Canadian Blood Services
it's in you to give

Surveillance Report

2016

Executive summary

We are pleased to present the fifth report for our stakeholders describing infectious disease surveillance. High quality and timely surveillance is key to the safety of the blood supply. This includes monitoring of transmissible disease markers that the blood is tested for (including bacteria), investigation of any reports of possible transfusion transmission, as well as a horizon scan for any new pathogens that may pose a risk now or in the future.

The most up-to-date tests for pathogens are used to identify infectious donations and prevent their release for patient use. In 2016, transmissible disease rates per 100,000 donations continued to be very low: HIV 0.3, hepatitis C 4.9, hepatitis B 6.6, HTLV 0.9 and syphilis 6.0. Selective testing of donors at risk of Chagas' disease identified 1 positive donation, and there were 12 donations positive for West Nile Virus. Residual risk estimates of a potentially infectious donation from a unit of blood were revised in 2015. The risk remains very low at 1 in 21.4 million donations for HIV, 1 in 12.6 million donations for HCV and 1 in 7.5 million donations for HBV. Lookback and traceback investigations did not identify any transfusion transmitted infections. Bacterial growth was identified in 16 platelet products. Of 926 samples from mothers donating stem cells collected from the umbilical cord and placenta (called "cord blood") after their babies were born, none were positive for any infectious agent.

Horizon scanning for emerging pathogens monitors potential threats to safety. Risk of a tick-borne disease, babesiosis, continues to be monitored. The parasite (*Babesia microti)* that causes babesiosis appears to be in the early stages of becoming established in a few places in Canada, especially in Manitoba. Chikungunya virus is now established in South and Central America and the Caribbean. It first appeared in the Caribbean in late 2013, and the outbreak extended into South and Central America. A second mosquito borne virus, Zika virus, was identified in Brazil in early 2015. It has spread into other countires in South and Central America, the Caribbean and small pockets of the southern United States. The mosquitoes that transmit these viruses are not resident in Canada. Travellers to some of these areas were being deferred for malaria risk, but in February of 2016 a 3 week deferral for any travel outside Canada, the USA and Europe was put in place to address risk from Zika virus and other short term travel-related infections.

This report features a new section on donor safety. Serious reactions to donation are quite rare, however a recent study showed that iron depletion is relatively common in female donors and people who donate frequently. In 2017, the waiting time between donations for females will be increased from 56 days to 84 days and for males the minimum required hemoglobin will increase from 125 g/L to 130g/L to align with the normal hemoglobin range in males.

In summary, transmissible blood-borne disease is very rare in Canadian Blood Services' donors. Ongoing surveillance and research will continue to play a prominent role in the safety of the blood supply for recipients and for donors.

Introduction

Safety of the blood supply from pathogens involves a multifaceted approach. Donor education materials on the internet and required reading just before donating explain risk factors for transmissible diseases and who should not donate. Before donating blood everyone must complete a health history questionnaire which includes questions about specific risk factors for transmissible diseases and answers are used to decide if people are safe to donate. On July 2, 2016, the pen and paper questionnaire was switched to an electronic questionnaire with both written and audio questions followed by an interview with trained staff. Donors also now have the option to complete the questionnaire on-line before attending a clinic. Electronic questionnaires create a more confidential and comfortable environment for donors to report risk behaviours. All donations are tested for markers of transfusion transmissible agents including HIV (human immunodefiency virus or the AIDS virus), hepatitis B (HBV) and hepatitis C (HCV), human T-cell lymphotropic virus (HTLV) (a rare cause of leukemia) and syphilis. West Nile virus (WNV) testing is done during the at-risk period of the year (spring, summer and fall) and in travelers during the winter season. In addition, donors at risk of Chagas' disease (which is acquired from the bite of an insect in Latin America) are tested, and all platelet products are tested for bacteria.

Surveillance includes monitoring of transmissible disease testing in donors, investigation of possible transfusion transmitted infections in recipients and horizon scanning for new, emerging pathogens. Monitoring the safety of donors is also essential. Although surveillance is conducted in "real time" over each year, final verification steps generally impose a short delay in producing a final report. This report describes Canadian Blood Services' approach to transmissible disease surveillance, as well as data for the calendar year of 2016.

1. Blood Donor Surveillance

The number of blood donations (whole blood and platelet and plasma apheresis) from first time and repeat donors are shown in Figure 1. The majority of donations are from repeat donors (89.7%) with 10.3% of donations from new donors.

