Risk of HIV infection from blood transfusion in Montreal

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Abstract

Objectives: To determine the incidence (including associated donor characteristics and time trends) of HIV infection among repeat blood donors and to estimate the risk of HIV transmission from blood transfusion in Montreal and in Canada as a whole.

Design: Retrospective cohort analysis.

Setting: Montreal Centre Blood Transfusion Service.

Participants: People who donated blood at least twice after Nov. 1, 1985, and at least once from Apr. 1, 1989, to Mar. 31, 1993.

Intervention: Blood was screened for HIV by enzyme-linked immunosorbent assay and results were confirmed by Western blot analysis.

Outcome measures: Incidence density (the incidence rate per person-time) of HIV infection among repeat blood donors by sex, age group and region of residence, and incidence density and risk among first-time donors and for Canada as a whole.

Results: There were 200 196 eligible donors and 432 631 person-years (PY) of observation. From 1989 to 1993, there were 18 HIV seroconversions among repeat donors. The crude incidence density was 3.3 per 100 000 PY (95% confidence interval [CI] 1.8 to 5.4 per 100 000 PY); it was 4.9 per 100 000 PY among men and 0.61 per 100 000 PY among women. Age-specific incidence per 100 000 PY was 2.5 among those 12–29 years of age, 5.1 among those 30–49, 2.9 among those 40–49, and 1.4 among those 50 and older. Based on an estimated mean "window period" (from when a donor's blood is capable of transmitting HIV until detectable antibody appears) of 25 days, the current risk of HIV infection from repeat donors in the window period is estimated at 1 in 440 000. Inclusion of blood units from first-time donors produces an overall risk of 1 in 390 000 (95% CI 1 in 250 000 to 655 000). The estimated risk per blood unit in Canada as a whole is 1 in 913 000 (95% CI 1 in 507 000 to 2 050 000).

Conclusions: This "sentinel" population of repeat blood donors is subject to important trends in HIV spread. Therefore, estimating the incidence density of HIV infection in repeat donors provides insight into the epidemiologic characteristics of HIV infection at minimal expense. As a result of measures to improve blood safety, including HIV testing, the incidence of HIV infection among blood donors in Canada is low and the risk of HIV transmission from transfusion is extremely small, although not zero.

Résumé

Objectifs : Déterminer l'incidence (y compris les caractéristiques des donneurs et les tendances temporelles corrélées) d'infection par le VIH chez les donneurs de sang habituels et estimer le risque de transmission du VIH par transfusion sanguine à Montréal et au Canada dans l'ensemble.

Conception : Analyse de cohorte rétrospective.

Contexte : Service de transfusion du Centre de Montréal.

Participants : Personnes qui ont donné du sang au moins 2 fois après le 1er nov. 1985 et au moins 1 fois entre le 1er avr. 1989 et le 31 mars 1993.

Intervention : On a analysé le sang pour y dépister la présence de VIH par immuno-essai enzymatique et les résultats ont été confirmés par immunotransferts de type Western.

Evidence

Études

Dr. Remis worked as a consultant for the National Office, Canadian Red Cross Society Blood Services, Ottawa, Ont., and is with the Department of Public Health Sciences, University of Toronto, Toronto, Ont.; Dr. Delage was with the Montreal Centre Blood Transfusion Service, Canadian Red Cross Society, Montreal, Que., and is now with the Laboratoire de santé publique du Québec, Sainte-Anne-de-Bellevue, Que.; and Mr. Palmer is with Sunnybrook Health Science Centre, North York, Ont.

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See related article page 391

Mesures des résultats : Densité de l'incidence (le taux de l'incidence personne-temps) de l'infection par le VIH chez les donneurs de sang habituels, selon le sexe, le groupe d'âge et la région de résidence, et densité de l'incidence et risque chez les nouveaux donneurs et pour le Canada dans l'ensemble.

