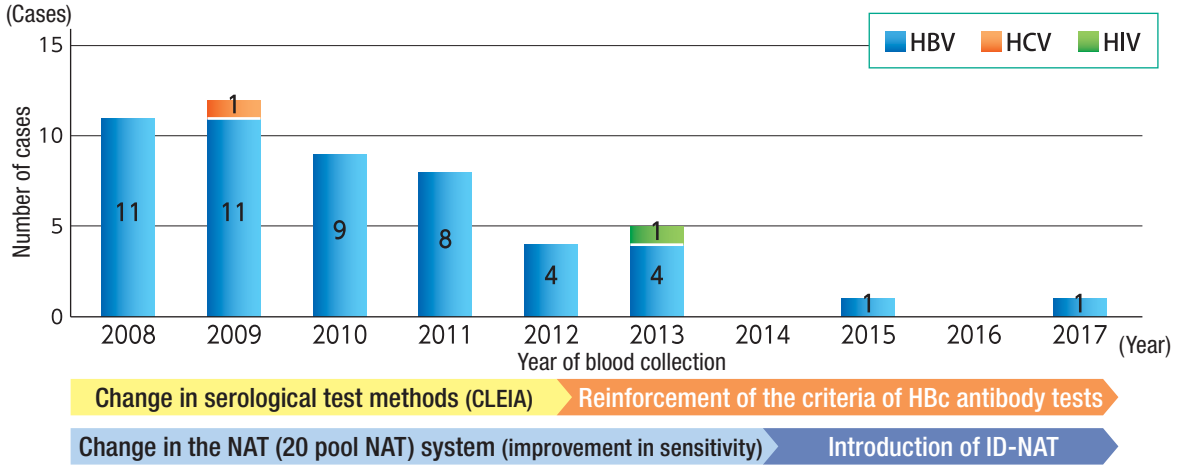
Effectiveness of the Introduction of Safety Measures for Blood Components for Transfusion and Risk of HBV, HCV, and HIV infection due to Transfusion

As measures to secure the safety of blood components for transfusion, the Japanese Red Cross Society reinforced the criteria of HBc antibody tests in August 2012, and introduced individual nucleic acid amplification test of HBV, HCV, and HIV infections due to transfusion (hereinafter referred to as "ID-NAT") in August 2014. We hereby report the effectiveness of the introduction of these safety measures against the above-mentioned infections in the current state as approximately three years have passed since the introduction of ID-NAT.

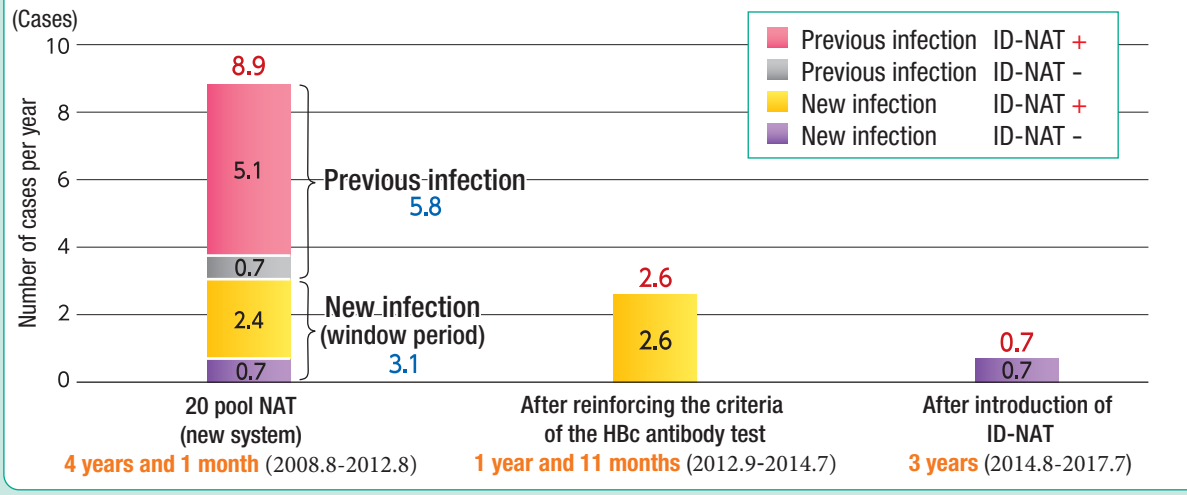
The remaining risk for the above-mentioned infections after the introduction of ID-NAT was calculated as the "theoretical residual risk" according to the WHO guideline (2016).[1] We calculated the "estimated annual number of cases of infection after transfusion" of HBV, HCV, and HIV to provide an idea of the "risks associated with transfusion" to be explained to patients when transfusion is performed based on this theoretical residual risk.

Effectiveness of the introduction of safety measures and the number of cases of HBV, HCV, and HIV infections (2008-2017)

Changes in the number of cases of infections (HBV, HCV, HIV) after transfusion by the year of blood collection



Infection State of the donors as the cause of HBV infection



- Concerning cases of HBV infection due to transfusion, cases due to previous infection have largely decreased after reinforcing the criteria of HBc antibody tests. In addition, cases of new infection (in the window period) have decreased to 2 cases for 3 years (0.7 cases annually) after the introduction of ID-NAT.
- One case each of HCV infection and HIV infection due to transfusion occurred before the introduction of ID-NAT, and both of the cases were due to blood components of ID-NAT positive (*1). No infection due to ID-NAT negative has been observed so far.