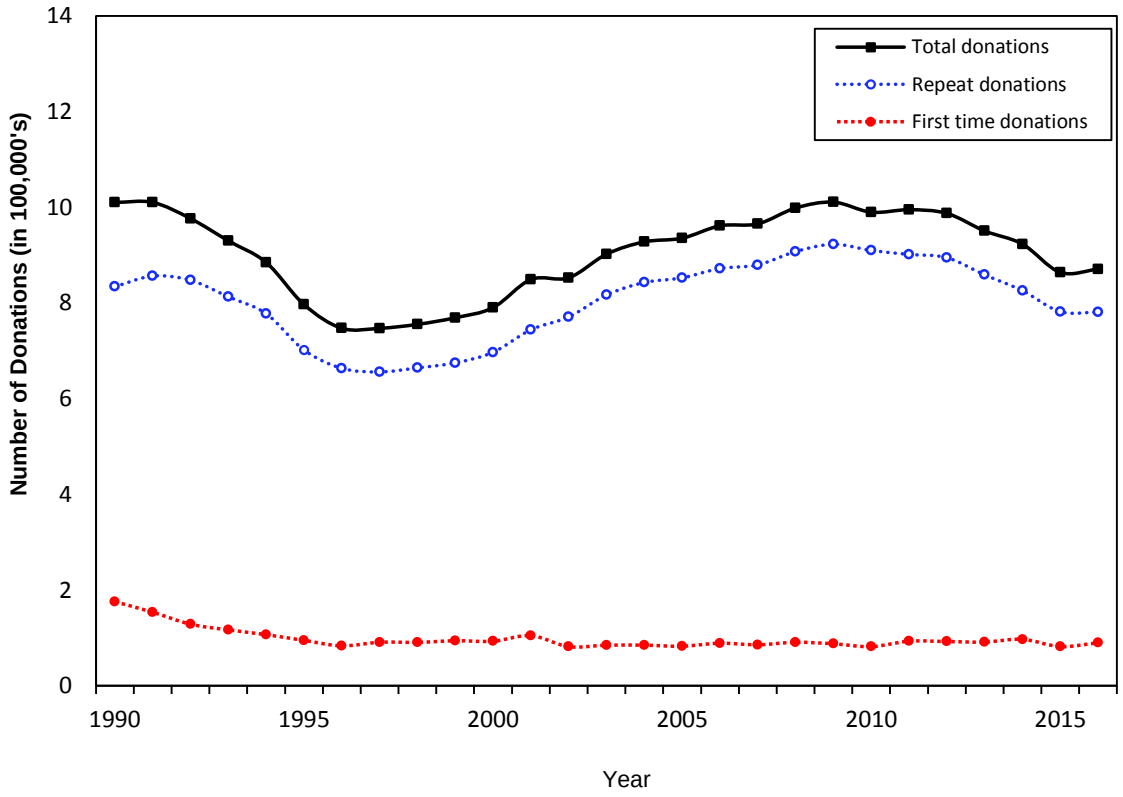


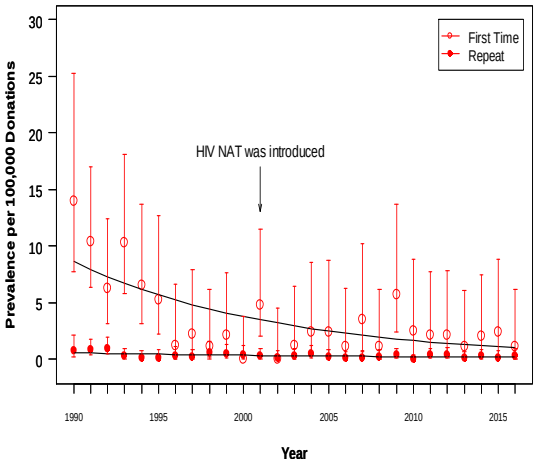
Figure 1 Donations in all Canadian Blood Services Regions, 1990-2016

The "Classical" Pathogens

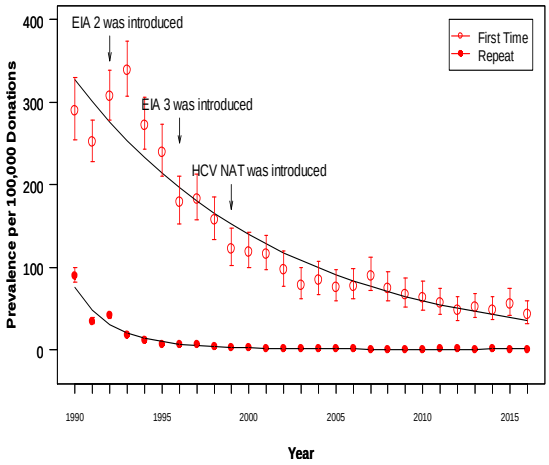
Details of screening tests used and dates of implementation are shown in Appendix 1. In Table 1 the numbers of positive donations and the rates are shown for 2016 by demographic groups. All transmissible disease positive donations occurred in whole blood donations (none in apheresis donations). As shown in Figure 2, the rate per 100,000 donations has decreased for most markers and the rate for repeat donations is extremely low. When a transmissible disease is detected, it is most often in a first time donor as these donors have not been tested previously and may have acquired the infection at any time in their life.