Résultats : Il y avait 200 196 donneurs admissibles et 432 631 années-personnes (AP) d'observation. De 1989 à 1993, on a enregistré 18 séroconversions du VIH chez les donneurs habituels. La densité brute de l'incidence a été de 3,3 pour 100 000 AP (intervalle de confiance [IC] à 95 %, 1,8 à 5,4 pour 100 000 AP); elle a été de 4,9 pour 100 000 AP chez les hommes et de 0,61 pour 100 000 AP chez les femmes. Les densités selon l'âge pour 100 000 AP ont été de 2,5 chez les 12 à 29 ans, 5,1 chez les 30 à 49 ans, 2,9 chez les 40 à 49 ans et 1,4 chez les 50 ans et plus. Si la «fenêtre» (période écoulée entre le temps où le sang d'un donneur peut transmettre l'infection et l'apparition d'anticorps détectable) moyenne estimative est de 25 jours, le risque d'infection par le VIH propagé par des donneurs habituels pendant la fenêtre est estimé à 1 sur 440 000. L'inclusion des unités de sang des nouveaux donneurs a produit un risque global de 1 sur 390 000 (IC à 95 %, 1 sur 250 000 à 655 000). Le risque estimatif par unité de sang au Canada dans l'ensemble s'est établi à 1 sur 913 000 (IC à 95 %, 1 sur 507 000 à 2 050 000).

Conclusions : Cette population «sentinelle» de donneurs habituels est exposée à des tendances importantes à la propagation du VIH. C'est pourquoi l'estimation de la densité de l'incidence de l'infection par le VIH chez les donneurs habituels donne un aperçu des caractéristiques épidémiologiques de l'infection par le VIH moyennant une dépense minime. Grace à l'adoption de mesures visant à améliorer la sûreté du sang, y compris les tests de dépistage du VIH, l'incidence de l'infection par le VIH chez les donneurs de sang au Canada est faible et le risque de transmission du VIH par des transfusions est extrêmement mince, même s'il n'est pas inexistant.

The Canadian Red Cross Society Blood Services (CRCSBS, formerly the Canadian Red Cross Society Blood Transfusion Service) is one of the largest voluntary blood distribution systems in the world. More than 80% of the 1 227 000 units collected by the CRCSBS in 1989 were from repeat donors. Since repeat donors donate at least once a year on average, more than 500 000 Canadians effectively constitute a "sentinel cohort" for monitoring the HIV epidemic in Canada. As a result of several factors, including donor demographic characteristics, self-exclusion, screening policies and testing for markers of infectious pathogens (including *Treponema pallidum*, hepatitis B virus, HIV, human T-cell lymphotrophic virus types I/II and hepatitis C virus), the prevalence and incidence of bloodborne pathogens in blood donors are markedly lower than those in the general population. Nevertheless, it is unlikely that blood donors would be isolated from important trends in HIV transmission, especially those related to heterosexual transmission.

The analysis of data on infectious markers among repeat blood donors has other benefits. The confidence of the Canadian public in the safety of the blood supply is critical. Although the blood supply appears to be relatively safe with respect to bloodborne pathogens, 100% safety cannot be achieved, mainly because of the limits of detection of HIV and other infections during the so-called "window period," from when blood is capable of transmitting an infection until detectable antibody appears. A more precise estimate of the current risk of HIV infection from blood transfusion would help to determine the level of risk and provide accurate, current information to the public and the scientific community. It would also help to identify additional measures to reduce risk further. Moreover, estimating the incidence of HIV infection among repeat blood donors may be carried out at minimal cost.

The objectives of our study were to estimate the incidence of HIV infection among repeat blood donors at the Montreal centre of the CRCSBS, to characterize associated donor factors and time trends, and to estimate as precisely as possible the risk of HIV transmission from blood transfusion in Montreal and in Canada as a whole.

Such a study has not been carried out in Canada before now; the appropriate data and the methods to extract and analyse them have not been established. To determine the feasibility of measuring the incidence of HIV infection among repeat donors, a pilot study was undertaken at the Montreal Centre Blood Transfusion Service (MCBTS) in

January 1992.[1] This pilot study, based on a 1 in 100 sampling and a manual review of donor files, covered the period April 1989 to February 1992. In this study, we refined the methods used in the previous study and extended the study period.

Methods

Study population

The MCBTS serves western Quebec, which includes the Montreal region. In 1989, the service collected 191 000 units, or about 72% of the blood collected in Quebec.

