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# Residual risk of HIV transmission through blood transfusion in five blood banks in Cameroon

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## Abstract

***Background*:** Cameroon remains a country with high HIV prevalence among blood donors so there is a need for surveillance of HIV transmission through blood transfusion in order to evaluate blood safety and justify the change of screening strategy. The last evaluation of the HIV screening strategy in Cameroon in 2011 revealed that 55 HIV transmissions per 10,000 of blood donations could have prevented using a four generation assay than using a combination of third generation Rapid diagnostic test and Enzyme immuno-Assay.

***Aims and objectives***: This study aimed to estimated and compare the HIV transmission risk among blood banks using different testing strategies.

***Study design and setting*:** A one year multi-center data records review study was conducted in five Blood Banks located in five regions of Cameroon in 2018. These Blood Banks were made of Yaounde Central Hospital (YCH), Douala Laquintinie Hospital (DLH), Bertoua Regional Hospital (BRH), Ebolowa Regional Hospital (ERH) and Maroua Regional Hospital (MRH).

***Material and methods*:** Records were reviewed using data from the 1st January to the 31st December 2017. Five blood banks out of 18 were selected based on the use of national standardized registries and properly completed data. The World Health Organisation incidence/window period model was used to estimate the residual risk.

***Statistics***: The incidence (percentage and 95% confidence interval) of HIV was calculated per 100,000 blood donations in 2017. The chi-square test was used to measure the association between groups and P-values <0.05 were considered significant. The study was approved by the National Institutional Ethics Committee.

***Results*:** Overall, 22,980 blood donor candidates were received and 20,430 (88.90%) [95% CI, 88.49-89.30] were tested for HIV. Among the 20,430 tested for HIV, 1827 (8.94%) [95% CI, 8.55-9.34] donated at least twice. HIV prevalence was estimated at 471/20,430 (2.31%) [95% CI, 2.11-2.52] among blood donors with an inconclusive rate of 701/20,430 (3.43%) [95% CI, 3.19-3.69]. Comparing HIV prevalence per Region between blood donors and the general population, the prevalence was mostly lower among blood donors than in the general population except in YCH and MRH. The rate of reactivity of the first-line test differ with the one of the second-line test with a kappa agreement of 0.556 (0.526-0.585: CI 95%) giving a moderate level of agreement between first and second-line test. Considering the HIV testing algorithm, incidence rates ranged from 411.52 to 1946.47 per 100,000 person-year corresponding to a residual risk to transmit HIV associated with the window period varied from 1 in 669.7 donations to 1 in 5543.54 donations. At the blood banks level, the incidence rates ranged from 382.41 to 2834.01 per 100,000 person-year and the residual risk to transmit HIV associated with the window period varied from 1 in 460 donations to 1 in 5965 donations.

***Conclusion*:** The residual risk of HIV transmission remains high in Cameroon and varies according to the screening strategies. Thus, there is a need to revise the HIV testing strategy and implement an existing plan to recruit and retain voluntary and regular blood donors.

**Keywords:** Blood donation, HIV transmission, Residual risk, Cameroon blood banks.

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## INTRODUCTION

Blood transfusion is one of the known therapeutic interventions that cuts across a number of clinical disciplines providing unique and life-saving benefits to patients. Blood can save lives, but can also be a vector for harmful infectious diseases, such as HIV infection and viral hepatitis.[1] Despite significant efforts

around the world to reduce transfusion-transmitted infections (TTIs), blood-borne HIV may still represent up to 10% of HIV infection in Sub-Saharan Africa. Bloch and collaborators in 2012 justified this issue by higher prevalence and less comprehensive testing standards [2]. The prevalence of HIV through transfusion during blood donations varies from 0.001% to 0.04% in High-income countries while it ranges from 0.56% to 2.69% in low-income countries [3].