Table 1 Confirmed positive donations and prevalence rates per 100,000 donations in 2016

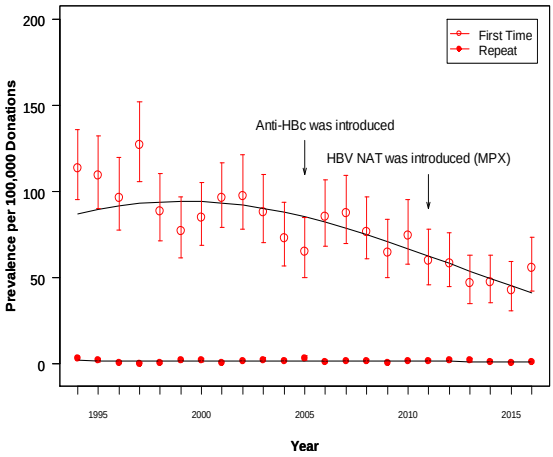
Characteristic	Number of Donations	Percent of Donations	HIV		HCV		HBV		HTLV		Syphilis	
			Pos	Rate	Pos	Rate	Pos	Rate	Pos	Rate	Pos	Rate
Donor status												
First time	89,970	10.3	1	1.1	39	43.4	50	55.6	8	8.9	38	42.2
Repeat	780,885	89.7	2	0.3	4	0.5	7	0.9	0	-	14	1.8
Sex												
Female	363,834	41.8	1	0.3	14	3.9	13	3.6	6	1.7	14	3.9
Male	507,021	58.2	2	0.4	29	5.7	44	8.7	2	0.4	38	7.5
Age												
17-29	197,613	22.7	1	0.5	4	2.0	16	8.1	2	1.0	5	2.5
30-39	138,086	15.9	0	-	6	4.4	9	6.5	0	-	10	7.2
40-49	144,272	16.6	2	1.4	4	2.8	17	11.8	3	2.1	18	12.5
50+	390,884	44.9	0	-	29	7.4	15	3.8	3	0.8	19	4.9
Total	**870,855**	**100.0**	**3**	**0.3**	**43**	**4.9**	**57**	**6.6**	**8**	**0.9**	**52**	**6.0**



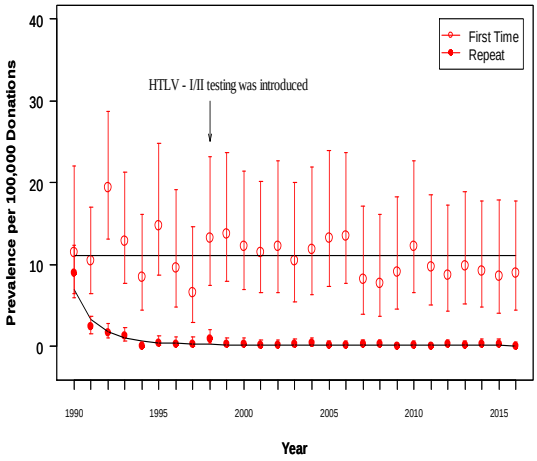
HIV prevalence per 100,000 donations
by donation status, 1990-2016



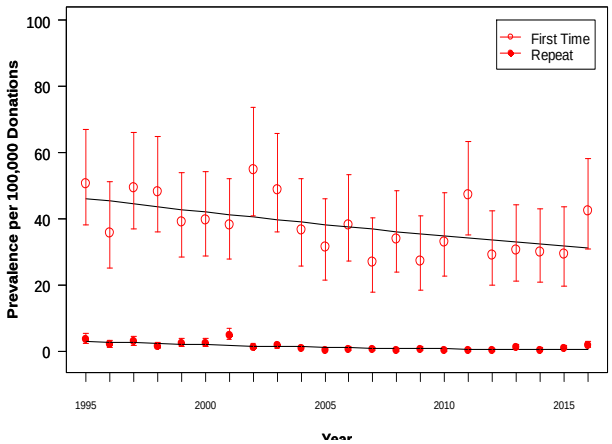
HCV prevalence per 100,000 donations
by donation status, 1990-2016



