-2024 total donor-years of observation}} \right) \times 100\,000$$

Of note, the methodology for calculating incidence was modified in 2018 due to a change in methodology to calculate the Donor-years of observation (DYO) and includes the inter-donation intervals from the current year only. Previous reports used two years of inter-donation interval data. From 2020 onward, the methodology was revised again, whereby the DYO was calculated as the sum of inter-donation intervals for unique donors only and was not adjusted for all repeat donations. For both modifications, the updated DYO calculation was applied retrospectively, for that report.

Newly acquired infection

Newly acquired infection was defined as newly diagnosed infection with evidence of a previous negative or indeterminate test result.

Newly diagnosed infection

Newly diagnosed infection was defined as the first occasion of diagnosis in Australia.

Prevalence

Prevalence is defined as the number of positive donations per 100 000 donations. It was calculated as follows:

$$\text{Prevalence in first-time donors} = \left(\frac{\text{Number of positive first-time donations}}{\text{Total number of first-time donations}} \right) \times 100\,000$$

$$\text{Prevalence in repeat donations} = \left(\frac{\text{Number of positive repeat donations}}{\text{Total number of repeat donations}} \right) \times 100\,000$$

$$\text{Prevalence in all donations} = \left(\frac{\text{Number of donations (both first-time and repeat) positive for a TTI marker}}{\text{Total number of donations (both first-time and repeat)}} \right) \times 100\,000$$



Residual risk estimates

Lifeblood routinely applies published models to derive risk estimates based on viral testing data from rolling two calendar year periods. In 2017, Lifeblood changed the method of estimating the WP risk for HIV and HCV, bringing it in line with the method for HBV adopted in 2016. This addressed the existing limitation that existing models were overly conservative, estimating the probability of collecting a WP donation, rather than the more appropriate estimate of the risk of infection in a recipient. The adoption of the method of Weusten *et al* leads generally to lower estimates and standardises the method with HBV. For HBV, there is a separate estimation of the risk associated with chronic OBI, defined as anti-HBc negative or positive, HBsAg negative and HBV DNA positive outside the acute phase of infection. This risk is summed with the HBsAg WP risk to derive an overall HBV residual risk. The method is based on assessing the probability of 'non-detection' by HBV NAT and the average probability of HBV transmission from NAT non-reactive donations. NAT non detection is derived by examining HBV NAT data and assessing the frequency of prior NAT non-detectable donations from donors identified as OBI by NAT. The transmission function is based on investigation of the outcome of transfusions from blood components (termed lookback) sourced from donors with OBI.

Statistical tests to analyse trends in transfusion-transmissible infections

Trends in prevalence and incidence of transfusion-transmissible infections were examined for the ten-year period, 2015-2024, and the nine-year period, 2016-2024, respectively. Poisson regression analysis was used to calculate incidence rate ratios (IRRs) and their 95% confidence intervals. A p-value of less than 0.05 was considered as statistically significant.

The trend in the total number of donations for the period 2015-2024 was examined by linear regression analysis. A p-value of less than 0.05 was considered as statistically significant.

Tabulated count data on the demographic characteristics (sex, age group, state/territory and year of donation) for all blood donors (both positive and negative donors) were retrieved for the year 2024, and five-year period, 2020-2024 (for HBV, HCV, HIV, HTLV and potentially infectious syphilis). Trends between demographic factors and TTI positivity among Australian blood donors were examined.

Syphilis: Potentially infectious syphilis and infectious syphilis

To distinguish between potentially infectious syphilis and infectious syphilis, the two definitions are presented here:

Potentially infectious syphilis includes repeat donors if they have seroconverted within the last two years (treponemal antibody test negative to positive) with a positive confirmatory result, or had a history of syphilis treatment since their last treponemal antibody test non-reactive donation, or were previously known to have past treated syphilis and subsequently had possible reinfection (four-fold RPR titre rise). First-time donors are included as potentially infectious syphilis cases if screening and confirmatory tests for treponemal antibodies are positive, in addition to an RPR titre >8, or clinical evidence (signs of syphilis) or recent contact with a confirmed case. Prior to 2017, the term 'Active syphilis' was used in Lifeblood surveillance reporting, including trend data presented in this report between 2015 to 2016.

Infectious syphilis is defined in the national case definition as syphilis infection of less than two years' duration (including primary, secondary and early latent stages). Of note, an expanded infectious syphilis national case definition was implemented in 2015, which includes 'probable' infectious syphilis (to capture infectious syphilis cases in people without prior testing history). This new subcategory has been included in the number of infectious syphilis notifications since 2015.



Screening tests for transfusion-transmissible infections

Transfusion-transmissible infection	Screening tests	Test target	Year of introduction	Median window period estimate	Estimated residual risk (per million units transfused)
Syphilis	<i>Treponema pallidum</i> antibodies*	Antibodies to <i>Treponema pallidum</i>	~1949	30 days	<1 in 1 million ¹
Hepatitis B	HBsAg†	Hepatitis B surface antigen (HBsAg)	1970	38 days	---
	nucleic acid test for HBV	HBV DNA	2010	17 days	<1 in 1 million
HIV	anti-HIV 1†	Antibody to both HIV 1 and HIV 2 (anti-HIV-1/2)	1985 (HIV-1)	22 days	---
	anti-HIV 2†		1992 (HIV-1/HIV-2)	15 days	---
	p24 antigen†	HIV-1 p24 antigen	2013 (HIV Ag/Ab)		
	nucleic acid test for HIV 1/2‡	HIV 1/2 RNA	2000 (HIV-1) 2021 (HIV-1/HIV-2)	5 days	<1 in 1 million
Hepatitis C	anti-HCV†	Antibody to HCV	1990	66 days	---
	nucleic acid test for HCV‡	HCV RNA	2000	3 days	<1 in 1 million
HTLV	anti-HTLV 1† anti-HTLV 2†	Antibody to both HTLV 1 and HTLV 2	1993	51 days	<1 in 1 million ²

* *Treponema pallidum* haemagglutination assay (TPHA) until December 2020, subsequently Abbott Alinity s (Abbott Diagnostics, Wiesbaden-Delkenheim, Germany) Chemiluminescent Immunoassay system.