In Cameroon, blood transfusion services are still hospital-based and practices vary from one blood bank to another. Previous studies report an HIV prevalence of 3.7% among the general population aged from 15 to 64 year old with an incidence of 0.27% [4], a high degree of viral diversity [5] and higher and varied prevalence from 1.2% to 5.13% reported among blood donors [6–9]. Meanwhile, HIV prevalence varies from one region to another, with the South region having the highest prevalence (6.3%) and the Far North the lowest (1.5%)[4]. Using the Yield method, a risk of 55 HIV transmissions per 10,000 of donations were reported by Tagny and collaborators using one Ab rapid diagnostic test (RDT) combined with one third-generation EIA (Enzyme Immuno-Assays) strategy. Authors revealed that another testing strategy using one fourth-generation EIA (Genscreen ULTRA HIV Ag/Ab) could have prevented 55 HIV transmissions per 10,000 donations and the risk with the fourth generation EIA was less than 1 in 2,000 donations [10].

To reduce the risk of HIV transmission through transfusion, the Cameroonian National Blood Transfusion Program (NBTP) recommend in 2017 the use of two highly sensitive (99.5%) and specific (99.5%) fourth-generation EIA/CLIA in parallel or two 4$^{th}$ generation rapid diagnostic tests (RDT) in emergency situations or remote areas for HIV screening [11] while WHO recommend a highly sensitive and specific anti-HIV-1 + anti-HIV-2 immunoassay or HIV combination antigen-antibody immunoassay (EIA/CLIA) that is able to detect subtypes specific to the country or region or a highly sensitive and specific anti-HIV-1 + anti-HIV-2 rapid assay in laboratories with small throughput, in remote areas or emergency situations [12].

Cameroon remains a country with high HIV prevalence among blood donors so there is a need for surveillance of HIV transmission through blood transfusion in order to evaluate blood safety and justify the change of screening strategy.

Eight years after the estimation of the residual risk of HIV transmission in one hospital based blood bank in Cameroon, it is important to assess its evolution in a larger sample and more blood banks using different testing approaches prior to the implementation of the NBTP recommendations and the establishment of the National and Regional Blood Transfusion Centres. Thus, this study intended to estimated and compare the HIV transmission risk among blood banks using different testing strategies.

## MATERIALS AND METHODS

This was a multi-center retrospective study, conducted in five blood banks located in five regions of Cameroon. These five Blood Banks were made of Yaounde Central Hospital (YCH), Douala Laquintinie Hospital (DLH), Bertoua Regional Hospital (BRH), Ebolowa Regional Hospital (ERH) and Maroua Regional Hospital (MRH). Two of the Blood Banks belong to the second category hospitals and three to the third category hospitals.

### Data collection

Eighteen blood banks from the ten regions of the country were enrolled in this study among which five were retained (Figure1). The data were manually extracted from registries from the 1$^{st}$ January to the 31$^{st}$ December 2017. The five blood banks included in this study were using national standardize registries provided by National Blood Transfusion Program in each phase of the blood donation process.

At these blood banks, each phase of the transfusion chain from donor selection to blood distribution is recorded in a specific registry and as such, there were registries for: blood donor candidate, blood collection, blood preparation (Fragmentation), Transfusion Transmitted Infections (HIV, HBV, HCV, syphilis), blood grouping, hemovigilance and blood distribution. Data were extracted from blood donor candidate, blood collection, TTIs and blood distribution registries. These data extracted included: the gender, age, the type of donation (first-time donor, lapsed, regular), the type of donor (voluntary/family/paid), the interval between the two last donations, the HIV screening assays and HIV test result for the first line and second-line test.

The general practice among blood banks included in this study was to invite blood donors to come back two weeks after their donation to get their testing results (blood grouping, HIV, HBV, HCV, syphilis). Thus, before the next donation, a repeat donor testing results was verified and those previously tested positive were excluded for donation.

### Blood bank classification

With respect to the hospital level, first category hospitals correspond to General hospitals and University teaching hospitals that are the fourth reference hospital; second category hospitals correspond to Central hospitals that are the third level of reference; third category hospitals correspond to Regional hospitals that are the second level of reference and fourth category hospitals correspond to District hospitals that are the first level of reference [13].