HBV prevalence per 100,000 donations
by donation status, 1994-2016



HTLV prevalence per 100,000 donations
by donation status, 1990-2016



Syphilis prevalence per 100,000 donations
by donation status, 1995 - 2016

Figure 2 Rate of HIV, HCV, HBV, HTLV and syphilis in first-time and repeat donations
(Note that these graphs have different scales on the y-axis)

All transmissible disease positive donations are destroyed. The main source of risk is from blood donors with a very recently acquired transmissible disease that is too recent to be detected by testing, but may be transmitted by transfusion. This is called the "window period" of infection. With current state-of-the-art testing the window period is very short. For HIV and HCV an infection would be detected within 1 to 2 weeks of a donor being infected, and for HBV within one month. The residual risk of infection is the estimated risk of a potentially infectious donation being given during the "window period". These estimates were revised in 2015 as shown in Table 2. The risk is currently extremely low, but of course it can never be zero.

Table 2 Estimated residual risk of HIV, HCV and HBV

HIV	HCV	HBV
1 in 21.4 million donations	1 in 12.6 million donations	1 in 7.5 million donations

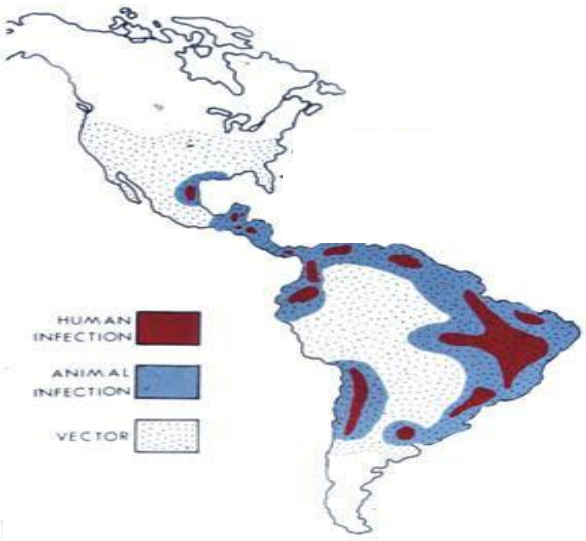
Risk Factors

Risk factor interviews are carried out with donors who test positive for transmissible diseases. For HCV the main risk factors are a history of intravenous drug use or a sexual partner with a history of intravenous drug use, a history of blood transfusion (prior to testing the blood for HCV), having been in prison and being born in Africa or Asia where HCV is more common. For HBV the main risk factor was being born in Africa or Asia where HBV is more common. For HTLV the main risk factors were being born overseas (especially the Caribbean), as well as a history of other sexually transmitted diseases, and a history of blood transfusion. For syphilis the main risk factor was a previous history of syphilis. HIV infections are very rare in donors, therefore difficult to generalize the risk factors. It should be noted that participation is voluntary and therefore there are only data for some donors, and that for many donors no risk factors were identified.

Chagas Disease *(Trypanosoma cruzi)*

Chagas disease is caused by infection with a parasite called *Trypanosoma cruzi* (*T. cruzi*). People can become infected with it after being bitten by an insect that is found mainly in parts of Mexico, Central and South America. The *T. cruzi* parasite can also be passed on from an infected mother to her child during pregnancy and from an infected blood donor by blood transfusion. The insect is not able to live in Canada. Since May, 2010, Canadian Blood Services has been testing donors with risk factors for antibodies to *T. cruzi.* In 2016, there were 18,680 donations from donors with risk factors, and 1 had a positive test for *T. cruzi* antibody.

