Canadian Blood Services
it's in you to give

Surveillance Report

2017

Executive summary

We are pleased to present the sixth annual report describing transmissible blood-borne infection 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) and 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 2017, transmissible infection rates per 100,000 donations continued to be very low: HIV 0.2, hepatitis C 6.1, hepatitis B 6.9, HTLV 1.5 and syphilis 5.4. Selective testing of donors at risk of Chagas' disease did not identify any positive donations, and there were 7 donations positive for West Nile Virus. Residual risk estimates of a potentially infectious donation from a unit of blood are 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. This year the maximum storage time for a platelet unit increased from 5 days to 7 days. This permited the introduction of an enhanced bacterial detection protocol and more units with bacterial growth were intercepted, while improving platelet inventory management. Of 581 potential peripheral stem cell or bone marrow donors tested, 3 (0.5%) were positive for antibody to hepatitis B core antigen. Of 1,241 samples from mothers donating stem cells collected from the umbilical cord and placenta (called "cord blood") after their babies were born, 1 (0.08%) 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. Travellers and former residents from malaria risk areas are temporarily deferred for malaria risk. In addition, a 3 week deferral for any travel outside Canada, the USA and Europe reduces risk from short term travel related infections, such as Zika virus. No new risks from travel related infections were identified this year.

Giving blood is very safe, and serious reactions in donors are quite rare. However, iron depletion is relatively common in female donors and people who donate frequently. Iron stores are not currently being measured on donors. However, iron deficiency can progress to a drop in donor hemoglobin, and donors may then fail their pre-donation hemoglobin screen. In order to help prevent iron deficiency, this year the waiting time between whole blood donations for females was increased from 56 days to 84 days, and the minimum hemoglobin for males was increased from 125 g/L to 130 g/L.This reduced the low hemoglobin deferral rate overall, as

deferrals in females decreased substantially from 13.5% to 9.5% of donation attempts, while the increases in deferrals in males was smaller, from 1.4% to 2.3.

In summary, transmissible blood-borne infections are 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 infections and who should not donate. Before donating blood everyone must complete a health history questionnaire which includes questions about specific risk factors for transmissible infections. This is followed by an interview with trained staff to decide if the person is eligible to donate blood. Donors also now have the option to complete the questionnaire on-line before coming to a clinic. 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 comes from the bite of an insect in Latin America) are tested, and all platelet products are tested for bacteria.

Surveillance includes monitoring of transmissible infection 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 blood-borne infection surveillance, as well as data for the calendar year of 2017.

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 (87.8%) with 12.2% of donations from new donors.

