Canadian Blood Services
it's in you to give

Surveillance Report

2015

Executive summary

We are pleased to present the fourth 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 2015, transmissible disease rates per 100,000 donations continued to be very low: HIV 0.4, Hepatitis C 5.8, Hepatitis B 4.4, HTLV 1.0 and Syphilis 3.6. Selective testing of donors at risk of Chagas' disease identified 1 positive donation, and there were 2 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 8 platelet products. This year we also report on infectious disease testing for stem cells collected from the umbilical cord and placenta (called "cord blood") after babies are born. Of 878 samples tested, one was positive for hepatitis C.

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. Starting in late 2013 and continuing through 2015, large outbreaks of a mosquito borne infection have occurred in South and Central America and the Caribbean. Chikungunya virus, 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, and more recently into the Caribbean. The mosquitoes that transmit these viruses are not found in Canada. Travellers to some of these areas are being deferred for malaria risk, but the situation is being carefully monitored to determine whether further action is warranted.

In summary, transmissible disease continues to be very rare in Canadian Blood Services' donors. Ongoing surveillance will continue to play a prominent role in the safety of the blood supply.

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. All donations are tested for markers of transfusion transmissible agents including HIV (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.

Canadian Blood Services carries out comprehensive surveillance of blood borne pathogens to monitor changing trends in known infections and to identify new infectious diseases. This information allows us to put additional safeguards in place to reduce any risk to recipients of blood products. Surveillance includes monitoring of transmissible disease testing in blood donors, investigation of possible transfusion transmitted infections in blood recipients and horizon scanning for new, emerging pathogens. 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 2015.

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 (90.5%) with 9.5% of donations from new donors.

