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Risk of transfusion-related acute lung injury and human immunodeficiency virus associated with donations from trans donors in Quebec, Canada

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Abstract

Background and Objectives: Blood operator must establish selection criteria according to the populations at risk of blood-related infections and complications. Therefore, this study aimed to assess the risks of transfusion-related acute lung injury (TRALI) and human immunodeficiency virus (HIV) associated with donations from trans persons.

Materials and Methods: Donor screening data from Héma-Québec were used. The risks of TRALI and HIV were estimated based on internal data and assumptions derived from the literature. The risk was assessed under four scenarios: a most likely scenario, an optimistic scenario and two pessimistic scenarios. All scenarios assumed no prior screening for trans donors.

Results: The trans population comprised 134 donors, including 94 (70.1%) trans men. Of the 134 donors, 58 (43.3%) were deferred from donating a blood-derived product because of an ongoing gender-affirming genital surgery, and the remaining 76 (56.7%) were eligible donors. The risk of having a TRALI-causing donation, given that it comes from a trans man, was estimated at one every 115–999 years for all scenarios. The risk of having an HIV-contaminated donation, given that it comes from a trans woman, was estimated at one every 1881–37,600 years for all scenarios.

Conclusion: This study suggests that donations from trans persons are associated with a negligible risk of TRALI and HIV.

KEYWORDS
blood safety, risk analysis, trans donors, transfusion medicine, transfusion-transmissible infection

HIGHLIGHTS

- Using a risk model simulation, this study helps understand the risks of transfusion-related acute lung injury (TRALI) and human immunodeficiency virus (HIV), potentially associated with donations from trans donors.
- Our analysis suggests that the risk of having a TRALI-causing donation from a trans man and that of having an HIV-contaminated donation from a trans woman is negligible.

- This study highlights the fact that it may be possible to adopt more inclusive practices for trans donors while negligibly affecting blood safety.

INTRODUCTION

Blood operators must establish selection criteria according to the populations at risk of blood-related infections. In particular, gender is associated with various risks related to blood transfusion. For example, the prevalence of human immunodeficiency virus (HIV) is higher among men who have sex with men [1]. The incidence of transfusion-related acute lung injury (TRALI) is highest in recipients of plasma or platelets donated by women with a pregnancy history because pregnancy increases the likelihood of developing anti-human leukocyte antigen (anti-HLA) antibodies [2].

These gender-specific risks are more difficult to assess with trans persons, since the gender identity of these individuals differs from the sex assigned at birth. Moreover, gender transition is unique: it can be social, medical (hormone therapy, gender-affirming genital surgery, etc.) and/or legal [3, 4]. Concerning the legal transition, in Canada, gender is categorized as 'male', 'female' or 'other' on federal-government-issued identification documents (IDs) and can be modified without any medical transition [5]. The same process applies in Quebec, but 'male' and 'female' are the only available categories in provincial-government-issued IDs.

Héma-Québec (a blood operator in Canada) also uses a gender-based classification scheme to screen trans donors prior to donation, which can lead to challenges. For example, trans men (for whom the sex assigned at birth was 'female') may not be asked about their pregnancy history, which may increase the risk of having a TRALI-causing donation. Similarly, trans women (for whom the sex assigned at birth was 'male') may not be asked about sexual contacts with other male partners, which may increase the risk of having a donation contaminated by HIV and other sexually transmitted infections given a higher prevalence among trans women due to unprotected receptive anal intercourse (URAI) [6, 7].

As the number of current and potential trans donors has increased in Canada, this study aimed to assess the risks of TRALI or HIV associated with donations from trans donors.

MATERIALS AND METHODS

Donor screening

At Héma-Québec, trans identity can be self-reported by the donor or captured through questions, such as (1) In the last 6 months, have you consulted a physician for health problems or for a surgery?; and (2) In the last three days, have you taken any medication?

Once trans status is identified, the Assistant Director of Medical Affairs interviews the donor (questions in Table S1) to determine the most suitable questionnaire (i.e., male- or female-specific) and donor eligibility. When gender on government-issued IDs differs from that deemed more suitable for the gender-specific questionnaire, an admissibility card is issued to the donor, which must be presented at each following donation.