### Demographics of donors

In this study, a regular or repeat blood donor was a person who has donated blood at least twice in the same blood bank in 12 months' time; lapsed blood donor was a person who had a history of donation but the interval between two donations was more than 12 months. Every person whose blood was tested for the first time for infectious disease markers in a blood bank was considered as a first time donor [14].

### HIV screening strategies per blood bank

Each blood bank included in this study practiced HIV pre-donation testing. Pre-donation testing approaches consist of testing the potential blood donors for TTIs before he donates blood, so potential blood donors are tested and their ability to donate depends both on blood donor selection and on their HIV testing result (Figure 1). Three screening strategies (A1, A2, and A3) were used by the five blood banks as described in Figure1. Although the first-line test did not vary during the study period, the second line test varied. No specific assay was used to confirm the positive result. However, repeatedly reactive results using the HIV national algorithm for RDT were considered positive. The result was negative if both first Ab RDT and the test performed at the laboratory level were non-reactive. A test result was inconclusive when the first test is reactive and the seco

### Estimation of incidence and residual risk

The incidence/window period model was used to estimate the residual risk (RR). According to this method, RR=vDWP (window period) multiplied by incidence; Incidence = number of repeat donors tested positive during one year divided by the total number of repeat donors in the year multiplied by 100 000 [14]. The Length of the viraemic phase of the diagnostic window period (vDWP) of 28 days was used for Ab RDT and 16 days for combo EIA/CLIA as recommended by WHO [14].

Blood donors tested reactive for HIV were retested following the Cameroon national algorithm for diagnosis and the result was considered positive when both first and second-line tests were repeatedly positive.

**Data management**

The data were extracted manually, entered using Excel software stored in a password secured Excel spreadsheets.

**Statistical analysis**

The SPSS software version 22 was used to analyze the collected data. Descriptive and analytical statistics were used to summarize the data obtained. The incidence (percentage and 95% confidence interval) of HIV was calculated per 100,000 blood donations in 2017. The chi-square test was used to measure the association between groups and a p-value <0.05 was considered significant.

**Ethical clearance**

This study was approved by the National Ethics Committee.

**RESULTS**

**1. Demographics of Donors**

According to the five blood banks selected for RR estimation, 22,980 blood donor candidates were received, 2,550 (11.10%) [95% CI, 10.69-11.51] were deferred before pre-donation testing and 20,430 (88.90%) [95% CI, 88.49-89.30] were tested for HIV. The total number of individuals who donated at least twice during the study period was 1,827 (8.94%) [95% CI, 8.55-9.34] for the five participating blood banks as showing in table 1.

**2. HIV prevalence**

The overall HIV prevalence 2.31% (n=471) [95% CI, 2.11-2.52] with 701 (3.43 %) [95% CI, 3.19-3.69] of inconclusive results (table 1). The age range [45-50[, the first time donors and family donors had a higher prevalence (p-value 0.00-0.00). Prevalence among first-time donors was 2.86 times higher than regular donors.

**3. Comparison of HIV prevalence per Region**

Comparing HIV prevalence per Region between blood donors and the general population, the prevalence was mostly lower among blood donors than in the general population except in YCH and MRH. This prevalence was 10 times lower among blood donors in Douala and about 2.5 times lower among blood donors in Ebolowa and Bertoua than among the general population (figure2).

4. **Analysis of inconclusive results**

The rate of reactivity of the first-line test was 728/20430 (3.56%) [95% CI, 3.31-3.83] while the rate of positivity of the second-line test was 915/20430 (4.48%) [95% CI, 4.20-4.77] (Table3) with a kappa agreement of 0.556 (0.526-0.585: CI 95%) giving a moderate level of agreement between first and second-line test.

**5. Estimation of incidence rates and residual risks**

**5.1 Estimation of incidence rates and residual risks according to testing strategy**

The total HIV seroconversion cases was 16 varied from 1 to 8 cases according to the algorithm (table 4). The incidence rates ranged from 411.52 to 1946.47 per 100,000 person-year corresponding to a residual risk to transmit HIV associated with the window period varied from 1 in 669.7 donations to 1 in 5543.54 donations. Considering the five participant blood banks, the incidence rate of HIV positive donors was 875.75 [95% CI, 819-936] per 100,000 person-years and the RR was 499.06 [95% CI, 460-540] per one million donations that correspond to 1 in 2083.9 [1/2174-1/1852] donations.

