Transfusion and risk of infection in Canada

In Canada and other countries, many steps are taken to minimize the risk of infection through transfusion of blood or blood products (1). However, the infection risk can never be zero because these are biological products taken from living donors who are never 'germ free' (2). This is in contrast to other drugs that can be manufactured de novo under sterile conditions in a laboratory. The present note provides information on transfusion infection risks in Canada, which may be helpful to practitioners in their discussions with patients and parents when obtaining informed consent before blood or blood product administration.

While any infectious agent that has a blood phase has the potential to be transmitted by transfusion of blood or blood products, the probability of infection in the recipient depends on a number of factors including (3):

- the prevalence of the agent in the blood of the donor population;
- the tolerance of the agent to the blood handling, storage and manufacturing procedures;
- the infectivity and pathogenicity of the agent;
- the recipient's health status; and
- the effectiveness of donor screening or donor testing for the agent.

The recent recognition of the possible transmission of West Nile virus after receipt of blood in the United States (4) and of transfusion-related babesiosis in Canada (5) illustrates the importance of vigilance and questioning about transfusions when a blood infection occurs with an unexpected or 'new' agent.

In Canada, the infectious disease risks of transfusion are minimized through multiple steps, including blood collection from volunteer unpaid donors, donor interview and selection procedures, donor screening by serological and other tests (Table 1), and viral inactivation procedures included in the manufacturing of plasma-derived products (6). For example, solvent and detergent procedures dissolve the lipid envelope of the human immunodeficiency virus, hepatitis B virus and hepatitis C virus, but are not effective against nonlipid enveloped viruses such as hepatitis A virus or parvovirus B19. A variety of other viral removal and viral inactivation steps are also used in the manufacturing process. The leucocyte reduction technique that is used by Canadian Blood Services and Héma-Quebec to ensure the safety of the blood supply also reduces infection transmission risk, particularly for cytomegalovirus (7).

Unfortunately, the solvent and detergent procedures noted above cannot be used on red blood cells or platelets because neither can withstand these vigorous viral inactivation processes. Pathogen reduction techniques suitable for these labile blood components are in development and, in some cases, are now in clinical trials.

Almost all reported acute infectious complications during blood product transfusion are associated with bacterial pathogens (8) (Table 2). While the use of closed multicom-

TABLE 1
Testing of blood donors in Canada* by Canadian Blood Services and Héma-Québec

HIV-type 1/2/0† group	Antibody/P24 antigen/NAT
HBV	Hbs Ag Anti-HBc‡
HTLV type I/II	Antibody
Syphilis	Nontreponemal test – Treponemal test/PK-TP
HCV	Antibody/NAT
Other§	CMV antibody on selected units only

**Personal communications considered. Dr Gilles Delage, Héma-Quebec; Dr Heather Hume, Canadian Blood Services; †The human immunodeficiency virus (HIV) antibody (Ab) test is not licensed to detect HIV group O, which is why donors are asked questions related to travel to the parts of the world where HIV-O infection is prevalent; ‡Antibody to hepatitis B core antigen (Anti-HBc) testing is being considered; §Héma-Quebec is developing bacterial culture testing for thrombopharesis platelets. CMV Cytomegalovirus; Hbs Ag Hepatitis B surface antigen; HBV Hepatitis B virus; HCV Hepatitis C virus; HTLV Human T-lymphotropic viruses; NAT Nucleic acid testing*

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TABLE 2
Bacterial agents associated with acute infection during blood product transfusion

Blood component	Storage	Bacterial agent
Packed red cells	1-6°C for 35 to 42 days	*Yersinia enterocolitica* Gram-negative, including *Pseudomonas* species
Whole blood	1-6°C for 35 to 42 days	Gram-negative organsims
Platelets	20-24°C for 5 days	Skin flora (eg, *Staphylococcus epidermidis* Diptheroids) *Salmonella* species *Escherichia coli* *Enterococci* species *Clostridium* species *Serratia marcescens*
Plasma	18°C, thawed, 1-6°C=24 h	*Staphylococcus aureus* *Pseudomonas aeruginosa*

ponent plastic blood pack collection systems has helped to decrease the problem, contamination of platelet concentrates is still a concern (9). The risk of bacterial contamination of frozen components such as fresh frozen plasma and cryoprecipitates is now very low due to the killing of the usual microbes by freezing and other storage conditions. Where plasma has been found to be the source of infection, this has been due in the past to contamination of the water bath used to thaw the product (10). Newer microwave techniques, using microwaves specifically designed for this purpose, minimize this risk.

The estimated per unit risk of contamination in Canada for a number of viral, bacterial, parasitic, prion and tick borne agents are presented in Table 3. Where Canadian data are not available, data from the United States and other countries are included (3). As the data in Table 3 show, the risks of transmission of infectious agents by blood in Canada is indeed extremely low. For context, a one in 3,000,000 risk is similar to the risk of being hit by lightning.