Study population

The study population included all self-identified trans individuals who went through the donor screening process at Héma-Québec between 11 August 2015 and 25 August 2021. Eligible and deferred trans donors were included in the analysis, but Héma-Québec donors who self-identified as non-binary were excluded.

Study measures

The risks of TRALI and HIV were assessed based on internal data from Héma-Québec and assumptions derived from the literature.

Risk of TRALI

The risk of having a TRALI-causing donation was calculated using a deterministic approach, assuming the following: (1) Trans male donors who were asked about their pregnancy history are representative of the overall population; (2) There is no prior donor screening for trans donors, that is, the risk is calculated as if no trans men were identified; (3) Only trans men contribute to the risk of TRALI; and (4) Only platelet and plasma (excluding source plasma) donations contribute to the risk of TRALI.

Parameters

The risk of TRALI depends on the number of past pregnancies [8]. Consequently, the following parameters were used to estimate the risk of having a TRALI-causing donation from trans male donors: (1) the prevalence of pregnancy history among trans male donors who were asked about their pregnancy history; (2) the proportion of cis gender women with anti-HLA among those with a pregnancy history, as reported by Triulzi et al. [8]; and (3) the risk of TRALI among recipients of anti-HLA-containing donations, as reported by Kleinman et al. [2].

Therefore, the risk of having a TRALI-causing donation, given that the donation is from a trans man, was calculated as follows:

$$\begin{aligned} &P(\text{TRALI}|\text{Transgender man donation}) \\ &= P(\text{TRALI}|\text{anti}-\text{HLA}) \times P(\text{anti}-\text{HLA}|\text{Pregnancy}) \\ &\quad \times P(\text{Pregnancy}|\text{Transgender man donation}) \end{aligned}$$

The risk of having a TRALI-causing donation from a trans man, among all donations, was calculated as follows:

$$P(\text{TRALI}) = P(\text{TRALI}|\text{Transgender man donation}) \times P(\text{Transgender man donation})$$

where the probability of a donation from a trans man was defined as the mean annual number of donations from trans men at Héma-Québec from 2015 to 2021 divided by the number of platelet and plasma donations in 2019 (pre-pandemic).

Scenarios

The risk of TRALI was assessed under four main scenarios, which differed in the way parameters related to the prevalence of pregnancy history and the probability that a donation contains anti-HLA given a pregnancy history were elicited. In the *most likely scenario*, the prevalence of pregnancy history among trans men was set according to the number of donations from trans men with a pregnancy history between 2015 and 2021, and the probability of having an anti-HLA-containing donation (given a pregnancy history) was set as the mean obtained among all females with a pregnancy history, regardless of the number of pregnancies. In the *optimistic scenario*, the prevalence of pregnancy history was the same as that in the most likely scenario, and the probability of having an anti-HLA-containing donation, given a pregnancy history, assumed all individuals with a pregnancy history only had one previous pregnancy. In the *pessimistic scenario A*, the prevalence of pregnancy history was the same as that in the most likely scenario, and the probability of having an anti-HLA-containing donation, given a pregnancy history, assumed all individuals with a pregnancy history had four or more previous pregnancies. In the *pessimistic scenario B*, the prevalence of pregnancy was four times as high as that in the most likely scenario, and the probability of having an anti-HLA-containing donation was the same as that in the most likely scenario. An additional scenario ('pessimistic scenario C') was also evaluated (detailed in Data S2), with the same parameters as those in the most likely scenario except for the average number of annual donations from trans men. This scenario assumes a higher proportion of donations from trans men among all donations and therefore reflects the worst case for the overall risk of TRALI.

Risk of HIV infection

The risk of having an HIV-contaminated donation was also calculated using a deterministic approach assuming the following: (1) There is no prior donor screening for trans donors, that is, the risk is calculated as if no trans women were identified; (2) Trans female donors engaged in URAI at a rate similar to that of MSM in the last 3 months (to address the lack of published information on trans female donors); (3) Only trans women contribute to the risk of having an HIV-contaminated donation; and (4) Platelets, plasma (excluding source plasma) and red blood cell donations contribute to the risk of HIV infection.