The database used for this study was constituted from the master donor file and included donors who donated blood at least once from Apr. 1, 1989, to Mar. 31, 1993. In September 1991, before this study was undertaken, the file was purged of donors who had not donated since Apr. 1, 1989. The master donor file included data only on the 2 most recent blood donations. To ensure that all possible donations were included in the analysis, in September 1993 we merged the master donor file with the current donation file (which included all donations at the MCBTS from April 1987 until then) with the use of the donor identification numbers. We were unable to exclude autologous donations from the databases analysed.

Thus, the study period was Apr. 1, 1989, to Mar. 31, 1993. We excluded (1) donors who donated only once, (2) donors whose only previous donation was before Nov. 1, 1985, (when routine HIV testing of blood began) and (3) donors whose first tested donation was HIV-positive. Thus, the study population consisted of donors who donated blood to the MCBTS at least twice between Nov. 1, 1985, and Mar. 31, 1993, and at least once during the study period.

MCBTS used the following HIV test kits during the 4-year study period: April 1989–June 1990: HIV Elisa, Dupont, Wilmington, Del.; June 1990–March 1992: HIVAB HIV-1 EIA, Abbott Laboratories, Chicago; March 1992–November 1992: HIV 1/2, Abbott Laboratories; and November 1992–March 1993: HIV-1/HIV-2 EIA Genetic Systems Corp., Seattle.

Data analysis

Data from the master donor file and the current donation file were downloaded from the MCBTS mainframe computer. Data analysis was carried out with SAS statistical software (SAS Institute Inc., Cary, NC).

The measure used in this study was "incidence density," a measure of the number of new cases per unit of population-time (e.g., person-years at risk). In our study, the incidence density was based on person-years of observation of blood donors from the date of the first donation after Nov. 1, 1985, to the date of the most recent donation during the study period. For donors who had donated at least once from Nov. 1, 1985, to Mar. 31, 1989, the person-time experience was counted from Apr. 1, 1989, to the most recent donation. Person-time was allocated to 1 of 16 cells by sex, age group (< 30, 30–39, 40–49 and ≥ 50 years) and region of residence (island of Montreal v. other). The incidence density was calculated as the number of HIV infections per 100 000 person-years (PY) according to these variables during the entire 4-year study period and by fiscal year (Apr. 1 to Mar. 31).

To calculate the incidence density, we used the following assumptions. First, for each seroconversion (constituting the numerator), the time of the infection was assigned over the period from the last seronegative to the first seropositive blood donation under the assumption of constant incidence (i.e., an equal probability of seroconversion was assigned to each day in this interval) according to the method described by Kitayaporn and colleagues.[2] Second, person-time for each donor was assigned to the age category and the region of residence at the time of his or her most recent donation in the study period.

In our method, when the interval between donations spanned the beginning of the study period (or the beginning or the end of the fiscal year for the year-by-year analysis), only the person-time (for the denominator) and the seroconversions (for the numerator) applicable to the period of interest were used in the calculation.

Statistical analysis

We calculated the 95% confidence interval (CI) of the incidence density of HIV infection with the use of the χ^2 distribution.[3] On the basis of the normal distribution, we also calculated the 95% CI of the ratio of the HIV incidence density among first-time donors to that among repeat donors and of the ratio of HIV prevalence among repeat donors in the rest of Canada to that in the MCBTS[3] for the purposes of the Monte Carlo simulation (discussed later).

Differences in the incidence density of HIV infection according to sex, age and region of residence were tested for statistical significance with the use of Epi-Info software (version 6.04, May 1996, US Centers for Disease Control and Prevention, Atlanta, and World Health Organization, Geneva, Switzerland).

Risk of HIV infection from blood

We estimated the risk of a unit of blood being infected with HIV but producing no detectable antibody on en-

zyme-linked immunosorbent assay. The prevalence of such units was calculated with the following formula:

Prevalence = incidence × duration (P = I × D)

The latency period from HIV infectivity (the ability of an exposure to transmit infection) to the appearance of detectable antibody (the effective mean window period) was taken as 25 days. This estimate is based on the more sensitive enzyme-linked immunosorbent assays available since 1992.[4,5] We calculated the risk of HIV infection with the use of this recent estimate.