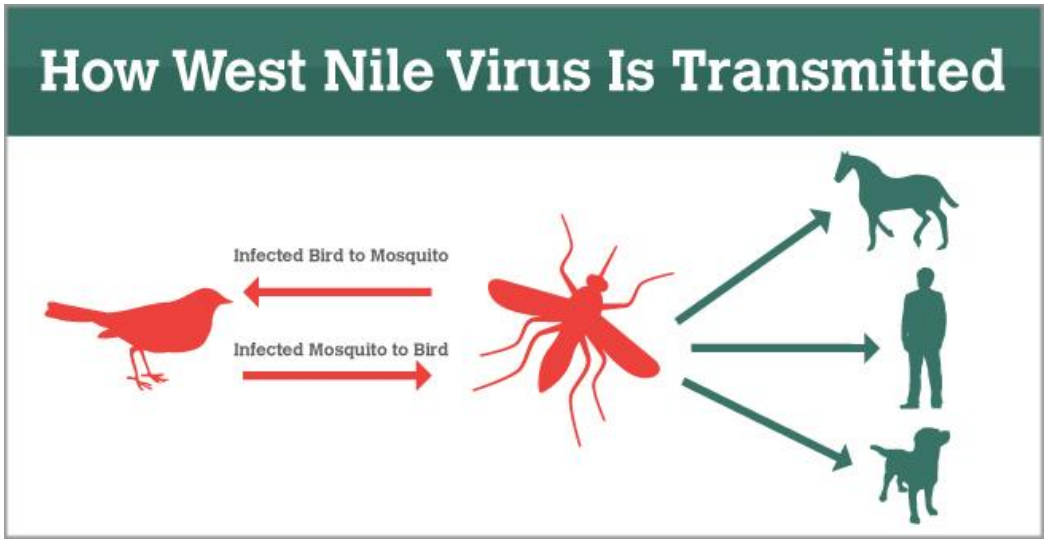
Riduviid bug which carries *T. cruzi* (the parasite that causes Chagas' disease)



Regions of the world endemic for *T. cruzi*

West Nile Virus

West Nile virus is a mosquito borne virus that has been present in North America since 1999 (in Canada since 2002). Although symptoms can be severe, they are usually mild and most people are not aware of their infection. During spring, summer and fall, donations are routinely tested in a minipool of 6 donations. However, to further reduce the risk, a risk assessment algorithm is applied to identify all donations from areas where West Nile virus is active and these are tested as single units rather than in a minipool. In 2016, 12 donations tested positive for West Nile virus. They were identified in August and September in Ontario, Manitoba and Saskatchewan. As of December 2015 seasonal WNV testing was implemented, with only donors with travel risk being tested over the winter.

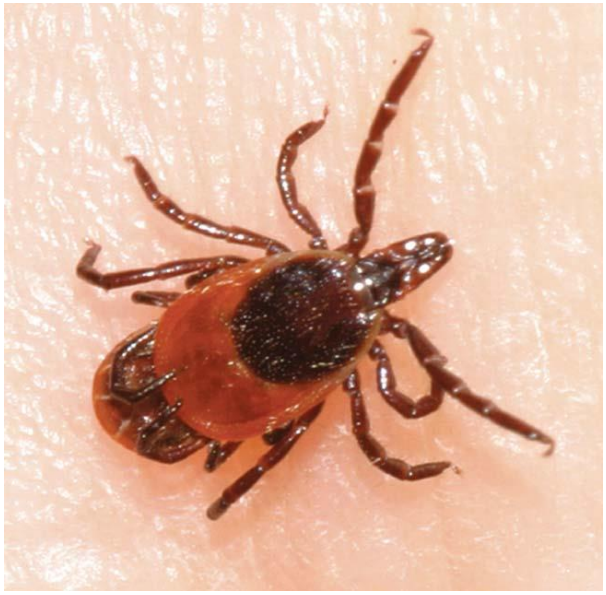


2. Surveillance for Emerging Pathogens

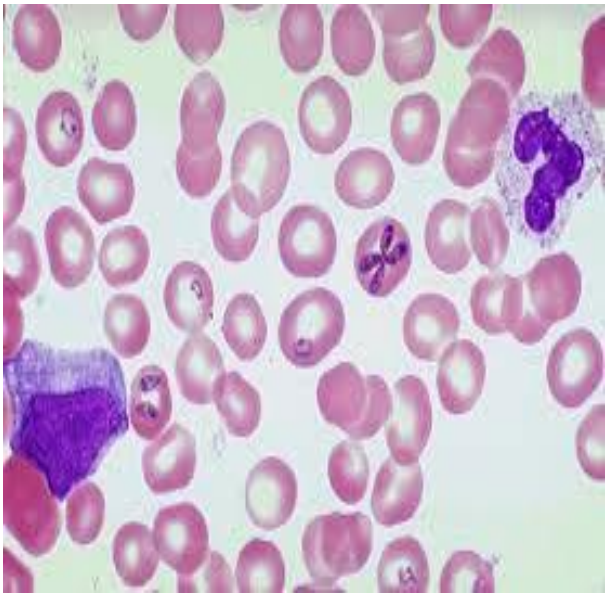
A horizon scan of potentially blood borne infectious diseases in the general community ensures rapid revision of safety policy. Even before new infectious disease is reported in Canada, we can be aware of them by monitoring outbreaks in other parts of the world. International travel is commonplace and infections can rapidly enter from other countries. To ensure that potential risks are identified in a timely fashion, Canadian Blood Services needs to be connected with the latest infectious disease information at all times. Integral to this is active participation of Canadian Blood Services medical and scientific staff in public health and infectious disease professional organizations as well as monitoring of web sites and journals where new information is posted. In order to ensure readiness to act in the event of a new infectious disease threat, Canadian Blood Services maintains a plan to address pandemic influenza, which can be adapted to deal with other large outbreaks affecting donors and staff.