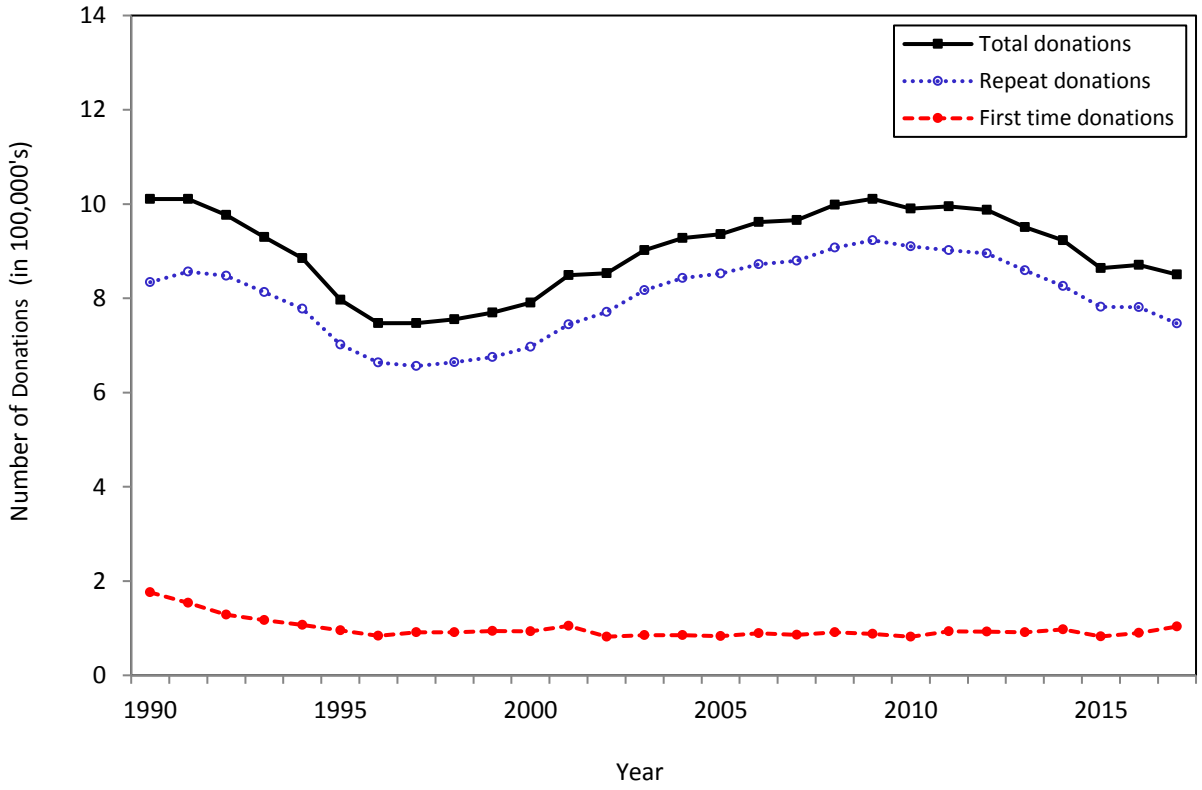


Figure 1 Donations in all Canadian Blood Services Regions, 1990-2017

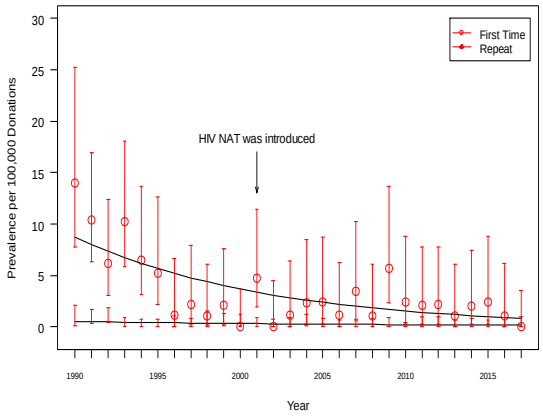
The "Classical" Pathogens

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 of positive tests per 100,000 donations are shown for 2017 by demographic groups. All transmissible infection 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 infection 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 lives.

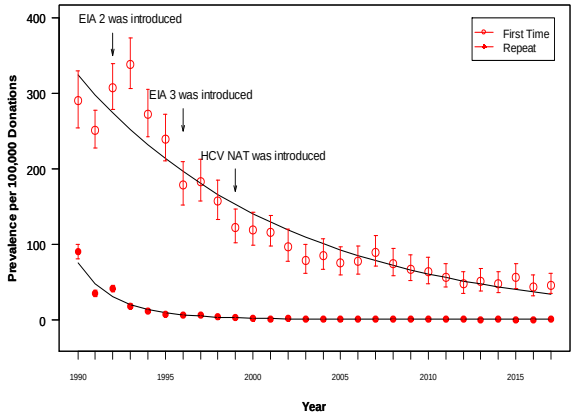
Table 1 Confirmed positive donations and prevalence rates per 100,000 donations in 2017

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	103,793	12.2	0	-	48	46.3	54	52.0	13	12.5	32	30.8
Repeat	746,792	87.8	2	0.3	4	0.5	5	0.7	0	-	14	1.9
Sex												
Female	342,784	40.3	1	0.3	20	5.8	18	5.3	8	2.3	12	3.5
Male	507,801	59.7	1	0.2	32	6.3	41	8.1	5	1.0	34	6.7
Age												
17-29	190,737	22.4	0	-	4	2.1	18	9.4	3	1.6	10	5.2
30-39	141,077	16.6	0	-	6	4.3	10	7.1	2	1.4	8	5.7
40-49	137,011	16.1	0	-	7	5.1	13	9.5	6	4.4	11	8.0
50+	381,760	44.9	2	0.5	35	9.2	18	4.7	2	0.5	17	4.5
Total	850,585	100	2	0.2	52	6.1	59	6.9	13	1.5	46	5.4

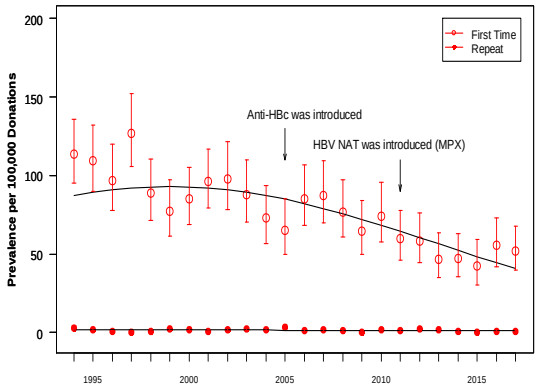
NB 1 HBV and 1 HCV NAT yield (positive only on NAT) donation.