We also determined the risk of HIV transmission from units collected from all donors (i.e., repeat and first-time donors), since HIV incidence is likely somewhat higher among first-time donors than among repeat donors. It is impossible to calculate HIV incidence among first-time donors from the data available at the blood transfusion service as we did for repeat donors. According to one investigator, the incidence of HIV infection among first-time donors is approximately double that among repeat donors (Dr. Michael P. Busch, Vice-President of Research and Scientific Services, Irwin Memorial Blood Centers, San Francisco: personal communication, 1994). A recently published study estimated the incidence of HIV infection among first-time donors on the basis of the relative HIV incidence among first-time compared with repeat donors immediately after the introduction of HIV testing; the observed ratio was 1.8.[6] The relative HIV prevalence among first-time versus repeat donors at the MCBTS was somewhat unstable during the 14 months after Nov. 1, 1985, when HIV testing was instituted; the ratio for cumulative data to Mar. 31, June 30, Sept. 30 and Dec. 31, 1986, varied from 2.0 to 1.6. For the purpose of this analysis, we used a ratio of 1.8.

We also estimated, in a preliminary fashion, the risk of HIV infection from blood transfusion in Canada as a whole. To do so, we estimated the incidence of HIV infection among donors in the rest of Canada from the ratio of the HIV prevalence among repeat donors in the rest of Canada to that among repeat donors in MCBTS. The estimate of the risk of HIV infection from a blood transfusion in Canada also took into account the somewhat higher prevalence of HIV among first-time donors than among repeat donors.

Several of the parameters used to estimate the risk of HIV infection from a unit of blood donated during the window period are uncertain. These parameters include (1) the incidence of HIV infection among repeat blood donors in Montreal, (2) the mean window period, (3) the ratio of the incidence of HIV infection among first-time donors to that among repeat donors and (4) the ratio of the incidence of HIV infection among donors in the rest of Canada to that among donors in Montreal. Therefore, for these parameters, we assigned a frequency distribution based on the CI around the incidence density among repeat blood donors in Montreal, and around the proportion for each of the 2 ratios. The distribution around the estimate of the window period was based on the plausible limits of its value. We calculated risk with a Monte Carlo simulation, a statistical method that allows one to determine the point estimate and the distribution of an outcome (in this case, the risk of HIV infection from a transfusion) by incorporating the uncertainty in the input parameters. For this purpose, we used commercial risk-analysis software (Crystal Ball, version 4.0, Decisioneering Inc., Aurora, Colo.).

We assumed that the probability of transmitting HIV infection from an infected unit was 100%. In fact, the probability of transmission of HIV infection from a seropositive unit has been estimated at 90%.[7] Although no data are available on the specific probability of transmission from a unit donated during HIV seroconversion, the probability may be somewhat higher than 90% given the high level of viremia during this stage of infection.[8,9]

Results

Data on the 200 196 donors who met the study criteria were extracted from the master donor file. The number of donors and PY in the study population are shown in Table

Table 1: Number of donors and person-years* by sex and age group from master donor file and current donations file, Montreal Centre Blood Transfusion Service, Apr. 1, 1989, to Mar. 31, 1993

	No. of donors (and person-years)		
Age group	Men	Women	Total
< 30 yr	32 730 (58 264)	29 062 (49 230)	61 792 (107 494)
30–39 yr	35 983 (82 985)	23 797 (51 533)	59 780 (134 518)
40–49 yr	30 491 (75 821)	18 358 (42 679)	48 849 (118 500)
≥ 50 yr	20 281 (50 460)	9 494 (21 658)	29 775 (72 118)
Total	119 485 (267 529)	80 711 (165 101)	200 196 (432 631)

*No. of person-years may not sum to totals because of rounding.

1. The distribution of the interval between donations was determined for all donations, including donations made before the study period. Among the 200 196 donors, the mean interval between donations was 326.9 days, with a median of 238 and a range of 1 to 2602 days. Approximately 4.7% of the intervals between donations were 56 days or less, the current minimum period between donations of whole blood. Some of these short intervals may have been related to apheresis or autologous donations. However, these short-interval donations affected the analysis only minimally since they accounted for only about 0.2% of the person-time included. The mean person-time per donor was 2.16 PY; it was somewhat higher among men (2.24 PY) than among women (2.05 PY).