TABLE 1 Trans donor characteristics

	Trans men		Trans women	
	N	(%)	*N*	(%)
Age group (years)[a]				
18–29	65	(48.5)	15	(11.2)
30–39	17	(12.7)	11	(8.2)
40–49	7	(5.2)	8	(6.0)
50–70	5	(3.7)	6	(4.5)
Ethnicity				
White	75	(56.0)	35	(26.1)
Other	9	(6.7)	1	(0.8)
Unknown	10	(7.4)	4	(3.0)
Donor status[b]				
Active	37	(27.6)	13	(9.7)
Inactive	30	(22.4)	16	(11.9)
Never donated	27	(20.1)	11	(8.2)
Deferral due to ongoing gender-affirming genital surgery				
Active	41	(30.6)	17	(12.7)
Ended	53	(39.5)	23	(17.2)
History of pregnancy				
Yes	3	(2.2)	0	(0.0)
No	43	(32.1)	6	(4.5)
Unknown[c]	48	(35.8)	34	(25.4)
Total	94	(70.1)	40	(29.9)

Abbreviation: HQ, Héma-Québec.
[a]Age at the time of the first donation.
[b]A donor was considered active if a donation was made in the last 24 months.
[c]Includes persons who never donated and donors who were not asked about pregnancy history.

Parameters

Risk assessment was stratified based on whether the donation was made during or outside the window period. Missed HIV-contaminated donations made during the window period are caused by undetectable viral loads. Missed HIV-contaminated donations made outside the window period might (theoretically) be caused by failures of nucleic acid tests (NATs), test transcription errors and clinical test errors, but are virtually impossible because of the performance of current tests [9]. This risk, which is essentially zero, has nevertheless been included. The probability of having an HIV-contaminated donation, among donations from trans women, was therefore:

$$P(\text{infectious donation}|\text{Transgender woman donation}) = P(\text{window period donation}|\text{Transgender woman donation}) + P(\text{Test and clinical error}|\text{Transgender woman donation})$$

TABLE 2 Parameters and estimates for the risk of TRALI

Parameter	Estimate				Step	Calculation/ reference
	Most likely scenario[a]	Optimistic scenario[b]	Pessimistic scenario A[c]	Pessimistic scenario B[d]		
Average number of donations from trans men within a year[e]	24	24	24	24	A	HQ database
Average number of donations from trans men with pregnancy history in a year[e,f]	0.67	0.67	0.67	2.67	B	HQ database
Prevalence of pregnancy history among donations from trans men	**0.0278**	**0.0278**	**0.0278**	**0.1111**	**C**	**=B/A**
Probability of anti-HLA among women with pregnancy history	0.244	0.112	0.322	0.244	D	Triulzi et al. [8]
Risk of TRALI among recipients of anti-HLA-containing donations	0.0134	0.0134	0.0134	0.0134	E	Kleiman et al. [2]
Total number of donations per year[g]	67,456	67,456	67,456	67,456	F	HQ database
Risk of TRALI among donations from trans men	$\mathbf{9.08 \times 10^{-5}}$	$\mathbf{4.17 \times 10^{-5}}$	$\mathbf{1.20 \times 10^{-4}}$	$\mathbf{3.63 \times 10^{-4}}$	**G**	**=E × D × C**
Number of donations from trans men per TRALI	11,011	23,987	8343	2753	H	=1/G
Number of years for one TRALI-causing donation[h]	**459**	**999**	**348**	**115**	**I**	**=H/A**
Risk of TRALI[h] among all donations	$\mathbf{3.23 \times 10^{-8}}$	$\mathbf{1.48 \times 10^{-8}}$	$\mathbf{4.26 \times 10^{-8}}$	$\mathbf{1.29 \times 10^{-7}}$	**J**	**=G·(A/F)**

Note: Bold indicates the main parameters or final risk estimates for TRALI.
Abbreviations: HQ, Héma-Québec; TRALI, transfusion-related acute lung injury.
[a]Most-likely scenario: The prevalence of pregnancy history among donations from trans men was set according to the number of donations from trans men with a pregnancy history between 2015 and 2021; the probability of having an anti-HLA-containing donation among women with a pregnancy history was set as the mean among all females with a pregnancy history, regardless of the number of pregnancies.
[b]Optimistic scenario: The probability of having an anti-HLA-donation among women with a pregnancy history was set as the mean among all females with one pregnancy.
[c]Pessimistic A scenario: The probability of having an anti-HLA-containing donation among women with a pregnancy history was set as the mean among all females with four or more pregnancies.
[d]Pessimistic B scenario: The prevalence of pregnancy history among donations from trans men was set as four times that in the most-likely scenario.
[e]Based on donations made from 2015 to 2021.
[f]Among trans men who were asked about pregnancy history.
[g]Based on the number of plasma and platelet donations in 2019, excluding source plasma.
[h]Only considering the risk of TRALI due to donations from trans men.