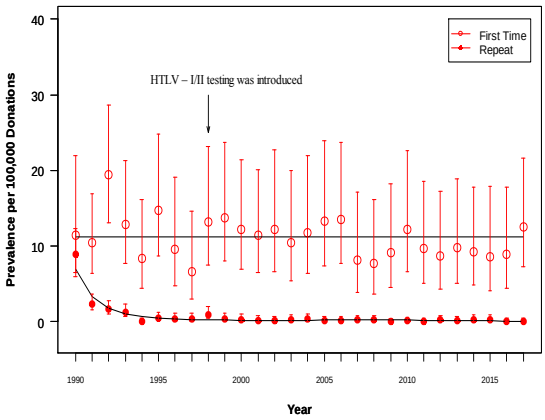
HIV prevalence per 100,000 donations
by donation status, 1990-2017



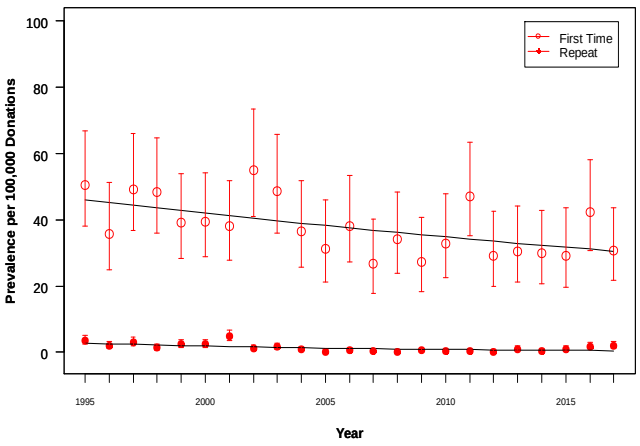
HCV prevalence per 100,000 donations
by donation status, 1990-2017



HBV prevalence per 100,000 donations
by donation status, 1994-2017



HTLV prevalence per 100,000 donations
by donation status, 1990-2017



Syphilis prevalence per 100,000 donations
by donation status, 1995 - 2017

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 infection positive donations are destroyed. The main source of risk is when a blood donor acquired the infection too recently to be detected by testing. 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 infections. The main risk factors are shown in Table 3. HIV infections are very rare in donors, therefore it is 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.

Table 3 Risk factors for infectious disease in blood donors

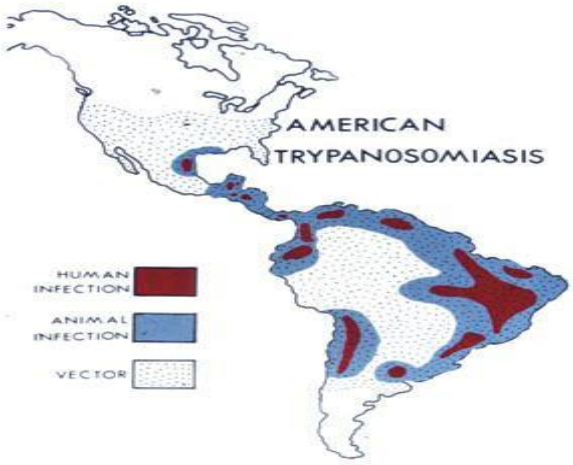
Infection	Risk Factor
HIV	Heterosexual risks Male to male sex
HCV	History of intravenous drug use History of blood transfusion (prior to testing) Been in prison, born in Africa or Asia
HBV	Born in Africa or Asia
HTLV	Born overseas (especially Caribbean) History of other sexually transmitted disease History of blood transfusion
Syphilis	Previous history of syphilis

Note: Not all donors are interviewed, and many do not disclose any risk factors

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 in parts of Mexico, Central and South America. The *T. cruzi* parasite can also be passed on from mother to child during pregnancy and by blood transfusion. In 2017, there were 18,911 donations from donors with risk factors, and none had a positive test.

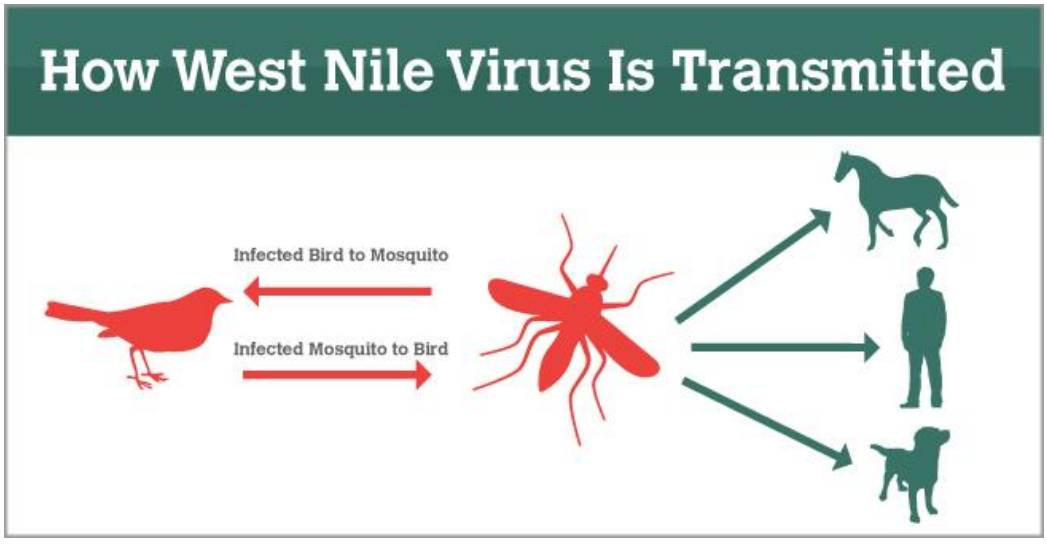
Riduviid bug which carries *T. cruzi* (the parasite that causes Chagas' disease)