Babesiosis

Babesiosis is acquired from the bite of a tick (*Ixodes scapularis*), more commonly called the black-legged tick. Usually it causes mild flu-like symptoms, and many people are not even aware that they have had it. However, it can also be transmitted by blood transfusion from an infected donor, and infection in blood recipients can result in severe illness or death. To date babesiosis cases have been documented in the United States, mainly in the North Eastern states, but following the designation of this infection as a reportable disease in 2012 more than 1,500 cases are now reported per year. In addition, over 150 infections in the USA are believed to have been acquired from a transfusion. The parasite appears to be in the early stages of becoming established in ticks in Canada, but to date only one human case acquired from tick exposure in Canada has been reported. In a 2013 study, 10,062 blood donations were tested from areas of potential risk and none were positive. Ongoing monitoring indicates that *Babesia microti* presents very low risk to the blood supply at this time, but the study should be repeated periodically.



Black-legged tick



Babesia microti

Hepatitis E

Hepatitis E is relatively common in developing countries where it is spread through contaminated food and water. It also is associated with eating undercooked pork. Similar to hepatitis A, healthy people often do not get very sick, generally clear the infection and often never know that they had it. However, blood recipients could become very ill. In a 2013 study 10,062 blood donations from various locations in Canada were tested for hepatitis E virus (nucleic acid testing) and a subset of 2,048 donations were also tested for the antibody to hepatitis E. None were positive for the virus, but 110 donations (5.1%) were positive for antibody. This indicates that some donors were likely infected with the hepatitis E virus at some point in their lives, but had cleared the infection at the time of donation, so they did not pose a risk to blood recipients. A study is currently in progress to test a larger number of donors for hepatitis E virus.

Tropical Mosquito Borne Viruses

Some mosquito borne viruses in travel destinations popular with Canadians carry potential risk for transfusion transmission for a period of time after donors return from travel. Malaria risk is present in parts of the Caribbean, Mexico, Central and South America, as well as parts of Asia and Africa. Donors are deferred after travel to these risk areas until enough time has passed that an infection would be cleared. Dengue virus is present in many of the same areas as malaria, and extends into adjacent areas where malaria does not. Although present in these areas for many years, there have been no transfusion transmitted cases of Dengue virus in Canada. Chikungunya virus has caused outbreaks since the 1950s, mostly in Asia and Africa, but has more recently been seen in the Caribbean, Mexico and Central/South America. Most individuals infected with Chikungunya virus experience mild to moderate flu-like symptoms, but in severe cases debilitating joint pain occurs. In late 2013, Chikungunya appeared for the first time in the Americas, in particular the Caribbean. The risk of transfusion

transmission in Canada, at the height of the epidemic was estimated to be very low (less than 1 in 6 million donations).

Zika Virus

In 2015, another mosquito borne virus, Zika virus, was reported in Brazil and this large outbreak has spread to Central/South America, Mexico and the Caribbean. Most people infected with Zika virus do not have symptoms, but those who do can experience headache, rash, fever and joint pain. It has been linked with microcephaly in newborns of infected mothers. The types of mosquitoes that carry this virus are found in southern parts of the USA but at this point do not survive in Canada. Some of the risk from tropical mosquito borne viruses such as Zika virus was being addressed with deferral for malaria risk travel, but in February 2016, a 21 day deferral after returning from travel outside of Canada, continental USA or Europe was implemented to address risk from Zika virus and other short term travel-related infections. With this in place, the risk of travel-related Zika virus in the blood supply is estimated to be less than 1 in 200 million donations. Zika virus can also be transmitted sexually, which in non-endemic countries such as Canada would be from infected travelers to their sexual partners. Reports of sexual transmission are very rare, and the risk to the Canadian blood supply was estimated to be vanishingly small (1 in 41.6 million donations). There have been some cases of endemic (locally acquired) Zika virus in the southern United

States, however the risk to the Canadian blood supply from travelers to the US is extremely low (1 in 45.5 million donations). To date there have been no cases of transfusion transmitted Zika virus in the US or Canada.