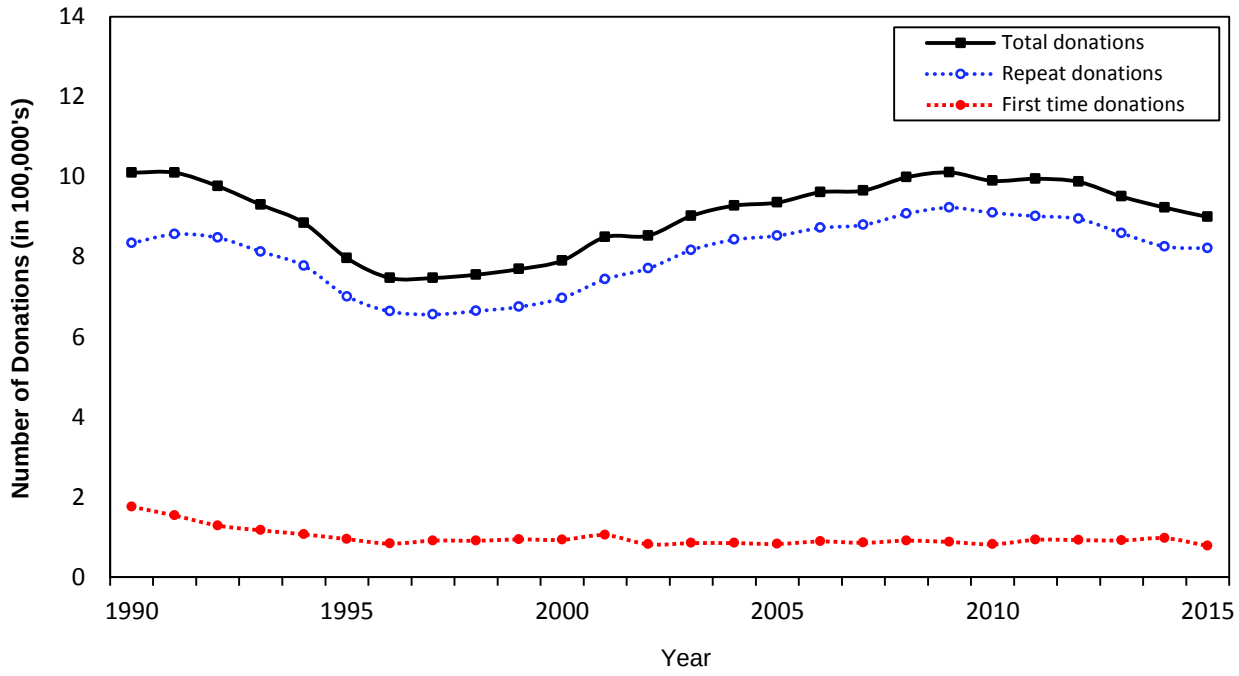


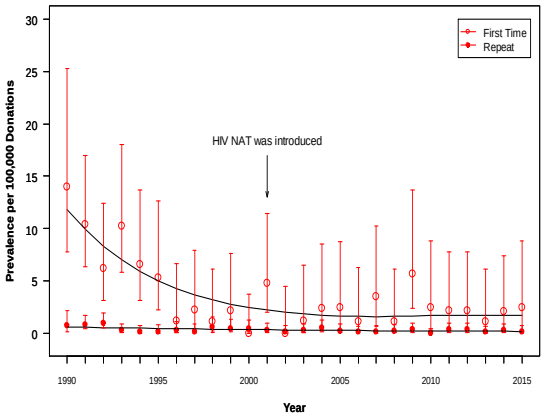
Figure 1 Donations in all Canadian Blood Services Regions, 1990-2015

The "Classical" Pathogens

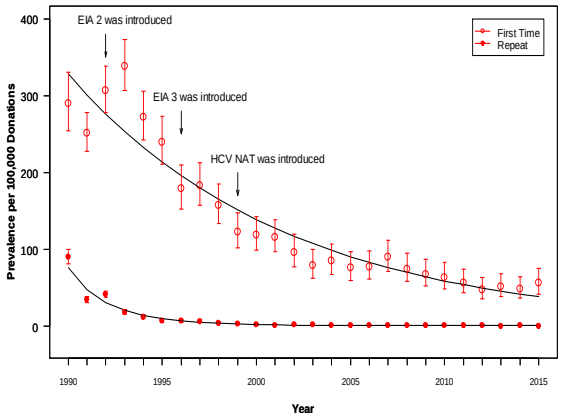
All blood donations are tested for transmissible diseases and rates of positive testing results are monitored in order to detect changes in trends. Details of screening tests used and dates of implementation are shown in Appendix 1. In Table 1 the number of positive donations and the rate is shown for 2015 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 2015

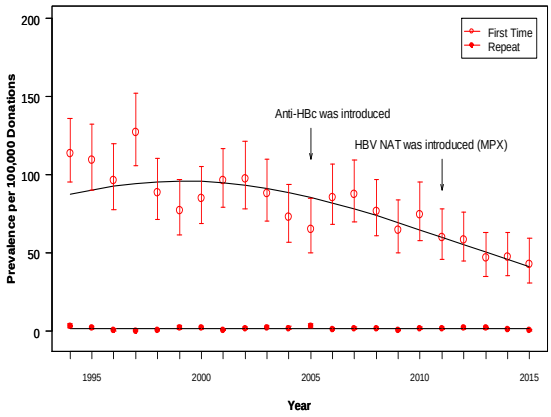
Characteristic	Number of Donations	Percent of Donations	HIV		HCV		HBV		HTLV		Syphilis	
			Pos	Rate	Pos	Rate	Pos	Rate	Pos	Rate	Pos	Rate
Donor status												
First time	82,140	9.5	2	2.4	46	56.0	35	42.6	7	8.5	24	29.2
Repeat	782,032	90.5	1	0.1	4	0.5	3	0.4	2	0.3	7	0.9
Sex												
Female	362,511	42.0	2	0.6	16	4.4	11	3.03	6	1.7	10	2.8
Male	501,661	58.0	1	0.2	34	6.8	27	5.38	3	0.6	21	4.2
Age												
17-29	196,165	22.7	1	0.5	13	6.6	8	4.1	2	1.0	5	2.6
30-39	129,275	15.0	2	1.6	7	5.4	12	9.3	0	-	3	2.3
40-49	147,237	17.0	0	-	5	3.4	8	5.4	3	2.0	10	6.8
50+	391,495	45.3	0	-	25	6.4	10	2.6	4	1.0	13	3.3
Total	**864,172**	**100**	**3**	**0.4**	**50**	**5.8**	**38**	**4.4**	**9**	**1.0**	**31**	**3.6**



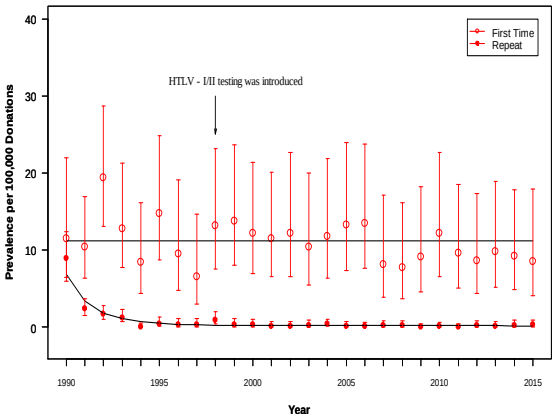
HIV prevalence per 100,000 donations
by donation status, 1990-2015