Even though the risk of transmission is extremely low, the possibility of new unrecognized agents remains. Experience from hepatitis C and human immunodeficiency virus traceback and look-back programs, where authorities have tried to trace transfusion recipients, have shown that many patients are unaware that they actually received a transfusion. Because no national electronic record of transfusion yet exists, to facilitate any potential future tracing programs for a new transmittable agent, it is important to make sure that transfused patients are aware of the receipt of blood and blood products, and that the discharge note adequately documents the nature of the transfusions that took place and the label code numbers for the specific products.

TABLE 3
Estimated risk of infectious agent blood/blood products

Agents and products	Transfusion-transmitted	Pathogenic	Canadian estimated risk of contamination
Viruses for which all blood donors are tested			
HIV*	Yes	Yes	<1/4,000,000
HCV*	Yes	Yes	<1/1,000,000
HBV*	Yes	Yes	1/1,000,000 to 1/2,000,000
HTLV* types I and II	Yes	Yes	<1/4,000,000
Other viruses			
CMV	Yes	Yes	40%-70% donors harbour virus†
Parvovirus B19	Yes	Yes	1/10,000 to 1/15,000
HGV*	Yes	Unknown	1-2 in 100; not pathogenic
TTV*	Yes	Unknown	1/100; rarely pathogenic
SEN-V*	Yes	Unknown	1/00; not pathogenic
HHV-8*	Unknown	Yes	Unknown
West Nile virus	Yes	Yes	1/10,000 to 1/15,000 – Unknown‡
Parasites			
Malaria	Yes	Yes	4 cases reported in Canada
Chagas (*Trypanosoma cruzi*)	Yes	Yes	2 cases reported in Canada
Babesiosis (*Babesia microti*)	Yes	Yes	1 case reported in Canada
Prion			
CJD/vCJD	Unknown	Yes	Unknown

**Based on 3% to 5% of the Canadian population from the 17 to 65 years age group being blood donors. Based on reported cases from Public Health. Based on sensitivity and specificity of the tests used at Canadian Blood Services (11) and Héma-Québec; †Cytomegalovirus (CMV) risk is decreased by leukoreduction procedures; ‡West Nile virus 1/10,000 to 1/15,000 is a theoretical estimation if West Nile virus became endemic in Canada next year. CJD Creutzfeldt-Jakob disease; HBV Hepatitis B virus; HCV Hepatitis C virus; HGV Hepatitis G virus; HHV-8 Human herpes virus 8; HIV Human immunodeficiency virus; HTLV Human T-lymphotropic viruses; TTV Transfusion-transmitted virus; vCJD Variant CJD*

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The recommendations in this note do not indicate an exclusive course of treatment or procedure to be followed. Variations, taking into account individual circumstances, may be appropriate. This article also appears in Can J Infect Dis 2003;14(2):81-83.

ERRATUM

In the PID Note "Vaccines schedules" published in *Paediatr Child Health* 2003;8:13-5, misrepresentations appeared in Tables 3 and 4. Table 3 (page 14), VZV column, second row, should read "X (if ≥13 years old)". Table 4 (page 14), MenC-conjugate vaccine column, for age 4-11 months, should have a dose, "X" for the first visit, and a second dose, "X" for two months later (two doses in total). The corrected tables (including further corrections on vaccine acronyms) can be downloaded from the Canadian Paediatric Society Web site, www.cps.ca, via the following path: "publications", "position statements", "infectious diseases and immunization", "PID Note – Vaccine Schedules". Please find the revised tables below.

TABLE 3
Immunization schedule for children seven years of age and older not previously immunized in infancy (and still nonimmune)

	Vaccines							
Timing	**dT±ap**	**IPV**	**Hib**	**MMR**	**HBV**	**VZV***	**PCV-7 conjugate***	**MenC-congugate***
1st visit	X	X	†	X		X	†	X
2 months later	X	X	†	X		X (if ≥13 years old)	†	
6-12 months later	X	X	†				†	
Teenage years	dT±ap at 14-16 years*		†		X 3 doses‡		†	
Adult years	dT every 10 years							

**These vaccines may not be publicly funded in all provinces for this indication; †Not indicated in this age group; ‡Hepatitis B vaccine (HBV) is also available for a two-dose schedule in 11- to 15-year-olds. ap Acellular pertussis; d Diptheria; IPV Inactivated polio vaccine; Hib* Haemophilus influenza *type b; MenC Meningococcal C; MMR Measles mumps rubella; PCV Pneumococcal conjugate vaccine; T Tetanus toxoid; VZV Varicella zoster vaccine. See Table 4 for more details*

TABLE 4
Immunization schedule for vaccines against encapsulated bacteria for healthy children not previously immunized in the first three to six months of life

	Hib vaccine (age at first visit)			PCV-7 conjugate* vaccine (age at first visit)			MenC-congugate* vaccine (age at first visit)	
Timing	**7-11 months**	**12-17 months**	**18 months to 5 years**	**7-11 months**	**12-23 months**	**24 months to 5 years**	**4-11 months**	**≥12 months**
At 1st visit	X	X	X	X	X	X	X	X
2 months later	X			X	X		X	
4 months later				X (past 12 months)				
At 18 months	X							

**These vaccines may not be publicly funded in all provinces for this indication. Hib* Haemophilus influenza *type b; MenC Meningococcal C; PCV Pneumococcal conjugate vaccine*