3. New Initiatives

Pathogen Reduction

A study of a pathogen reduction system for platelet products was completed this year. The Mirasol Pathogen Reduction System for Platelets uses riboflavin (vitamin B_2) to inactivate many viruses, bacteria and parasites when exposed to ultraviolet light. It may also reduce the risk of graft versus host disease for platelet recipients. Before considering implementing such a system it is important to confirm that it does not reduce the effectiveness of the platelets to stop bleeding in patients. To do this, adult patients who have blood cancers and low platelets and who have volunteered to be in the study were randomly assigned to either receive the Mirasol pathogen reduced platelets or our regular platelets, and were then monitored for any adverse effects, especially unexpected bleeding. This study was carried out at selected hospitals in Canada, the Netherlands and Norway. Over 567 platelet recipients were enrolled in the study, including 131 from Canada. The final results of the study will be announced by mid-2017.

Donor Eligibility Criterion for Male to Male Sex

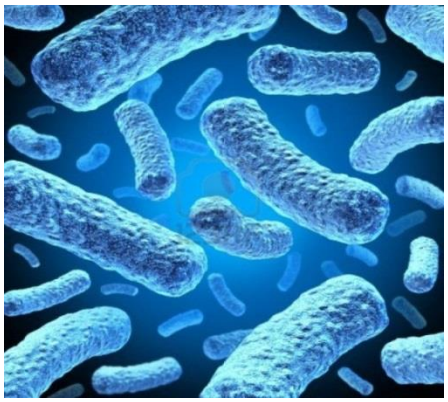
Since the 1980s men who have had sex with another man even once since 1977 were not eligible to donate blood to reduce the risk from HIV. With much improved donor testing and surveillance for emerging pathogens, following consultation with patient and community stakeholders, in July, 2013, male donors became eligible to donate if they have not had sex with another man in the past 5 years. Evaluation of the change in Canada to a 5 year deferral period over two years showed no decrease in safety, but a small increase in newly eligible male donors. HIV rates in blood donors did not increase, and donor compliance with the deferral was not adversely affected. Additional consultations were carried out with our stakeholder groups over 2015, and a 12 month deferral was implemented in August, 2016. Other countries such as the USA, England and Australia have also switched to a 12 month deferral. HIV rates have not increased after the change, and a donor survey to estimate compliance with the deferral is planned for 2017.

4. Lookback/Traceback

All cases of potential transfusion transmission of disease are investigated. When a donor tests positive for a transmissible disease, or if the donor reports a transfusion transmissible disease after donating, a lookback file is opened. All previous donations are identified and hospitals are asked to contact the recipients of these donations to arrange testing. A traceback is initiated when a recipient is found to have a transmissible disease and it is queried as to whether it could have been from their blood transfusion. All blood products that the recipient received are identified by the hospital, and Canadian Blood Services attempts to contact the donors of these products to arrange testing.

There were 70 lookback cases for repeat donors opened for donations in 2016 (30 for donors that tested positive with in-house testing, 39 from external testing or public health notification and 1 identified during traceback investigation). Of these 49 were closed (all recipients that could be contacted were tested, 7 HIV, 32 HCV, and 10 HBV). The remaining 21 cases were still open at the end of 2016. There were also 24 cases involving repeat donors from previous years closed. No closed cases were associated with transfusion transmission. There were 58 traceback cases opened in 2016 (3 HIV, 48 HCV, 7 HBV). Of these, 47 were closed (all donors that could be contacted were tested), and 11 remain open. There were also 18 cases from previous years closed. There were no closed cases associated with transfusion transmission.

5. Bacteria



Bacteria in blood products usually come from the skin of donors during their blood donation, although occasionally they may originate from bacteria present in the donor's bloodstream. The amount of contaminating bacteria is usually very low, but because platelet products are stored at room temperature the bacteria can multiply to reach high concentrations and then pose a serious risk to the recipient. Canadian Blood Services tests all apheresis and pooled platelet products for bacteria using the BacT/ALERT System in which a sample from the product is inoculated into a culture bottle and monitored for growth for the full shelf life of the product. The product is recalled and returned to Canadian Blood Services if any bacterial growth is detected and the product is still available (ie, has not been transfused or discarded). In 2016, 113,133 platelet products (21,266 apheresis and 91,867 pooled products) were tested, of which 24 apheresis and 74 pooled products had initial positive results for bacterial growth in the culture bottle. From these, 1 and 15 cultures were confirmed as true bacterial contaminations, for apheresis and pooled products, respectively. In addition, 4 apheresis and 7 pooled products with initial positive results were not confirmed as they were issued and/or transfused. This represents 27 products in total (2.39 per 10,000) with a chance of bacterial contamination with current testing, including both true positives and suspected positives.