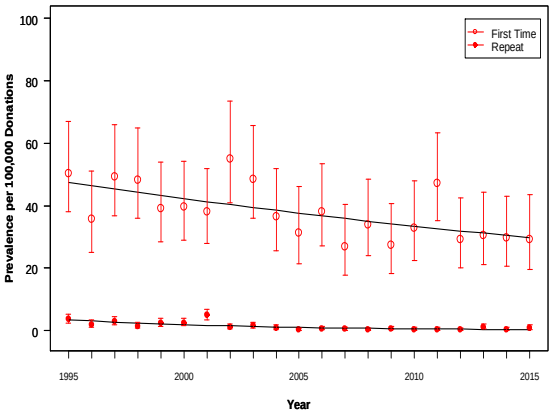
HCV prevalence per 100,000 donations
by donation status, 1990-2015



HBV prevalence per 100,000 donations
by donation status, 1994-2015



HTLV prevalence per 100,000 donations
by donation status, 1990-2015



Syphilis prevalence per 100,000 donations
by donation status, 1995 - 2015

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 and never released into inventory. 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 HIV the main risk factor is multiple sex partners. 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. 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.

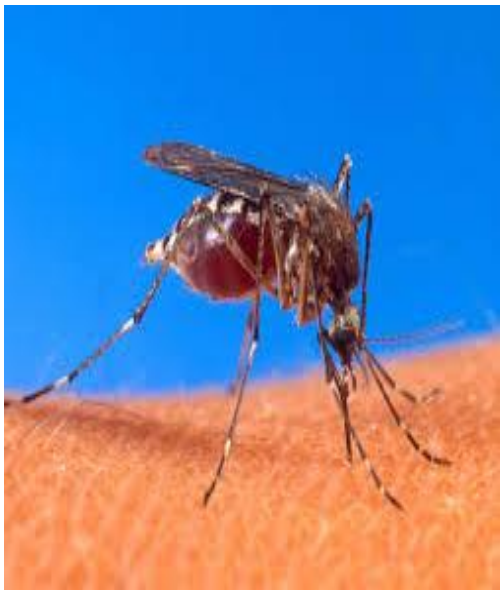
Chagas Disease *(Trypanosoma cruzi)*

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

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 2015, there were 15,265 donations from donors with risk factors, and 1 had a positive test for *T. cruzi* antibody.

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. All 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 2015, 2 donations tested positive for West Nile Virus. They were identified in August and September in Ontario (Hamilton and Toronto). As of December 2015 seasonal WNV testing was implemented, with only donors with travel risk being tested over the winter.

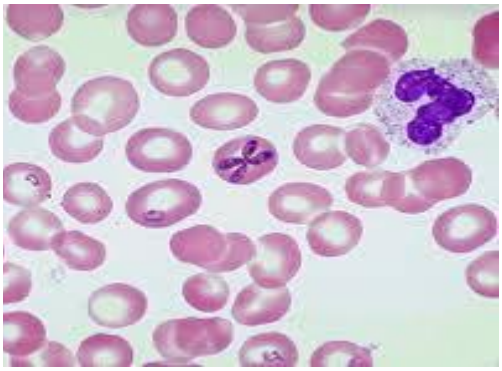
2. Surveillance for emerging pathogens

A central feature of surveillance is a horizon scan of potentially blood borne infectious diseases in the general community. It is important to be aware of emerging infectious diseases in other parts of the world as well as in Canada since 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 staff and donors.

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 the number of reported cases has been increasing following the designation of this infection as a reportable disease in 2012, and 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.

Black-legged tick



Babesia microti

Hepatitis E

Hepatitis E is relatively common in developing countries where it is spread through contaminated food and water. 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 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 being planned to test a larger number of donors for Hepatitis E virus.