Eighteen repeat blood donors (17 men and 1 woman) in the study population had a seroconversion to HIV-positive status. The number of seropositive donors and the incidence of HIV infection by sex and age group are presented in Table 2. The crude overall HIV incidence density was 3.3 per 100 000 PY (95% CI 1.8 to 5.4 per 100 000 PY). The incidence density was 4.9 per 100 000 PY among men (95% CI 2.6 to 8.3) and 0.61 per 100 000 PY among women (95% CI 0.02 to 3.4); the eightfold difference in the incidence density by sex was statistically significant ($p = 0.02$). The incidence density of HIV infection was highest among donors 30–39 years of age. The incidence density of HIV infection among repeat donors by region of residence is shown in Table 3. It was 3 times greater among donors from Montreal than among donors residing elsewhere (mainly in western Quebec); this difference was statistically significant ($p = 0.04$).

The incidence density of HIV infection among repeat donors by fiscal year is shown in Table 4. It varied from 3.0 to 3.6 per 100 000 PY during the fiscal years covered and showed no clear increasing or decreasing trend.

On the basis of a window period of 25 days, and assuming no change in the incidence density of HIV infection since the 1989–93 period, the prevalence of blood that carried HIV infection but did not have detectable antibody collected from repeat donors at the MCBTS was 0.23 per 100 000, or 1 in 440 000. For all donors (i.e., including units from first-time donors), the current risk of HIV infection from a unit distributed by the MCBTS is an estimated 0.26 per 100 000, or 1 in 390 000 (95% CI 1 in 250 000 to 655 000). Finally, the risk of HIV from all donated units in Canada was estimated at 1 in 913 000 (95% CI 1 in 507 000 to 2 050 000).

Discussion

We observed a crude HIV incidence density of 3.3 per 100 000 PY in repeat donors in Montreal, with an incidence density per 100 000 PY of 4.9 among men and 0.61 among women. For men, the incidence density was highest among donors 30–39 years of age, and lower among donors both younger and older in the 4 age groups examined. Among women, there was only 1 seroconversion, in

Table 2: HIV incidence density and number of seroconversions among repeat donors by sex and age group

Age group	Incidence per 100 000 person-years (and no. of seroconversions) Men	Women	Total	95% CI* for total incidence per 100 000 person-years
< 30 yr	4.7 (5)	0.0 (0)	2.5 (5)	0.47–7.8
30–39 yr	8.3 (8)	0.0 (0)	5.1 (8)	2.0–10.6
40–49 yr	4.6 (4)	0.0 (0)	2.9 (4)	0.7–8.0
≥ 50 yr	0.0 (0)	4.6 (1)	1.4 (1)	0.04–7.7
Total	4.9 (17)	0.61 (1)	3.3 (18)	1.8–5.4

*CI = confidence interval.

Table 4: HIV incidence density and number of seroconversions among repeat donors by sex and fiscal year

Fiscal year	Incidence per 100 000 person-years (and no. of seroconversions) Men	Women	Total	95% CI for total incidence per 100 000 person-years
1989–90	5.2 (5)	0.0 (0)	3.3 (5)	0.94–8.2
1990–91	3.6 (2)	2.0* (0)	3.0 (2)	0.78–7.9
1991–92	5.4 (3)	0.07 (1)	3.3 (4)	0.84–8.8
1992–93	5.8 (7)	0.0 (0)	3.6 (7)	0.56–12
Total	4.9 (17)	0.61 (1)	3.3 (18)	1.8–5.4

*Seroconversions are indicated during the fiscal year in which the positive unit was donated. However, as described in Methods, to calculate the incidence density, the numerator is assigned on a prorated basis from the date of the last negative unit donated to the date of the first positive unit donated.

Table 3: HIV incidence density and number of seroconversions among repeat donors by sex and region of residence

Region of residence	Incidence per 100 000 person-years (and no. of seroconversions) Men	Women	Total	95% CI for total incidence per 100 000 person-years
Island of Montreal	10.8 (11)	0.00 (0)	6.3 (11)	2.7–12.1
Outside Montreal	2.6 (6)	0.94 (1)	2.0 (7)	0.71–4.4
Other/unknown	0.0 (0)	0.00 (0)	0.0 (0)	–
Total	4.9 (17)	0.61 (1)	3.3 (18)	1.8–5.4

a woman in the age group 50 years and older. The density among donors living in Montreal was more than 3 times higher than that among donors living outside Montreal. The incidence density of HIV infection appeared to be relatively stable during the 4-year study period, although it is difficult to draw conclusions from such a small number of seroconverting repeat donors.