The HIV window period is only about 9 days with NAT [10]. So the probability of having an HIV-contaminated donation made during the window period depends on the number of incident infections over a year among trans female donors (i.e., seroconverters) and on the mean interval between donations (MID). The probability of having an HIV-contaminated donation made during the window period, given that the donation is from a trans woman, is therefore:

$$\begin{aligned} &P(\text{window period donation}|\text{Transgender woman donation}) \\ &= P(\text{window period donation}|\text{seroconverter}) \\ &\quad \times P(\text{seroconverter}|\text{Transgender woman donation}) \\ &= \frac{\text{WP}_{\text{length}}}{\text{MID}}(\text{Incidence}_{\text{repeat}} \times \%_{\text{repeat}} + \text{Incidence}_{\text{repeat}} \times \text{FT}_{\text{correction}} \times \%\text{FT}) \end{aligned}$$

To determine the incidence of HIV for first-time donors, an adjustment factor of 1.65 is applied for repeat donors, as proposed by Davison et al. [9]. The proportion of repeat and first-time donors was derived from Héma-Québec data on all trans female donors since 1986.

Trans female donors were assumed to have sexual behaviours similar to those of MSM in the last 3 months. Therefore, HIV incidence for trans female donors was assumed to be the same as that for MSM plasma donors who did not comply with the current 3-month deferral, as reported by Aubé et al. [11]. Uncertainty about the difference in HIV incidence for trans female donors versus MSM donors was addressed in the scenarios (see further below).

For donations made outside the window period, the risk of HIV infection was calculated as follows, based on the prevalence of HIV among trans female donors:

$$\begin{aligned} &P(\text{Test and clinical error}|\text{Transgender woman donation}) \\ &= P(\text{Test and clinical error}|\text{HIV positive donation}) \\ &\quad \times (\text{Prevalence}_{\text{repeat}} \times \%_{\text{repeat}} + \text{Prevalence}_{\text{FT}} \times \%\text{FT}) \end{aligned}$$

The prevalence of HIV among trans female donors was derived from the results of Aubé et al. for non-compliant MSM plasma donors [11].

The risk of an HIV-contaminated donation from a trans woman (among all donations) was also assessed.

$$\begin{aligned} P(\text{infectious donation}) = &P(\text{infectious donation}|\text{Transgender woman donation}) \\ &\times P(\text{Transgender woman donation}) \end{aligned}$$

The probability of having a donation from a trans woman was the annual mean number of donations from trans women between 2015 and 2021 divided by the total number of donations in the year 2019.