Mosquito borne viruses

Some mosquito borne viruses in travel destinations popular with Canadians carry potential risk for transfusion transmission from an infected donor 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 from travelers to these areas. Chikungunya virus and Zika virus have caused outbreaks since the 1950's, mostly in Asia and Africa but have 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. Most people infected with Zika virus do not have symptoms, but those who do can experience headache, rash, fever and joint pain, and it has been linked (although not proven) with microcephaly in newborns of infected mothers. 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). In 2015, Zika virus was also reported in Brazil and this large outbreak has spread to Central/South America, Mexico and more recently into the Caribbean. The types of mosquitoes which carry these viruses are found in southern parts of the USA but at this point do not survive in Canada. There have been a few cases of endemic (locally acquired) Chikungunya in Florida but no cases of endemic Zika virus in North America to date. Currently some of the risk from Dengue, Chikungunya and Zika viruses is already addressed with deferral for malaria risk travel, but the risk is being carefully monitored to determine whether any additional precautionary travel deferral is required.

Note: In February, 2016 Canadian Blood Services implemented a deferral of 21 days after returning from travel outside of Canada, continental USA or Europe to address risk from Zika virus and other short term travel-related infections.

Middle East Respiratory Syndrome

The Middle East respiratory syndrome (or MERS) was first reported in Saudi Arabia in 2012. It is caused by MERS-CoV, a coronavirus from the same family of viruses that caused the SARS outbreak in Toronto in 2003. So far over 1,290 cases of MERS-CoV have been reported, but they have all been linked to the Middle East (mostly Saudi Arabia) where camels are thought to be an important animal reservoir for the virus. No cases have been reported in Canada to date.

3. New Initiatives

Pathogen Reduction

A study of a pathogen reduction system for platelet products is currently under way. 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 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 are randomly assigned to either receive the Mirasol pathogen reduced platelets or our regular platelets, and are being monitored for any adverse effects. This study is currently being carried out at selected hospitals in Canada, the Netherlands and Norway. To date, over 525 platelet recipients have been enrolled in the study, including 114 from Canada. In total the study will involve 618 platelet recipients.

Donor Eligibility Criterion for Male to Male Sex

Since the 1980's 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. Some other countries have implemented shorter deferral periods (for example 12 months in England and Australia) and have not seen any

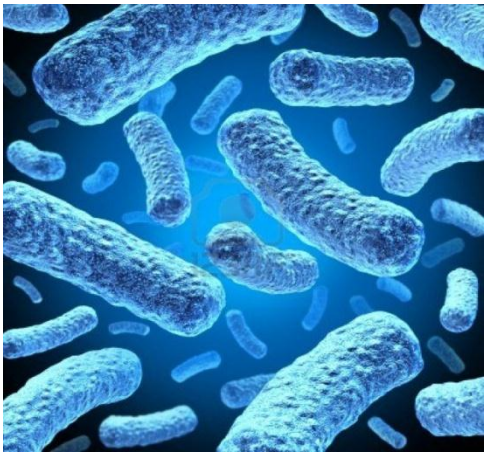
evidence of increased risk to the blood supply. In December, 2015 the US FDA modified regulatory guidance to permit a 12 month deferral period. Evaluation of the change in Canada to a 5 year deferral period over two years showed no decrease in safety, but a small increase in newly eligible male donors. HIV rates in blood donors did not increase, and donor compliance with the deferral was not adversely affected. Having carried out additional consultations with our stakeholder groups over 2015, a proposal to change to a one year deferral will be made to our regulator, Health Canada, in 2016.

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 (even if it is not one that would normally be tested for) 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 207 lookback files opened for donations that tested positive in 2015 (107 for donors that tested positive, 97 from public health notification and 3 identified during traceback investigation). Of these, 98 were from first time donors which had no previous donations to examine. The remaining 109 cases included 9 HIV, 75 HCV, 21 HBV, and 4 HTLV positive donors; no lookbacks were started for Chagas disease. Of these, 58 cases were closed (all recipients that could be contacted were tested) and 51 cases were still open. There were also 66 cases from previous years closed. No cases were associated with transfusion transmission. There were 88 traceback cases opened in 2015 (5 HIV, 64 HCV, 18 HBV, and 1 HTLV). Of these, 73 were closed (all donors that could be contacted were tested), and 15 remain open. There were also 33 cases from previous years closed. There were no 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 a systemic infection in the donor. 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 5-day 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 2015, 112,038 platelet products (22,860 apheresis and 89,178 pooled products) were tested, of which 31 apheresis and 65 pooled products had initial positive results for bacterial growth in the culture bottle. From these, 1 and 7 cultures were confirmed as true bacterial contaminations, for apheresis and pooled products, respectively. In addition, 7 apheresis and 6 pooled products with initial positive results were not confirmed as they were issued and/or transfused. This represents 21 products in total (1.87 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. Cord blood stem cells can be used to treat over 80 diseases and disorders such as leukemia and inherited disorders. To successfully transplant cord blood stem cells, the donation and recipient need to match very closely on a number of criteria. About three quarters of Canadian patients who need stem cell transplants must look outside of their immediate families for a match. Canadian Blood Services' Cord Blood Bank collects cord blood stem cells at five hospitals in Canada. Delivery of those stem cells to patients in Canada and around the world is coordinated by Canadian Blood Services'

OneMatch Stem Cell and Marrow Network. Canadian Blood Services' Cord Blood Bank benefits patients by providing people in need of stem cells with an increased opportunity for transplant. It also reduces Canada's reliance on internationally sourced cord blood stem cell donations.