We estimate that the risk of HIV infection from blood collected from repeat donors in the region served by the MCBTS was approximately 1 in 440 000 units transfused. This estimate is based on the incidence density of HIV infection observed from April 1989 to March 1993 and on the most current estimates of the mean duration of the window period. Since 1992, the sensitivity of test kits has improved, primarily through the use of recombinant antigens for both HIV-1 and HIV-2; a recently published study based on current tests estimated the mean window period at 25 days.[4,5] Taking into account the higher incidence of HIV infection among first-time donors increased the estimate to 1 in 390 000, a modest increase in incidence, since repeat donors provide 84% of units collected at the MCBTS.

Our analysis of current risk assumes a constant incidence density of HIV infection since the 1989–93 period. However, further methods to decrease the risk of transmission of HIV and other bloodborne agents have been instituted since then. Testing for hepatitis C was introduced in June 1990 and measures to reinforce the direct questioning of potential donors have been implemented. Thus, a study such as ours should be repeated to determine the incidence density of HIV infection more recently.

Our analysis did not take into account the potential benefits of p24 antigen testing in reducing the risk of HIV infection through transfusion. Schreiber and collaborators[10] estimated that the addition of this type of testing would decrease HIV risk from transfusion by 27%. In fact, since such testing was initiated in March 1996, there have been fewer p24-antigen-positive, antibody-negative units identified than predicted (Dr. Michael P. Busch, Vice-President of Research and Scientific Services, Irwin Memorial Blood Centers, San Francisco: personal communication, 1994.) Thus, the protection afforded by this measure may be less than estimated. The low number of p24 antigen-positive, antibody-negative donors identified could be due to a lower-than-expected incidence of HIV infection among donors or a less-than-expected shortening of the window period by p24 antigen testing.

This analysis was carried out at the MCBTS. Because of the largely urban nature of the population from which donors at this centre are recruited and because HIV is more prevalent in urban than in rural populations, the incidence of HIV infection among donors at this centre may be higher than that at the other 15 blood transfusion centres in Canada, which include many rural regions. In fact, the cumulative incidence of AIDS in the Montreal region is about twice that in the rest of Canada.[11,12] To determine the risk for Canada as a whole, HIV incidence studies such as this one should be carried out in the other blood centres. However, we estimated the risk in all of Canada in a preliminary fashion by estimating the incidence density of HIV infection among repeat donors in the rest of Canada based on the ratio of HIV prevalence among repeat donors in the other centres to that among repeat donors at MCBTS during 1989–93. (This extrapolation was based on the assumption that the relative incidence density of HIV infection in Montreal compared with the rest of Canada is the same as the relative HIV prevalence; we have no data to support or refute this assumption.) Including first-time donors and using the most recent estimate of the mean window period of 25 days provided an estimate for the current risk of HIV from a unit of blood in Canada as a whole of 0.11 per 100 000, or 1 in 913 000 (95% CI 1 in 507 000 to 2 050 000). Based on this, approximately 1.5 HIV transmissions would occur in Canada every year (i.e., 950 000 donated units each year, about 1.4 components administered per donated unit and a risk of HIV infection of 1 in 913 000).

The incidence and prevalence of bloodborne infectious agents among blood donors are likely to be much lower than in the general population. This is due in part to the measures in place to ensure the safety of the blood supply from infectious agents, in particular hepatitis B and C viruses and HIV. These measures include self-exclusion of prospective donors, the systematic review of possible risk factors at the time of donation, the ballot system permitting the donor to designate his or her blood as "not for transfusion," and serologic testing of donated units before distribution. Blood donors in whom hepatitis B surface antigen is detected are deferred from further blood donation by the MCBTS. Donors who have hepatitis B virus (HBV) infection are probably at an increased risk of having HIV infection because of the similar modes of transmission of these infections. Thus, in addition to the other approaches used to select "low-risk" donors, the elimination of chronic HBV carriers further diminishes the risk of HIV infection among blood donors. Nevertheless, the elimination of carriers has only a partial effect, since only 5% to 10% of adults infected with HBV become chronic carriers. Thus, only a small proportion of this population would be eliminated from the blood-donor pool in this way. Testing for hepatitis C, instituted in 1990, would eliminate as donors some people at risk for HIV infection, especially injection drug users, who are at high risk for both infections.