TABLE 3 Parameters and estimates for the risk of HIV infection

Parameter	Estimate				Step	Calculation/reference
	Most likely scenario[a]	Optimistic scenario[b]	Pessimistic scenario A[c]	Pessimistic scenario B[d]		
HIV prevalence among repeat, non-compliant MSM donors	1.55×10^{-4}	1.55×10^{-4}	1.55×10^{-4}	1.55×10^{-4}	A	Aubé et al. [11]
HIV prevalence among first-time, non-compliant MSM donors	0.001554	0.001554	0.001554	0.001554	B	Aubé et al. [11]
HIV incidence among repeat, non-compliant MSM donors	1.55×10^{-4}	1.55×10^{-4}	1.55×10^{-4}	1.55×10^{-4}	C	Aubé et al. [11]
Incidence adjustment factor	1	0.5	2	1	D	Scenario's adjustment
HIV incidence for trans women donors	$\mathbf{1.55 \times 10^{-4}}$	$\mathbf{7.77 \times 10^{-5}}$	$\mathbf{3.11 \times 10^{-4}}$	$\mathbf{1.55 \times 10^{-4}}$	**E**	**=C × D**
First-time donor adjustment factor	1.65	1.65	1.65	1.65	F	Davison et al. [9]
HIV window period (days)	9	9	9	9	G	O'Brien et al. [10]
Mean interval between donations (days)	228.125	228.125	228.125	228.125	H	HQ database
Proportion of repeat donors	87%	87%	87%	87%	I	HQ database
NAT, test transcription and clinical test error probability	1.01×10^{-5}	1.01×10^{-5}	1.01×10^{-5}	1.01×10^{-5}	J	Aubé et al. [11]
Number of donations from trans women per year	8	8	8	80	K	HQ database
Total number of donations per year[e]	272,248	272,248	272,248	272,248	L	HQ database
Residual risk of donations made during the window period among donations from trans women	6.64×10^{-6}	3.32×10^{-6}	1.33×10^{-5}	6.64×10^{-6}	M	=[E × I + E × F × (1 − I)](G/H)
Residual risk of donations made outside the window period among donations from trans women	3.38×10^{-9}	3.38×10^{-9}	3.38×10^{-9}	3.38×10^{-9}	N	=[A × I + B × (1 × I)] × J
Residual risk of HIV infection among donations from trans women	$\mathbf{6.65 \times 10^{-6}}$	$\mathbf{3.32 \times 10^{-6}}$	$\mathbf{1.33 \times 10^{-5}}$	$\mathbf{6.65 \times 10^{-6}}$	**O**	**=M + N**
Number of donations from trans women per HIV-contaminated donation	150,476	300,798	75,257	150,476	P	=1/O
Number of years per HIV-contaminated donation[f]	**18,809**	**37,600**	**9407**	**1881**	**Q**	**=P/K**
Residual risk of HIV infection[f] among all donations	$\mathbf{1.95 \times 10^{-10}}$	$\mathbf{9.77 \times 10^{-11}}$	$\mathbf{3.90 \times 10^{-10}}$	$\mathbf{1.95 \times 10^{-9}}$	**R**	**=O × (K/L)**

Note: Bold indicates the main parameters or final risk estimates for HIV.
Abbreviations: HIV, human immunodeficiency syndrome; HQ, Héma-Québec; MSM, men who have sex with men; NAT, nucleic acid testing.
[a]Most likely scenario: HIV incidence among trans female donors was set as the same as that among repeat, non-compliant MSM donors. The number of donations from trans women per year was set as the mean, annual number of deferral-free donations per trans female donor from January 1, 2018 to August 21, 2021.
[b]Optimistic scenario: HIV incidence among trans female donors was set as half that among repeat, non-compliant MSM donors.
[c]Pessimistic scenario A: HIV incidence among trans female donors was set as twice that among repeat, non-compliant MSM donors.
[d]Pessimistic scenario B: The annual number of donations from trans female donors was set as 10 times that in the most likely scenario.
[e]Based on the number of donations of plasma, platelets and red blood cells in 2019, excluding source plasma.
[f]Only considering the risk of HIV transmission due to donations from trans women.

Scenarios

The risk of HIV infection was assessed under four scenarios, which differed on the basis of the incidence of HIV among trans female donors and the annual number of donations from trans women. In the *most likely scenario*, the incidence of HIV among trans female donors was assumed to be the same as that among non-compliant MSM donors, and the number of donations from trans female donors was the mean annual number of deferral-free donations per trans female donor from 1 January 2018 to 21 August 2021. In the *optimistic scenario*, the incidence of HIV among trans female donors was half that among non-compliant MSM donors, and the annual number of donations from trans women was the same as that in the most likely scenario. In the *pessimistic scenario A*, the incidence of HIV among trans female donors was twice as high as that among non-compliant MSM donors, and the annual number of donations from trans women was the same as that in the most likely scenario. In the *pessimistic scenario B*, the incidence of HIV among donations from trans women was the same as that in the

most likely scenario, and the number of donations from trans women was 10 times that in the most likely scenario.

RESULTS

Trans donor characteristics

The Héma-Québec trans population comprised 134 donors, including 94 (70.1%) trans men. Fifty-eight (43.3%) were deferred from donating a blood-derived product because of an ongoing gender transition, more specifically gender-affirming genital surgery, and 76 (56.7%) were eligible donors (Table 1).

Risk of TRALI

In the most likely scenario, the risk of having a TRALI-causing donation, given that it comes from a trans man, was estimated at 9.08×10^{-5} (or 1 per 11,011 donations; Table 2). In the province of Quebec, the risk of having a TRALI-causing donation, among all donations, was estimated at 3.23×10^{-8} (or 1 per 30,946,905 donations), which is significantly lower than the above risk given the small proportion of trans men among all donors. The time required to observe one TRALI-causing donation from a trans man was estimated at 459 years.