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). During spring, summer and fall, donations are routinely tested in a minipool of 6 donations and only travelers are tested over the winter. In 2017, 7 donations were positive. They were identified from July to September in Ontario, Saskatchewan and British Columbia.



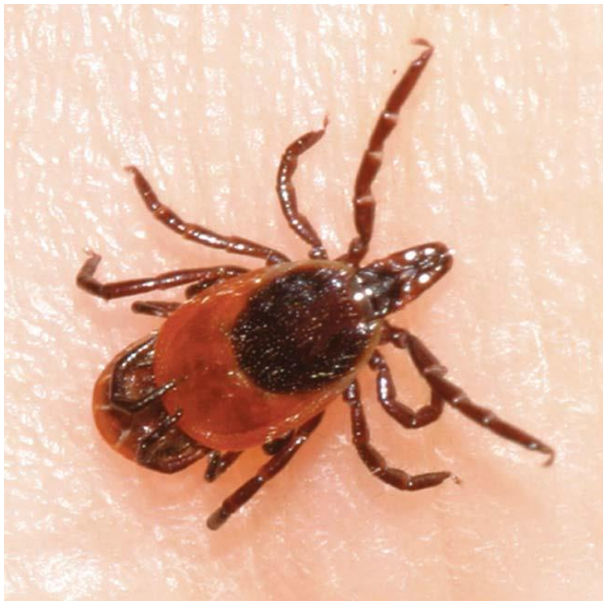
2. Surveillance for Emerging Pathogens

A horizon scan of potentially blood borne infections in the general community ensures rapid revision of donor policies to maintain safety. Even before a new infectious disease is reported in Canada, we are aware of emerging infectious agents 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. Canadian Blood Services medical and scientific staff participate in public health and infectious disease professional organizations and monitor web sites and journals where new information is posted. Canadian Blood Services maintains a plan to address pandemic influenza, which can be adapted to deal with other large outbreaks affecting donors and staff.

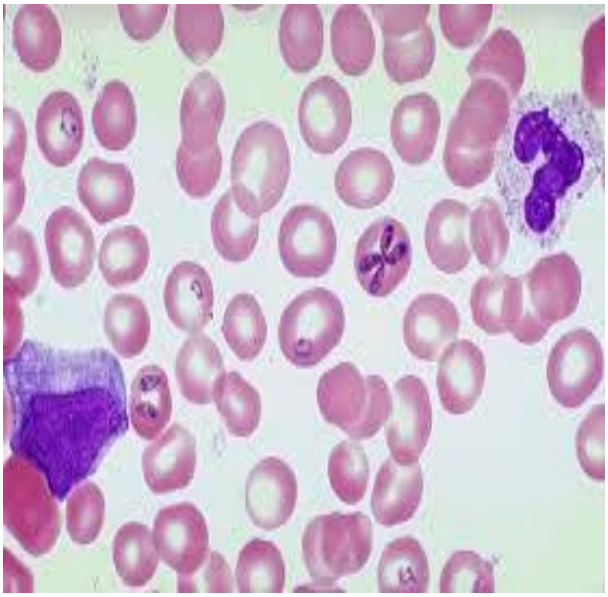
When appropriate the Alliance of Blood Operators (ABO) Risk Based Decision Making Framework can be used. This ensures that relevant assessments including infection risk to recipients, operational impact of strategies, stakeholder input and health economics are considered.

Babesiosis

Babesiosis comes from the bite of the black-legged tick (*Ixodes scapularis*). 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, and infection in blood recipients can result in severe illness or death. To date babesiosis cases in the general population have been reported mainly in the North Eastern part of the United States; following the designation of this infection as “reportable” in 2012 more than 1,500 cases are now reported per year. Cumulatively more than 150 infections in the United States 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 only one human case from tick exposure in Canada has been reported. In a 2013 study carried out at Canadian Blood Services and Héma-Québec, 13,993 blood donations were tested and none were positive. Ongoing public health surveillance of ticks indicates no increase in risk, but a donor study will be carried out in 2018 to confirm this in blood donors.