6. Canadian Blood Services' Cord Blood Bank

The blood that is left in the umbilical cord and placenta (called "cord blood") after a baby is born contains immature cells called stem cells. Canadian Blood Services collects cord blood at 5 sites in Canada. Participating mothers at these centres who volunteer to donate their cord blood complete a questionnaire about medical conditions that could be passed on to a patient as well as risk factors for transmissible disease. A blood sample from the mother is tested for the same transmissible infections as blood donors (HIV, hepatitis B and C, HTLV, syphilis, West Nile virus and Chagas disease). If the donation is suitable for transplantation (i.e., has enough stem cells) and is negative for all infections, the cells are frozen and stored until a patient needs them. In 2016, there were 926 blood samples tested and none were positive for any infectious disease markers.

7. Donor Safety

Canadian Blood Services takes numerous precautions to ensure that blood donations are safe for donors as well as recipients. Donor safety measures include a medical history, a hemoglobin fingerstick screen, as well as hydration and refreshments with monitoring post-donation. Problems from donation are rare, but it is important to keep track of any incidents that occur so that donor care can be improved.

The Donor Reaction and Incident Manual (DRIM) at Canadian Blood Services provides a guideline for assessment and management of reactions and incidents related to donation. In 2013, the DRIM was updated to align with international definitions, terms and descriptions. The recent standardization of definitions and the centralization of reporting allows for better monitoring of donor reactions. Adverse reactions are more often seen in first time donors, young donors (17-25 years old) and in female donors. The majority of reactions are mild, such as feeling faint and bruising at the needle site. In 2016, nerve irritation from the venipuncture was reported in 3 out of 10,000 donations. Fainting (vasovagal reaction with loss of consciousness) was reported in 15 out of 10,000 donations with a further breakdown of these reactions by sex and donation history in Table 3.

Table 3. Vasovagal Reactions with loss of consciousness* per 10,000 donations

	Male	Female
First Time Donor	42.2	58.4
Repeat Donor	6.6	14.3

*moderate and severe vasovagal reactions only

Note: For all comparisons $p<0.01$

The most common reason for a donor deferral at the clinic is a failed hemoglobin fingerstick screen. Low hemoglobin is often related to low iron stores. Iron is needed to make hemoglobin and subsequently red blood cells. Canadian Blood Services requires a minimum hemoglobin level to ensure donor safety and product quality. Iron stores can be measured by testing the blood for ferritin; however this test cannot be performed on the clinic and is not routinely done. Canadian Blood Services recently completed a study of over 13,000 donors which showed that low iron stores (iron deficiency) is most often seen in female donors and people who donate regularly. To reduce the chance of developing iron deficiency the minimum interval between donations for females will be increased from 56 days to 84 days in 2017, with a maximum of 4 donations of whole blood annually. For males, the minimum required hemoglobin will increase from 125 g/L to 130g/L to align with the normal hemoglobin range in males. Research is ongoing into the possibility of performing ferritin testing in some donors and it is expected that further steps will be taken in the future.

Information about iron and the safety of blood donation can be found at www.blood.ca as well as in the 'What you must know to give blood' pamphlet provided to all donors prior to every donation. Scientific studies can be found in the reference section of this report.

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APPENDIX I.

Implementation Dates of Testing

	Marker	Implementation Date*
1	**Syphilis**	1949
2	**HBV (Hepatitis B Virus)**	
	HBsAg	1972
	Anti-HBc	2005
	HBV NAT	2011
3	**HIV (Human Immunodeficiency Virus)**	
	Anti-HIV-1 EIA (enzyme-linked immunosorbent assay)	1985
	Anti-HIV-1/2 EIA	1992
	HIV-1 p24 antigen	1996 (discontinued in 2003)
	HIV-1 NAT	2001
	Anti-HIV-1/2 (including HIV-1 subtype O) EIA	2003
4	**HTLV (Human T-Lymphotropic Virus)**	
	Anti-HTLV-I	1990
	Anti-HTLV-I/II	1998
5	**HCV (Hepatitis C Virus)**	
	Anti-HCV EIA/ELISA	1990
	HCV NAT	1999
6	**WNV (West Nile Virus)**	
	WNV NAT	2003
7	**Chagas' disease (*Trypanosoma cruzi)* selective testing**	2010
8	**Bacteria**	
	BacT Alert	2004

*These are the dates that testing for the marker began. Tests have been upgraded as new versions of the test became available.