In the optimistic scenario, the number of years required to observe one TRALI-causing donation was estimated at 999 years (Table 2). The risk of having a TRALI-causing donation from a trans man was estimated at one every 348 years in the pessimistic scenario A, and one every 115 years in the pessimistic scenario B. In the pessimistic scenario C, given the particularly large number of yearly donations from trans men, it was estimated at one every 46 years (Table S2).

Risk of HIV infection

In the most likely scenario, the risk of having an HIV-contaminated donation from a trans woman was estimated at 6.65×10^{-6} (or 1 per 150,476 donations), and the corresponding annual risk (among all donations) was 1.95×10^{-10} (or 1 per 5,120,841,305 donations; Table 3). The time required to observe one HIV-contaminated donation from a trans woman was estimated at 18,809 years in the province of Quebec.

In the optimistic scenario, the number of years required to observe one HIV-contaminated donation was estimated at 37,600 years. This number was estimated at 9407 years in the pessimistic scenario A and 1881 years in the pessimistic scenario B.

DISCUSSION

This study helps us to understand the risks of TRALI and HIV potentially associated with donations from trans donors. For TRALI, few of the trans male donors who were asked about pregnancy history had one (6.5%). Consequently, the probability of having a TRALI-causing donation from a trans man was particularly low, with one event every 459 years in the most likely scenario. The risk of having an HIV-contaminated donation from a trans woman was even lower, with one event every 18,809 years in the most likely scenario.

Overall, the risk of having a TRALI-causing donation ranged from one event every 999 years in the optimistic scenario to one event every 115 years in the most pessimistic scenario (i.e., when multiplying the incidence of pregnancy history by 4), excluding additional pessimistic scenario C in Data S2. Results were therefore robust to increases in the incidence of pregnancy history, for which there was significant uncertainty since this information was missing for 31.3% of trans male donors (excluding those who have never donated). As for the pessimistic scenario C, in which the annual number of donations from trans men was increased, the number of years to observe a TRALI-causing donation was, as expected, lower than in the other scenarios. However, the risk of TRALI among all donation remained very low at 3.23×10^{-7} (Table S2). Of note, these low risk estimates were obtained assuming none of the trans men disclosed a pregnancy history at a prior screening, which likely overestimates risk. Also, only platelet and plasma donations (excluding source plasma) were assumed to contribute to the overall risk, since those are the only deferred donations for women with a history of pregnancy at Héma-Québec.

Pregnancy is a significant risk factor for the development of anti-HLA, but the extent of this contribution differs across studies. Although some studies reported a higher probability of anti-HLA than reported by Triulzi et al. for women with a history of pregnancy [8, 12], the pessimistic scenario A assumed all women had four or more pregnancies and thus the parameters remain representative of the literature. As for the probability of TRALI given an anti-HLA-containing donation, the most recent estimate was 0.59% [2], which may be an overestimation since it includes all "possible TRALI" events, notwithstanding whether they were caused by transfusion.

The risk of having an HIV-contaminated donation from a trans woman ranged from one event every 37,600 years in the optimistic scenario to one event every 1881 years in the most pessimistic scenario B. This risk therefore appears to be largely theoretical and remained negligible when assuming large increases in the risk of HIV infection among trans women or increases in the number of donations from trans women. Assumptions on HIV incidence and prevalence for trans female donors were based on those of MSM donors who did not comply with Héma-Québec's 3-month deferral. However, not all trans female donors have sex with men and thus exhibited sexual behaviours that are at risk for HIV in the last 3 months. Furthermore, trans female donors who are aware of the current deferral of 3 months after male-to-male sexual contact may assume that they are also excluded, in which case the real incidence of HIV in the overall trans female population would be lower than that assumed in the current study. The risk of HIV infection remained low when assuming a substantial increase in the number of trans female donors; further, even this estimate was likely an overestimation

considering that the other assumptions on incidence were conservative. The risk of an HIV-contaminated donation missed because of NAT system failure, test transcription and clinical test errors could have been ignored considering their negligible contribution. It should be noted that people who donate generally consider their blood safe.