Black-legged tick



Babesia microti

Hepatitis E (HEV)

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. A 2013 study at Canadian Blood Services and Héma-Québec showed that 5.1% of donations were positive for antibody (indicating a previous infection with Hepatitis E) although none were positive for the virus using nucleic acid testing (NAT), therefore unlikely to be infectious. In 2015 a larger study, also carried out at Canadian Blood Services and Héma-Québec, of over 50,000 donations was completed with more sensitive NAT. 1 in 4,615 donations were positive for HEV, although the antibody profile and viral concentration suggest most were not infectious at the time of donation. The risk appears to be considerably lower than some countries in Europe that have implemented or plan to implement testing strategies. The ABO Risk Based Decision Making Framework is being used to consider strategies to address risk.

Tropical Mosquito Borne Viruses

Some mosquito borne viruses in travel destinations popular with Canadians carry potential risk for transfusion transmission. This is generally only 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 risk areas for 12 months, enough time for infected individuals to develop symptoms. Former residents of endemic areas are deferred for 3 years because there is a chance they may have the infection longer without obvious symptoms. Other tropical mosquito-borne infections that could be transmitted by transfusion include Dengue virus, Chikungunya virus, and Zika virus. Dengue virus has long been endemic in sunny destinations frequented by Canadians, but in

recent years there have been outbreaks of Chikungunya virus and Zika virus not previously seen in areas such as the Caribbean, Mexico, Central and South America. During outbreaks of infection, travelers are at particular risk of returning with an infection and may not have symptoms. Risk to the blood supply was determined to be very low based on quantitative risk assessment models. However, it is likely that other travel related infections will be seen in the future. As of 2016 Canadian Blood Services began deferring all donors who have travelled anywhere outside of Canada, the USA or continental Europe for 3 weeks after travel. Most tropical mosquito borne viruses have a short period after infection during which they could be present in the donor's blood that would be covered with a 3 week deferral.

3. New Initiatives

Pathogen Reduction

The Mirasol Pathogen Reduction System for Platelets, uses riboflavin (vitamin B_2) to inactivate many viruses, bacteria and parasites. Canadian Blood Services participated in an international study of the Mirasol system. Data is now being analyzed and final results have not yet been released. The aim was to confirm that it does not reduce the effectiveness of the

platelets to stop bleeding. Adult patients who had blood cancers and low platelets and 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 and therapeutic benefit, particularly the rate of bleeding. This study was carried out at selected hospitals in Canada, the Netherlands and Norway. There were 567 platelet recipients enrolled in the study, including 131 from Canada.

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 of AIDS/HIV transmission. With much improved donor testing and surveillance for emerging pathogens the deferral period has been gradually reduced, moving to 5 years in 2013 and to 12 months in 2016. HIV rates in blood donors have not increased, and donor compliance was not adversely affected by the change to the 5 year deferral. Another compliance survey is in progress to assess the impact of the 12 month deferral. Other countries such as the USA, France and Australia have also switched to a 12 month deferral. In England their 12 month deferral was recently reduced to 3 months.

Canadian Blood Services is committed to ongoing revision of this policy, ideally to find a way to more finely define donor sexual risk rather than deferring all sexually active males having sex with males. In January of 2017 Canadian Blood Services and Héma-Québec hosted a meeting which included Canadian researchers in gay men's health, regulatory staff (Health Canada and the USA Food and Drug Administration), stakeholders and international experts. The attendees brainstormed to identify the key areas of research needed to assess the safety of potential changes to the deferral. Canadian Blood Services and Héma-Québec then launched a competitive grant program to allocate funding provided by Health Canada to Canadian researchers. To date, 11 research projects are being funded in this grant program.

https://blood.ca/en/research/our-funded-research-projects?combine=msm

Lookback/Traceback

All cases of potential transfusion transmission of infection are investigated. When a donor tests positive for a transmissible infection, or if the donor reports a transfusion transmissible infection 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 infection 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 55 lookback cases for repeat donors opened for donations in 2017 (23 for donors that tested positive with in-house testing, 32 from public health notification). Of these, 37 cases were closed (all recipients that could be contacted were tested): 4 HIV, 22 HCV, and 11 HBV; 18 cases remain open. There were also 11 cases involving repeat donors from previous years closed. There were 55 traceback cases opened in 2017 (3 HIV, 42 HCV, 10 HBV). Of these, 41 were closed (all donors that could be contacted were tested), and 14 remain open. There were also 11 cases from previous years closed. There were no closed lookback or traceback cases associated with transfusion transmission.