Established on September 30, 2013, Canadian Blood Services' Cord Blood Bank now collects cord blood donated from volunteering mothers at designated hospitals in Ottawa and Brampton, Ontario, Edmonton, Alberta and Vancouver, British Columbia. 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 and 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 (e.g., has enough stem cells) and is negative for all infections, the cells are frozen and stored until a patient needs them. In 2015, there were 878 blood samples tested of which one was positive for Hepatitis C. No donations were positive for any other infections.

7. References

Donor Screening

O'Brien SF, Fan W, Xi G, Yi Q-L, Goldman M. Evaluation of the confidential unit exclusion form: the Canadian Blood Services experience. Vox Sang 2010; 98:138-144.

O'Brien SF, Xi G, Yi Q-L, Goldman M. Understanding non-disclosure of deferrable risk: A study of blood donors with a history of intravenous drug use. Transfus Med 2010; 20:15-21.

Goldman M, Yi Q-L, Ye X, Tessier L, O'Brien SF. Donor understanding and attitudes about current and potential deferral criteria for high-risk sexual behavior. Transfusion 2011; 51:1829-1834.

O'Brien SF, Osmond L, Choquet K, Yi Q-L, Goldman M. Donor attention to reading materials. Vox Sang 2015; 109:336-342.

Residual Risk

O'Brien SF, Zou S, Laperche S, Brant LJ, Seed CR, Kleinman SH. Surveillance of transfusion transmissible infections: Comparison of systems in five developed countries. Transfus Med Rev 2012; 26:38-57.

O'Brien SF, Yi Q-L, Fan W, Scalia V, Fearon MA, Allain J-P. Current incidence and residual risk of HIV, HBV and HCV at Canadian Blood Services. Vox Sang 2012; 103:83-86.

Babesia microti

O'Brien SF, Delage G, Scalia V, Lindsay R, Bernier F, Dubuc S, et al. Seroprevalence of *Babesia microti* infection in Canadian blood donors. Transfusion 2016;56:237-243.

West Nile Virus

O'Brien SF, Scalia V, Zuber E, Hawes G, Alport T, Goldman M, Fearon MA. West Nile Virus in 2006 and 2007: The Canadian Blood Services' Experience. Transfusion 2010; 50:1118-1125.

Chagas Disease

O'Brien SF, Scalia V, Goldman M, Fan W, Yi Q-L, Dines IR, Huang M, Ndao M, Fearon MA. Selective testing for Trypanosoma cruzi (*T. cruzi*): The first year post-implementation at Canadian Blood Services. Transfusion 2013; 53:1706-1013.

O'Brien SF, Scalia V, Goldman M, Fan W, Yi Q-L, Huang M, Ndao M, Fearon M. Evaluation of selective screening of donors for antibody to Trypanosoma cruzi (*T. cruzi*): Seroprevalence of donors who answer "no" to risk questions. Transfusion 2014;54:863-869.

Bacteria

Jenkins C, Ramírez-Arcos S, Goldman M, Devine DV. Bacterial contamination in platelets: incremental improvements drive down but do not eliminate risk. Transfusion 2011; 51:2555-2565.

Ramírez-Arcos S, Alport, T, Goldman M. Intermittent bacteremia detected in an asymptomatic apheresis platelet donor with repeat positive culture for *Escherichia coli*: A case report. Transfusion 2015;55:2606-2608.

Malaria

O'Brien SF, Uzicanin S, Choquet K, Yi Q-L, Fan W, Goldman M. Impact of changes to policy for Mexican risk travel on Canadian blood donor deferrals. Blood Transfusion 2013; 11:580-584.

O'Brien SF, Delage G, Seed CR, Pillonel J, Fabra CC, Davison K, Kitchen A, Steele WR, Leiby DA. The epidemiology of imported malaria and transfusion policy in 5 non-endemic countries. Transfus Med Rev 2015; 29:162-171.

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.