Despite these reassuring results, little is known about the incidence of HIV in the overall trans female population [13], and even less among trans donors. Among other things, although the risk was assessed regardless of gender-affirming genital surgery (Table S1), the incidence of HIV among trans women who have undergone gender-affirming genital surgery is unclear [7]. Among trans women, the incidence of HIV infection has also been shown to be higher for people of colour [6, 14], but this group accounted for only 2.25% of trans female donors.

Although deterministic and conservative, the TRALI and HIV risk assessments emphasize that trans donors pose a negligible risk even when assuming no prior screening. Efforts should be focused on screening individuals for high-risk behaviours, which could be done through a gender-neutral questionnaire. Such individualised risk assessment is already implemented in other countries, including in the United Kingdom following the FAIR (For the Assessment of Individualised Risk) steering group's recommendations [15–17]. It also did not significantly impact blood safety when introduced in Argentina [18], and no significant increase in the proportion of HIV-positive MSM donors was observed after the implementation in Italy [19]. Moreover, a recent study indicated low non-compliance with a 3-month MSM deferral and with the disclosure of other HIV behavioural risk factors in Quebec [20], which justifies transitioning to an individualised behavioural donor risk assessment. A gender-neutral approach may also be welcomed by the trans community, since past behaviours would not be associated with the person's gender, and there would be no need for the person to disclose details on gender transition that are not needed for the screening of high-risk behaviours [21].

This study is subject to some limitations. In both risk analyses, parameters were fixed, which limits the interpretability of the estimates and their accuracy. However, parameters were varied in the scenarios, and so additional variations were arguably not necessary. The use of conservative assumptions and the inclusion of pessimistic scenarios ensured that the risks were likely overestimated; since the risks of TRALI and HIV were both low, conclusions could be drawn despite this deterministic approach.

Also, most trans donors who agreed to go through the screening process were likely motivated and confident in the safety of their blood. Their sexual behaviour could therefore be less risky than that of potential trans donors who were not screened. Nonetheless, this would not significantly impact the HIV risk analysis since trans donors were assumed to have the same HIV prevalence and incidence as non-compliant MSM donors.

The risks of TRALI and HIV were estimated based on the past number of trans donors, which may not adequately reflect the actual and future size of the trans donor population.

For the TRALI risk analysis, the Héma-Québec database did not include information on the number of previous pregnancies, and this parameter influences the presence of anti-HLA. This lack of information was addressed using scenarios in which the number of pregnancies was varied.

Finally, the (few) published estimates on the prevalence and incidence of HIV infection among trans women may be outdated, hence the use of data among MSM donors. This knowledge gap highlights the need to consider trans women as a distinct population in future studies on HIV infection prevalence and incidence.

In conclusion, to the best of our knowledge, this is the first study to assess the risks of TRALI and HIV associated with donations from trans persons. Our analysis suggests that the risk of having a TRALI-causing donation from a trans man and that of having an HIV-contaminated donation from a trans woman are negligible, even when assuming no prior screening for trans donors. Therefore, it may be possible to adopt more inclusive practices for trans donors while negligibly affecting blood safety.

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CONFLICT OF INTEREST

The authors declare no conflict of interests.

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REFERENCES

1. Public Health Agency of Canada. Estimates of HIV incidence, prevalence and Canada's progress on meeting the 90–90-90 HIV targets, 2018. [Internet]. 2020 [cited 2021 May 5]. Available from: https://epe.lac-bac.gc.ca/100/201/301/weekly_acquisitions_list-ef/2021/21-09/publications.gc.ca/collections/collection_2021/aspc-phac/HP40-282-2018-eng.pdf
2. Kleinman SH, Triulzi DJ, Murphy EL, Carey PM, Gottschall JL, Roback JD, et al. The Leukocyte Antibody Prevalence Study-II (LAPS-II): a retrospective cohort study of transfusion-related acute lung injury in recipients of high-plasma-volume human leukocyte antigen antibody–positive or –negative components. Transfusion. 2011;51:2078–91.
3. MacKinnon KR, Ashley F, Kia H, Lam JSH, Krakowsky Y, Ross LE. Preventing transition "regret": an institutional ethnography of gender-affirming medical care assessment practices in Canada. Soc Sci Med. 2021;291:114477.