**5.2 Estimation of incidence rates and residual risks according to blood bank**

HIV seroconversion varied from 1 to 7 cases according to blood bank (Table). The incidence rates ranged from 382.41 to 2834.01 per 100,000 person-year and the residual risk to transmit HIV associated with the window period varied from 1 in 460 donations to 1 in 5965 donations. Considering the five participant blood banks, the incidence rate of HIV positive donors was 875.75 [95% CI, 819-936] per 100,000 person-years and the RR was 499.06 [95% CI, 460-540] per one million donations that correspond to 1 in 2004 [1/2174-1/1852] donations.

**DISCUSSION**

This study aimed at examining the prevalence and incidence of HIV infections among blood banks with different HIV testing strategies and to estimate the residual risks of HIV transmission based on data collected in 2017.

**Demographics of blood donors**

As previously described in the country, regular and voluntary blood donor rate remains low with an increase in paid donor rate as shown in this study [9,15]. According to the NBTP, only 10% of blood needs are covered each year, such situations have been described in some Sub-Saharan Africa countries [16] and this is probably the consequence of lack of full implementation of the existing strategy for promoting blood donation developed by NBTP. Recognition actions to blood donors have been established nationwide using four types of blood donor cards, however, advantages linked to each card are still to be defined[17].

**Strategies and algorithms used for HIV screening**

Three different strategies were used for HIV screening in the selected blood banks as described in table 1. Although a specific strategy or algorithm has not been defined by WHO, concerning blood donation screening, the use of third or fourth generation EIA combined with NAT is a routine practice in most developed countries[18] while RDT remains the widely routine practice in Sub-Saharan African countries [16]. Meanwhile, these RDT have repeatedly revealed lower sensitivity and specificity[16,19] and some were unable to detect some HIV-1 subtypes[20,21].

**HIV seroprevalence among blood donors**

The overall HIV prevalence among blood donors was lower than the global average in the general population aged 15-64 (2.31% vs 3.7%, P value = 0.06) [4]*. However, this remains high, when considering the prevalence of blood donors in lower-middle countries, that is 0.20% (0.05-0.44) [3]. HIV prevalence varied from 0.31 to 3.38% among blood banks. This variation could be explained by the varying HIV prevalence by region observed nationwide [4] and thus HIV prevalence among blood donors varied according to the HIV prevalence in the region where the Blood Bank is located for example Maroua and Yaounde (Figure1). Secondly, the variation could be due to the strategy in use for blood donation screening, the prevalence being 10 times lower at DLH compared to the general population. The effectiveness of donor selection using a blood donor history questionnaire that constitutes the first layer to reduce Transfusion Transmitted Infections may also justify the low prevalence.

**Inconclusive results**

The rate of inconclusive results was high 3.43% and varied according to blood bank from 0.23% to 4.49%. There was a moderate level agreement between the first-line test and the second-line test. According to WHO, In low prevalence settings (<5%), individuals with reactive first-line test, then non-reactive second-line test results should be considered HIV-negative with no need for specimens to be tested again on a third assay, since the negative predictive value of A2 is high (≥99%), and thus the probability that the negative result observed on A2 is truly negative is ≥99% [22]. Therefore, among the 728 blood donor

candidates who were reactive with the first-line test, the 257 non-reactive with a second-line test could have been declared negative and temporarily deferred. After applying this, the rate of inconclusive results will drop from 3.43% to 2.17%. Concerning the 2.17% non-reactive with the first-line test and reactive with the second-line test, a confirmation and differentiation assays should be performed [22,23], but such assays are not yet routine practice. Thus, blood donors with such a profile should be called for re-testing using a new sample in 14 days as is practiced now on the field. A study should be conducted to evaluated existing strategies with a focus on inconclusive results to come out with a clear and valid interpretation of results.