It is instructive to compare estimates of HIV preva-

lence from Canada and elsewhere that are based on data from volunteer blood services with those from population-based seroepidemiologic studies. Applying the observed age-, sex- and region-specific rates to the Quebec adult population 18 to 64 years of age provides a standardized incidence density of 2.9 per 100 000 PY and a total of 132 new HIV infections per year. One recent estimate of the annual number of new HIV infections in Quebec, from back-calculation and meta-analysis, was 500 to 2000 per year, with the most plausible range being 1000 to 1500.[13] Thus, according to this analysis, the incidence of HIV infection among blood donors is about 10% of that among all Quebec residents. Since the incidence of HIV infection among blood donors would be expected to be much lower than in the population as a whole, the incidence of HIV infection among blood donors we observed is consistent with these estimates. The relative incidence of HIV infection among blood donors compared with that among the overall population is comparable to the relative prevalence of HIV infection in these 2 groups. The HIV prevalence rate observed among first-time blood donors at the Montreal centre during the period 1989–93 was 17.7 per 100 000 (or 0.18 per 1000), approximately 18 times lower than the sex- and region-adjusted HIV prevalence of approximately 3.3 per 1000 population derived from a meta-analysis.[13]

Our estimate of the risk of HIV infection from transfused blood is lower than previously thought. This lower estimate is related to the more accurate estimates of the incidence of HIV infection now available, better approaches to estimating the incidence of HIV infection among first-time donors and, most important, the decrease in the window period afforded by more sensitive tests. In a study conducted in the US by Lackritz and colleagues,[6] the risk of donation in the window period for units collected by the Red Cross (representing about one-half of blood collected in that country) was estimated at 1 in 450 000.[6] A recent study by Schreiber and collaborators[10] of the residual risk associated with several bloodborne pathogens, including HIV, found a risk of 1 in 493 000; this study did not take into account the possibility of a higher incidence of HIV infection among first-time donors. These estimates are about double our estimate for Canada, which is consistent with the higher incidence of HIV infection and AIDS in the US than in Canada. However, the US estimate is substantially lower than earlier estimates; studies based on mean window periods of 56 days[14] and 45 days[15] yielded estimates of 1 in 153 000 and 1 in 225 000, respectively.

Our study design did not allow us to determine risk behaviour and other characteristics of repeat donors who had a subsequent HIV-positive unit. Studies in the US have shown that most first-time and repeat donors with HIV infection have risk factors that should have excluded them from donation.[16,17] To reduce the risk of HIV infection from blood transfusion further, such studies should be carried out in Canada. Studies should also explore potential measures to discourage people at high risk of HIV infection from donating blood.

Conclusion

This study, carried out at the MCBTS, shows that data from administrative donor files can be used to determine the incidence of HIV infection among repeat donors at a modest cost. The total costs for this project are somewhat difficult to estimate but are likely lower than $15 000 and consist mainly of the professional time of the investigators and programming support. These costs would likely be still lower for studies carried out in other blood centres, since the developmental work, which represents a significant proportion of the cost, has been completed.

The estimation of the incidence of HIV infection from the data on repeat blood donors that are readily available at regional centres of the CRCSBS appears to be feasible and worth while and provides insight into the epidemiologic characteristics of HIV infection. Our approach should be extended to other blood centres in Canada, with priority given to those in the cities where the incidence of HIV infection is thought to be highest.

Our study also allowed us to estimate the current risk of HIV infection associated with receiving a blood transfusion in Canada. As a result of the adoption of measures to improve blood safety, including HIV testing, the incidence of HIV infection among blood donors in Canada is low and the risk of HIV infection from blood transfusion is also low but not zero.

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