4. Coleman E, Bockting W, Botzer M, Cohen-Kettenis P, DeCuypere G, Feldman J, et al. Standards of care for the health of transsexual, transgender, and gender-nonconforming people, version 7. Int J Transgenderism. 2012;13:165–232.
5. Pandey S, Gorlin JB, Townsend M, Van Buren N, Leung JNS, Lee C, et al. International forum on gender identification and blood collection: responses. Vox Sang. 2021;117:1–23.
6. Becasen JS, Denard CL, Mullins MM, Higa DH, Sipe TA. Estimating the prevalence of HIV and sexual behaviors among the US transgender population: a systematic review and meta-analysis, 2006–2017. Am J Public Health. 2019;109:e1–8.
7. Baral SD, Poteat T, Strömdahl S, Wirtz AL, Guadamuz TE, Beyrer C. Worldwide burden of HIV in transgender women: a systematic review and meta-analysis. Lancet Infect Dis. 2013;13:214–22.
8. Triulzi DJ, Kleinman S, Kakaiya RM, MichaelP B, Norris PJ, Steele WR, et al. The effect of previous pregnancy and transfusion on HLA alloimmunization in blood donors: implications for a transfusion-related acute lung injury risk reduction strategy. Transfusion. 2009;49:1825–35.
9. Davison KL, Gregoire Y, Germain M, Custer B, O'Brien SF, Steele WR, et al. Changing the deferral for men who have sex with men – an improved model to estimate HIV residual risk. Vox Sang. 2019;114:666–74.
10. O'Brien SF, Grégoire Y, Pillonel J, Steele WR, Custer B, Davison KL, et al. HIV residual risk in Canada under a three-month deferral for men who have sex with men. Vox Sang. 2020;115:133–9.
11. Aubé E, Lewin A, O'Brien SF, Grégoire Y, Pillonel J, Steele WR, et al. HIV residual risk in Canada for apheresis source plasma donation without deferral for men who have sex with men. Vox Sang. 2021; 1–7:201–7.
12. De Clippel D, Baeten M, Torfs A, Emonds MP, Feys HB, Compernolle V, et al. Screening for HLA antibodies in plateletpheresis donors with a history of transfusion or pregnancy. Transfusion. 2014;54:3036–42.
13. Bauer GR, Travers R, Scanlon K, Coleman TA. High heterogeneity of HIV-related sexual risk among transgender people in Ontario, Canada: a province-wide respondent-driven sampling survey. BMC Public Health. 2012;12:292–303.
14. Poteat T, German D, Flynn C. The conflation of gender and sex: gaps and opportunities in HIV data among transgender women and MSM. Glob Public Health. 2016;11:835–48.
15. NHS. Blood donor selection policy: more people now able to give blood [Internet]. NHS Blood Donation. [cited 2022 Jan 14]. Available from: https://www.blood.co.uk/news-and-campaigns/news-and-statements/fair-steering-group/
16. Goldman M, Shih 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.
17. For the Assessment of Individualised Risk (FAIR) group. Can donor selection policy move from a population-based donor selection policy to one based on a more individualised risk assessment? Conclusions from the For the Assessment of Individualised Risk (FAIR) group [Internet]. 2020. Available from: https://nhsbtdbe.blob.core.windows.net/umbraco-assets-corp/21001/fair_sabto_20201211.pdf
18. Blanco S, Carrizo LH, Moyano RW, Mangeaud A, Gallego SV. Gender-neutral donor deferral policies: experience in Argentina implementing individual risk-assessment policies. Vox Sang. 2020; 115:548–54.
19. Suligoi B, Pupella S. Changing blood donor screening criteria from permanent deferral for men who have sex with men to individual sexual risk assessment: no evidence of a significant impact on the human immunodeficiency virus epidemic in Italy. Blood Transfus. 2013;11:441–8.
20. Lewin A, Grégoire Y, Delage G, Thibeault C, Viau C, Milot C, et al. Reported non-compliance with pre-donation screening among blood donors in Québec, Canada: a focus on the 3-month deferral for men who have sex with men. Vox Sang. 2022. Available from: https://pubmed.ncbi.nlm.nih.gov/35377497/
21. Butler-Foster T, Chin-Yee I, Huang M, Jackson KT. Toward understanding culturally sensitive care for transgender blood donors: a scoping review of health care provider knowledge. Transgender Health. 2020;5:104–15.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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