4. Bacteria

Canadian Blood Services takes many steps to ensure that blood components are sterile. However, occasionally a very small number of bacteria enter into the blood collection bag, usually from the donor's skin. Since platelets are stored at room temperature, bacteria can survive and multiply during storage to reach levels that could cause a transfusion reaction. Canadian Blood Services performs a bacterial culture on every platelet unit to detect bacteria and remove contaminated units before they are transfused. The protocol was enhanced in August, 2017, by increasing the delay before taking the sample for culture, increasing the volume of product sampled, adding a different kind of culture (anaerobic bottle) and introducing a product hold before placing platelets in inventory (Table 4). Platelet storage time was extended from 5 to 7 days, to give the additional time required in the enhanced protocol, and to improve platelet inventory management.

To date, the new protocol has increased the positive rate of bacterial detection, showing improved sensitivity. However, since contaminated units are so rare, a longer follow-up period is necessary to adequately analyze results.

Table 4 Testing approach for 5 day and 7 day platelets, buffy coat pools and single apheresis collections.

	**Pre – Aug 14, 2017 (5 day platelet storage)**	**Post – Aug 14, 2017 (7 day platelet storage)**
Time post collection, pre-sampling	≥ 24 hrs	≥ 36 hrs
Volume/bottle	8-10 ml	8-10 ml
Culture Bottles	1 aerobic	1 aerobic 1 anaerobic
Post-inoculation hold	None	≥ 6 hrs

For double apheresis, two additional aerobic bottles are cultured

5. Blood Stem Cells

Blood stem cells can multiply to renew themselves; the new cells develop into blood cells such as red cells, white cells and platelets. In adults, they are found mainly in the marrow of large bones, with a few cells in the bloodstream. The cord blood of newborn babies, taken after birth from the umbilical cord and placenta after the delivery of a healthy baby, is also very rich in stem cells. Blood stem cells are very important in treating various types of diseases such as leukemia, lymphoma and multiple myeloma. Blood stem cells can be obtained from the bone marrow, from circulating blood (called peripheral blood stem cells) or from the umbilical cord (cord blood) after a baby is born. Canadian Blood Services has a coordinated national stem cell strategy which includes the OneMatch Stem Cell and Marrow Network and the Canadian Blood Services' Cord Blood Bank. Infectious disease testing for stem cells includes all markers that blood donations are tested for.

OneMatch Stem Cell and Marrow Network

The OneMatch Stem Cell and Marrow Network (OneMatch) is a registry of Canadians who have volunteered to donate either bone marrow or peripheral blood stem cells should a

recipient need it at some time in the future. Potential registrants complete a questionnaire which includes risk factors for transmissible infections and are tested for their Human Leukocyte Antigen (HLA) profile. In 2017 there were about 420,000 registrants in the OneMatch database. In total, 581 registrants were identified as potential matches for recipients and had additional testing. Of these 3 (0.5%) were reactive for antibody to hepatitis B core antigen (anti-HBc). For comparison, about 1% of first time whole blood donors are reactive for this marker. All tested registrants had negative results for all other infectious disease markers.

Canadian Blood Services' Cord Blood Bank

Canadian Blood Services collected cord blood at five sites in Canada in 2017. Participating mothers at these hospitals who volunteer to donate their baby's cord blood complete a questionnaire about medical conditions that could be passed on to a recipient as well as risk factors for transmissible infections. If the donation is suitable for transplantation (i.e., has enough stem cells) with negative results for all infections, the cells are frozen and stored until a recipient needs them. In 2017, there were 1,241 blood samples from the mothers tested and one (0.08%) confirmed positive for HCV.

6. Donor Safety

Donor Reactions

Canadian Blood Services takes many precautions to make sure that giving blood is safe for donors. These include a health screening questionnaire and a hemoglobin fingerstick screen, as well as providing refreshments and monitoring the donor after donating. Most donors do not have any problems during or after their donation, but it is important to keep track of any incidents that happen so that donor care can be improved.

Definitions of reactions are shown in Table 5. Reaction rates per 10,000 whole blood donations are shown in Figure 3. People more likely to experience a reaction are first time donors, young donors (17-25 years old) and female donors. The reaction reporting system is oriented towards capturing moderate and severe reactions. Most reactions are mild, such as feeling faint or bruising at the needle site, but these are only recorded if mentioned by the donor at some point after donation. Note that it is difficult to know if cardiovascular events that happen shortly after donation are in any way related to donation, or simply happened by chance in the 24 hours after donation.

A further breakdown of fainting reactions (both moderate and severe) in whole blood donors by sex and donation history is provided in Table 6. These are similar to those reported in 2016 (p=0.5).

Serious reactions that can lead to physical injury or prolonged symptoms are rare but when they happen usually involve first time donors and female donors. The rates of injury (most commonly falls with cuts) with fainting are seen in Table 6. In 2017, Canadian Blood Services took steps to increase the blood volume of apheresis donors by allowing donors to drink fluids during the apheresis procedure, which can last 30 to 90 minutes compared to 5-12 minutes for a whole blood collection. Drinking fluids reduces the chance of feeling faint. All donors are encouraged to drink fluids before and after donation.