**HIV incidence and Residual Risk estimation**

In general, HIV prevalence was estimated to be 2524.2 per 100,000 donations among first-time donors, about 3 times higher than among regular donors; this high prevalence among first-time donors has been previously reported in our country and elsewhere[7,24]. The overall incidence was 875.75 per 100,000 person-years corresponding to a risk of 1 in 2004 transfusions among blood banks and 1 in 2084 according to strategy. This risk is comparable with 1 in 1,366 donations reported in Burkina Faso between 2015 and 2017 [25], eight times higher than 1 in 15,462 donations reported in Gabon between 2009 to 2011 [26], more than 90 times higher than (1 in 185,000) in China [27] between 2008 to 2010 and about 1,000 time more in Italy between 2009 to 2015 (1 in 1,917,250 for HIV) [28]. The testing strategy using a combination of two Ab RDT has a high risk, 1 in 670 donations. Several factors may explain the high risk observed in this study, including the high prevalence of HIV among blood donors 3.1% and screening strategies.

**Table 1:** Blood donor's socio-demographic characteristics per blood bank in 2017

| Blood banks | YCH n (%) [95% CI] | DLH n (%) [95% CI] | ERH n (%) (95% CI) | BRH n (%) (95% CI) | MRH n (%) (95% CI) | Total |
|---|---|---|---|---|---|---|
| Blood donation candidate | 11919 (51.87) [51.22-52.51) | 4992 (21.72) [21.19-22.26) | 775 (3. 37) [3.15-3.61) | 2659 (11.57) [11.16-11.99) | 2635 (11.47) [11.06-11.48) | 22980 |
| Mean age (+/- SD) | 31,1± 8.0 | 30,3 ±7.8 | 31,5± 9.4 | 27,1±7.6 | 31,5 ±9.4 | 30,5 ± 8,2 |
| Blood donors Tested for HIV | 10630 (89.18) [88.61-89.74) | 3897 (78.07) [76.89-79.21) | 738 (95.23) [93.48-96.62) | 2560 (96.28) [95.49-96.96) | 2605 (98.86) [98.38-99.23) | 20430 (88.90) [88.49-89.30) |
| Blood donors deferred | 1289 (10.82) [10.26-11.39) | 1095 (42.94) [20.79-23.11) | 37 (4.77) [3.38-6.52) | 99 (3.72) [3.04-4.51) | 30 (1.14) [0.77-1.62) | 2550 (11.10) [10.69-11.51) |
| Regular donors | 1046 (9.84) [9.28-10.42) | 243 (6.24) [5.49-7.04) | 127 (17.21) [14.55-20.13) | 247 (9.65) [8.53-10.86) | 164 (6.30) [5.39-7.30) | 1827 (8.94) [8.55-9.34) |
| Lapsed donors | 2239 (21.06) [20.29-21.85) | 971 (24.92) [23.56-26.30) | 202 (27.37) [24.18-30.74) | 565 (22.07) [20.48-23.73) | 483 (18.54) [17.07-20.09) | 4460 (21.83) [21.27-22.40) |
| First time donors | 7345 (69.10) [68.21-69.97) | 2683 (68.85) [67.37-70.30) | 409 (55.42) [51.75-59.05) | 1748 (68.28) [66.44-70.08) | 1958 (75.16) [73.46-76.81) | 14143 (69.23) [68.59-69.86) |
| Family donors | 10219 (96.13) (95.75-96.49) | 3788 (97.20) (96.64-97.70) | 663 (89.84) (87.43-91.92) | 1592 (62.19) (60.28-64.07) | 2307 (88.56) (87.28-89.76) | 18569 (90.89) (90.49-91.28) |
| Voluntary donors | 347 (3.26) (2.93-3.62) | 51 (1.31) (0.98-1.72) | 74 (10.03) (7.96-12.42) | 111 (4.34) (3.58-5.20) | 152 (5.83) (4.97-6.80) | 735 (3.60) (3.35-3.86) |
| Paid donors | 64 (0.60) (0.46-0.77) | 58 (1.49) (1.13-1.92) | 1 (0.14) (0.03-0.75) | 857 (33.48) (31.65-35.34) | 146 (5.60) (4.75-6.56) | 1126 (5.51) (5.20-5.83) |

**Legend:** Yaounde Central Hospital (YCH), Douala Laquintinie Hospital (DLH), Bertoua Regional Hospital (BRH), Ebolowa Regional Hospital (ERH) and Maroua Regional Hospital (MRH).