*1 ID-NAT using the stored samples of the causative components

Theoretical residual risk and estimated annual number of cases of infection after transfusion

- Based on the number of donations only with ID-NAT positive (serological test negative) from 2015 to 2017, the number of donations at a level below the detection limit by ID-NAT was calculated as the "theoretical residual risk."
- The "estimated annual number of cases of infection after transfusion" was calculated assuming that the number of blood components for transfusion supplied to medical institutions in one year is approximately 5 million units.

	Only ID-NAT positive	Theoretical residual risk*2	Estimated annual number of the cases of infection after transfusion
HBV	Approx. **44** cases (36-55 cases)	**One** case per **740,000** donations (annually 6.54)	**One** case per **1,600,000** transfusions (annually 3.1)*3
HCV	Approx. **4** cases (3-5 cases)	**One** case per **23,000,000** donations (annually 0.21)	Difficult to estimate (theoretical residual risk is small)
HIV	Approx. **1** case (0-1 case)	**One** case per **84,000,000** donations (annually 0.06)	Difficult to estimate (theoretical residual risk is small)

*2 Theoretical residual risk is represented as the maximum value ("mean + 3SD" for 3 years).
*3 "Estimated annual number of the cases of infection after transfusion" was calculated considering the risk of infection according to the difference in the state of infection of the donor[2] in addition to the theoretical residual risk.

[Calculation of theoretical residual risk]

(i) Calculation of the occurrence rate (the number of donations only with ID-NAT positive per 100,000 donors)

The number of donations only with ID-NAT positive for one year is divided by the annual number of donors (actual number of donors with multiple donations) to calculate the occurrence rate per 100,000 donors.
The number of donors (actual number of donors with multiple donations) from 2015 to 2017 was 2,400,000 (2,350,000 to 2,450,000).

$$\text{Occurrence rate} = \frac{\text{Number of donations only with ID-NAT positive for one year (donors with multiple donations)}}{\text{Annual number of donors (actual number of donors with multiple donations)}} \times 100{,}000$$

(ii) Calculation of residual risk (number of donations per 1 million donations)

The occurrence rate (abovementioned (i)) divided by 100,000 is multiplied by the window period of the ID-NAT to obtain the frequency per blood donation to be donated within the window period of the ID-NAT; this value is multiplied by 1 million to calculate the residual risk per 1 million donations. The residual risk of the first donor is calculated as the value 3 times that of a donor with multiple donations according to the WHO guideline (2016).

Residual risk = Occurrence rate (i)/100,000 × window period (yearly) × 1,000,000

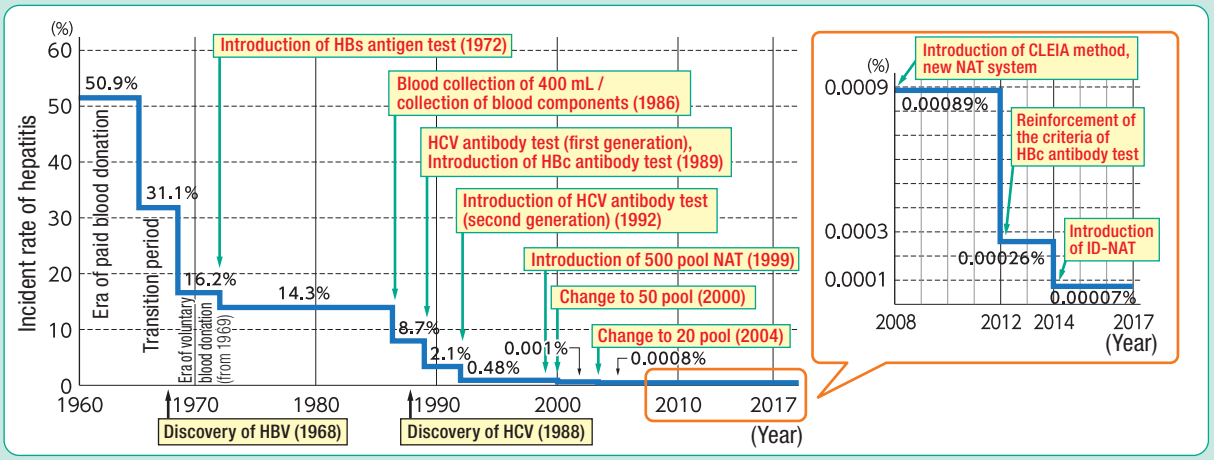
[Window period; 95% detection limit] HBV: 0.058 years (21 days) HCV: 0.014 years (5 days) HIV: 0.014 years (5 days)

(iii) Calculation of the theoretical residual risk

The residual risk (abovementioned (ii)) converted to the annual number of donations is to be the theoretical residual risk, and its maximum value (mean + 3SD) was calculated as follows:

HBV: One case per 740,000 donations (annually 6.54 donations)
HCV: One case per 23,000,000 donations (annually 0.21 donations)
HIV: One case per 84,000,000 donations (annually 0.06 donations)

Safety measures for blood components for transfusion and changes in the incident rate of hepatitis after transfusion



[References]

1) World Health Organization: WHO guidelines on the estimation of the residual risk of HIV, HBV or HCV infections via cellular blood components and plasma. Expert committee on biological standardization 2016.
2) Transfusion Information 0506-89 "Risk of Infections After Transfusion (HBV, HCV, HIV) Based on Analyses of Retrospective Surveillance and Reports on Infections"

In case any of adverse reactions and/or infections related to transfusion of blood components, please notify the medical representatives of your local JRC blood center immediately. Please provide the residual products, the recipient samples, and any other related materials; it is helpful to investigate and/or identify the cause. For storage of residual products and the recipient samples, refer to the "Guidelines for lookback studies of blood products."

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* For more information, please contact the medical representatives of your local JRC blood center.

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