Table 5 Reaction and definitions

Reaction	Definition
Vasovagal Moderate Severe	Donor loses consciousness (faint reactions) Unconscious less than 60 seconds and no complications Unconscious more than 60 seconds or complications
Major Cardiovascular Event	Chest pain or heart attack within 24 hours of blood donation, may or may not be related to donation
Re-bleed	The phlebotomy site starts to bleed after donation
Nerve Irritation	Needle irritation or injury of a nerve during phlebotomy. Usually described as sharpshooting pain, arm tingling or numbness
Inflammation/Infection	Redness or infection at the needle site, usually seen several days after donating
Local Allergic Reaction	Rash from skin cleaning solution or dressing, with raised vesicles on the skin
Arm Pain	Usually due to blood pressure cuff, tourniquet or arm position
Bruise/Hematoma	Temporary dark colour of the skin due to blood leakage from blood vessel at time of phlebotomy
Arterial Puncture	Needle inserted in an artery instead of a vein

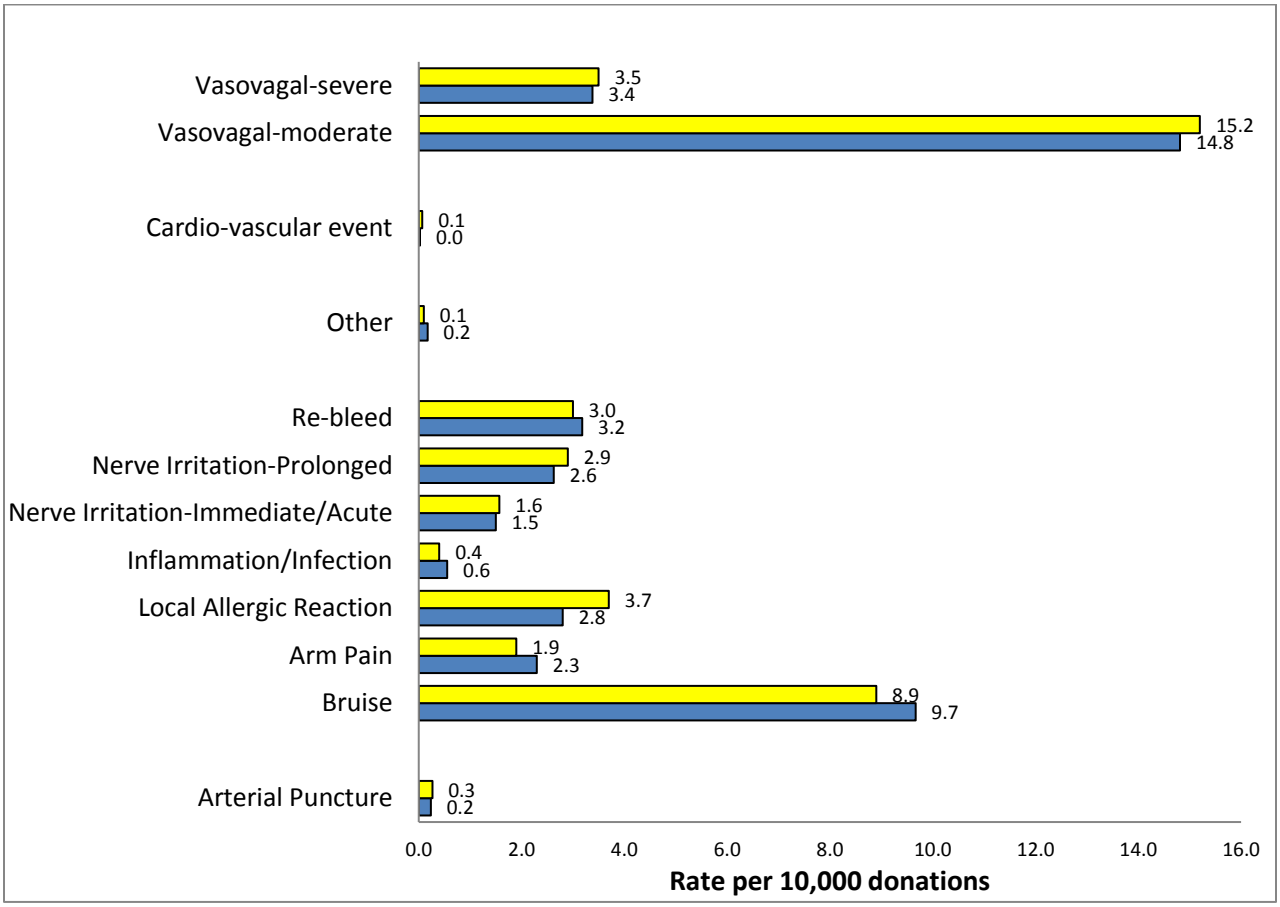


Figure 3 Reaction rates per 10,000 whole blood donations in 2017 (yellow) and 2016 (blue)