† Abbott PRISM (Abbott Diagnostics, Wiesbaden-Delkenheim, Germany) Chemiluminescent Immunoassay system until October 2020, subsequently Abbott Alinity s (Abbott Diagnostics, Wiesbaden-Delkenheim, Germany) Chemiluminescent Immunoassay system.

‡ Chiron Procleix HIV-1/HCV (Multiplex) Assay, and the HIV-1 and HCV Discriminatory Assays (Chiron Blood Testing, Emeryville, California) from June 2000 until July 2010. Subsequently replaced in 2010 by Novartis HIV-1/HCV/HSV Procleix Ultrio assay using a fully automated testing system (Procleix Tigris). Ultrio assay replaced by Grifols/Hologic HIV-1/HCV/HSV Procleix Ultrio Plus assay in August 2013. Ultrio Plus assay replaced by Grifols/Hologic HIV-1/2/HCV/HSV Procleix Ultrio Elite assay in May 2021.



Other supporting information

Blood donation: from volunteer to recipient

In Australia, blood donations from each state and territory are processed and tested at one of the four Lifeblood processing centres. Each of the states (except Tasmania and South Australia) has a processing centre in their capital city. Blood donations collected during the period of the report in South Australia and Tasmania were sent to Melbourne for testing while those collected in the Australian Capital Territory and Northern Territory were sent to Sydney for testing and further processing.

An overview of current donor selection criteria can be accessed from Lifeblood website www.lifeblood.com.au.

The 'tiered' safety approach

Internationally, blood services undertake a number of processes to minimise the risk of TTIs. Because no single process can completely eliminate the risk, scientific evidence demonstrates that a combination approach is most effective for minimising risk. In accordance with this, Lifeblood employs a four-tier approach to safety:

1. Through pre-donation public education using the www.lifeblood.com.au website, Lifeblood Donor Engagement staff, the media and the Lifeblood National Contact Centre as well as brochures and handouts in collection facilities, donors are informed of eligibility criteria for blood donation and common reasons for deferral from donation.
2. Individuals whose behaviours or actions result in them having an increased risk of transmitting blood-borne infection are excluded by specific responses to questions asked prior to donation.
3. State-of-the-art tests are undertaken on donated blood to identify prospective donors with pre-existing infection and newly acquired infections in repeat donors.
4. Where available, physical and/or chemical measures are applied to inactivate viruses and other infectious agents (pathogen inactivation/reduction technologies). Currently used for manufactured plasma products but is not routinely available in Australia for all fresh blood components.

Even the best testing is not 100% effective in identifying infection, primarily due to the existence of a 'window period' (WP). The WP varies in duration from several days (for HIV) to several weeks (for HBV) depending on the transfusion-transmissible infectious agent and the specific test used.

The testing used by Lifeblood has progressively improved; prior to June 2000, only serological assays were available, and the WPs for HIV, HCV and HBV were approximately 22, 66 and 38 days. Significant improvements included the introduction of nucleic acid tests (NAT) for HIV-1 and HCV in June 2000, HBV in 2010 and HIV-2 in 2021. Current WPs are approximately 5 days (HIV-1/2), 3 days (HCV) and 17 days (HBV), as outlined at <https://www.lifeblood.com.au/health-professionals/clinical-practice/adverse-events/other-transfusion-transmitted-infections/transfusion-transmissible-infections>. These advances incrementally lowered the risk of not detecting a recently infected donor but importantly the WP is not eliminated. Thus, despite state-of-the-art donation testing there remains a small but non-zero risk of transmission from donors with very recently acquired infection, who may test negative if they donate during the WP.

All viral positive donors are invited to participate in confidential interviews to establish likely routes of infection. Lifeblood also estimates the risk of transmission (termed 'residual risk') per unit transfused for each TTI and publishes annual updates.

Lifeblood has collected and periodically presented data about TTI-positive Australian blood donors since its establishment in 1996. In 2011, a review of available data pertaining to TTIs in Australia was jointly produced by Lifeblood and the Surveillance and Evaluation Program for Public Health at the Kirby Institute. The 2011 report included data for the period of 2005-2010 and demonstrated an overall reduction in prevalence of TTIs by almost 30% over the six years. Subsequently, annual surveillance reports have summarised data from the current year and trends for TTI-positive blood donors.



References

1. Jayawardena T, Hoad V, Styles C, Seed C, Bentley P, Clifford V, et al. Modelling the risk of transfusion-transmitted syphilis: a reconsideration of blood donation testing strategies. *Vox Sang*. 2019 Feb;114(2):107–16.
2. Styles CE, Seed CR, Hoad VC, Gaudieri S, Keller AJ. Reconsideration of blood donation testing strategy for human T-cell lymphotropic virus in Australia. *Vox Sang*. 2017 Nov;112(8):723–32.