**Table 2:** Donor screening test result for HIV per blood bank in 2017

| Variables | | N0 (%) | Seropositive n (%) [95% CI] | Inconclusive n (%) [95% CI] | $x^2$ | p-value |
|---|---|---|---|---|---|---|
| Gender | Female | 2836 (13.88) | 75 (2.64) [2.09-3.30] | 80 (2.82) [2.24-3.50] | 5.24 | 0.07 |
| | Male | 17594 (86.12) | 396 (2.25) [2.04-2.48] | 621 (3.53) [3.26-3.81] | | |
| | Total | 20430 | 471 (2.31) (2.11-2.52) | 701 (3.43) (3.19-3.69) | | |
| Age (years) | [16-20[ | 707 (3.46) | 10 (1.41) [0.68-2.59] | 24 (3.39) [2.19-5.01] | 24.76 | 0.03 |
| | [20-25[ | 4624 (22.63) | 87(1.88) [1.51-2.32] | 171(3.70) [3.17-4.28] | | |
| | [25-30[ | 5458 (26.72) | 132(2.42) [2.03-2.86] | 172 (3.15) [2.70-3.65] | | |
| | [30-35[ | 4136 (20.25) | 88 (2.13) [1.71-2.61] | 150 (3.63) [3.08-4.24] | | |
| | [35-40[ | 2576 (12.61) | 68(2.64) [2.06-3.33] | 88(3.42) [2.75-4.19] | | |
| | [40-45[ | 1565 (7.66) | 45 (2.88) [2.10-3.83] | 49 (3.13) [2.32-4.12] | | |
| | [45-50[ | 808 (3.95) | 32 (3.96) [2.72-5.54] | 29 (3.59) [2.42-5.11] | | |
| | [50-68] | 556 (2.72) | 9 (1.62) [0.74-3.05] | 18 (3.24) [1.93-5.07] | | |
| | Total | 20430 | 471 (2.31) (2.11-2.52) | 701 (3.43) (3.19-3.69) | | |
| Donation type | First time | 14143 (69.23) | 357 (2.52) [2.27-2.79] | 464 (3.28) [2.99-3.59] | 56.25 | 0.00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Lapsed | 4460 (21.83) | 98 (2.20) [1.79-2.67] | 142 (3.18) [2.69-3.74] | | |
| | Regular | 1827 (8.94) | 16 (0.88) [0.50-1.42] | 95 (5.20) [4.23-6.32] | | |
| | Total | 20430 | 471 (2.31) (2.11-2.52) | 701 (3.43) (3.19-3.69) | | |
| *Motivation* | *Family* | *18569* (90.89) | *440 (2.37)* [2.16-2.60] | *636 (3.43)* [3.17-3.70] | *14.21* | *0.006* |
| | Voluntary | 735 (3.60) | 9 (1.22) [0.56-2.31] | 14 (1.90) [1.04-3.17] | | |
| | Paid | 1126 (5.51) | 22 (1.95) [1.23-2.94] | 51 (4.53) [3.39-5.91] | | |

**Table 3**: Agreement between first-line and second-line test

| | | **Second-line test** | | **Total** |
|---|---|---|---|---|
| | | Reactive | Non-reactive | |
| **First-line test** | Reactive | 471 | 257 | 728 |
| | Non-reactive | 444 | 19258 | 19702 |
| Total | | 915 | 19515 | 20430 |