Table 6 2017 Fainting reactions (per 10,000 collections)

	Moderate & Severe (all)		Associated with injury	
Donation Status	**Male**	**Female**	**Male**	**Female**
First Time	54.7	86.7	3.7	4.1
Repeat	7.0	19.9	0.4	1.5

*all comparisons are statistically significant ($p<0.05$)

Donor Hemoglobin and Iron

The most common reason for a donor deferral at the collection site is a failed hemoglobin fingerstick screen. Low hemoglobin is often related to low iron stores. Iron is needed to make hemoglobin which carries oxygen in red blood cells. Studies at Canadian Blood Services showed that iron stores are often lower in females, and are further reduced by frequent donation in both females and males. Males with borderline hemoglobin are also more likely to have lower iron stores. To reduce the chance of developing iron deficiency, the minimum wait time between whole blood donations for females was increased from 56 days to 84 days in 2017. This longer interdonation period allows females more time to build back their iron stores and return to their baseline hemoglobin levels. Hemoglobin deferral rates have gradually decreased in female donors from about 13.5% of donation attempts to 9.5% ($p<0.001$). In 2017 the minimum hemoglobin for male donors was increased from 125 to 130 g/L to align with a healthy hemoglobin in males which is higher than for females. As a result, the hemoglobin deferral rate in males increased from 1.4% to 2.3% ($p<0.001$). There was an overall net decrease in hemoglobin deferrals due to the large decrease in females.

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.

7. References

Donor Screening

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

O'Brien SF, Osmond L, Fan W, Yi QL, Goldman M. Impact of a 5-year deferral from blood donation for men who have sex with men. Transfusion 2016; 56:1598-1602.

Goldman M, Shih A W-Y, O'Brien SF, Devine D. Donor deferral policies for men who have sex with men: past, present and future. Vox Sang 2018; 113:95-103.

Ross Fitzgerald https://blood.ca/en/blog/2018-01/evolution-donor-deferral-policy-where-do-we-go-here

Jenny Ryan https://blood.ca/en/blog/2016-11/research-aims-close-knowledge-gaps-donor-screening-men-who-have-sex-men

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, Goldman M, Fearon MA. Residual risk of HIV, HCV and HVB in Canada. Transfus and Apher Sci 2017;56:389-391.

Jenny Ryan https://blood.ca/en/blog/2016-06/whats-risk-infection-blood-transfusion

Babesia microti

O'Brien SF, Delage G, Scalia V, Lindsay R, Bernier F, Dubuc S, Germain M, Pilot G, Yi QL, Fearon MA. 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.

Hepatitis E

Fearon MA, O'Brien SF, Delage G, Scalia V, Bernier F, Bigham M, Weger S, Prabhu S, Andonov A. Hepatitis E in Canadian blood donors. Transfusion 2017;57:1420-1425.

Bacteria

Ramirez-Arcos S, DiFranco C, McIntyre T, Goldman M. Residual risk of bacterial contamination of platelets: six years of experience with sterility testing. Transfusion 2017;57:2174-2181.

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.

Iron Deficiency

Goldman M, Uzicanin S, Scalia V, O'Brien SF. Iron deficiency in Canadian blood donors. Transfusion 2014; 54:775-779.

O'Brien SF, Goldman M. Understanding iron depletion and overload in blood donors. ISBT Science Series 2017;12:11-18.

Goldman M, Uzicanin S, Scalia J, Scalia V, O'Brien SF. Impact of informing donors of low ferritin results. Transfusion 2016; 56:2193-2198.

Goldman M, Uzicanin S, Osmond L, Scalia V, O'Brien SF. A large national study of ferritin testing in Canadian blood donors. Transfusion 2017;57:564-570.

Pambrun C, Goldman M. https://professionaleducation.blood.ca/en/transfusion/publications/importance-iron-whole-blood-donors-canadian-perspective

Zika Virus

Germain M, Delage G, O'Brien SF, Grégoire Y, Fearon M, Devine D. Mitigation of the threat posed to transfusion by donors traveling to Zika-affected areas: a Canadian risk-based approach. Transfusion 2017;57:2463-2468.

Murphy MS, Shehata N, Colas JA, Chassé M, Fergusson DA, O'Brien SF, Goldman M, Tinmouth A, Forster AJ, Wilson K. Risk of exposure to blood products during pregnancy: guidance for Zika and other donor deferral policies. Transfusion 2017;57:811-815.

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
	BacT Alert modified for 7 day platelets	2017

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