**Table 4:** HIV seroconversion incidence rates and residual risk per testing strategy

| **Testing strategy** | **N0 (%)** | **Number of sero-Conversions** | **Incidence rate per 100.000 person-year [95% CI]** | **Length of window period in days (year)** | **An estimate of residual risk** | |
|---|---|---|---|---|---|---|
| | | | | | **Per 1 000 0000 of donation [95% CI]** | **Per number of donation [95% CI]** |
| A1 | 411 (22.50) | 8 (1.94) | 1946.47 [1,861-2,034] | 28 (0.077) | 1493.18 [1420-1570] | 669.7 [1/704-1/637] |
| A2 | 1173 (64.20) | 7 (0.59) | 596.76 [550-647] | 16 (0.044) | 261.59 [230-300] | 3822.7 [1/4348-1/3333] |
| A3 | 243 (13.30) | 1 (0.41) | 411.52 [372-453] | 16 (0.044) | 180.39 [150-210] | 1 in 5543.54 [1/6667-1/4762] |
| Total | 1827 | 16 (0.87) | 875.75 [819-936] | 20 (0.055) | 479.86 [440-520] | 2083.9 [1/2273-1/1923] |

**Table 5:** HIV seroconversion incidence rates and residual risk per blood bank

| **Testing strategy** | **N0 (%)** | **Number of sero-conversions n (%)** | **Incidence rate per 100.000 person-year [95% CI]** | **Length of window period in days (year)** | **An estimate of residual risk** | |
|---|---|---|---|---|---|---|
| | | | | | **Per 1 000 0000 of donation [95% CI]** | **Per number of donation [95% CI]** |
| YCH | 1046 (9.84) | 4 (0.38) | 382.41 [345-422] | 16 (0.044) | 167.63 [144-195] | 1 in 5965.52 [1/6944-1/5128] |
| DLH | 243 (6.24) | 1 (0.41) | 411.52 [372-453] | 16 (0.044) | 180.39 [150-210] | 1 in 5543.54 [1/6667-1/4762] |
| ERH | 127 (17.21) | 3 (2.36) | 2362.21 [2,269-2,458] | 16 (0.044) | 1035.49 [970-1100] | 1 in 965.73 [1/1031-1/909] |
| BRH | 247 (9.65) | 7 (2.83) | 2834.01 [2,732-2,939] | 28 (0.077) | 2174.03 [2080-2270] | 1 in 459.98 [1/481-1/440] |
| MRH | 164 (6.30) | 1 (0.61) | 609.76 [563-660] | 28 (0.077) | 467.76 [430-510] | 1 in 2137.85 [1/2325-1/1961] |
| Total | 1827 | 16 (0.87) | 875.75 [819-936] | 20.8 (0.057) | 499.06 [460-540] | 1 in 2003.77 [1/2174-1/1852] |

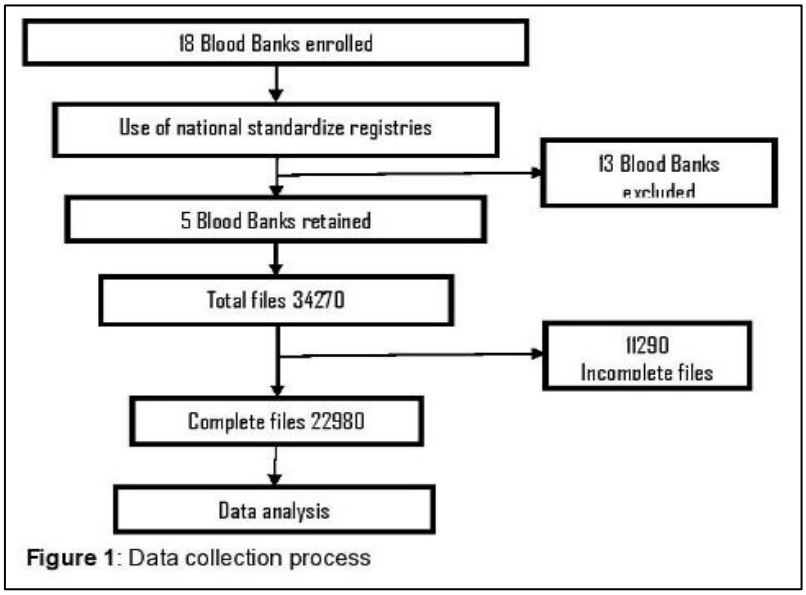



**Figure 1**: Data collection process

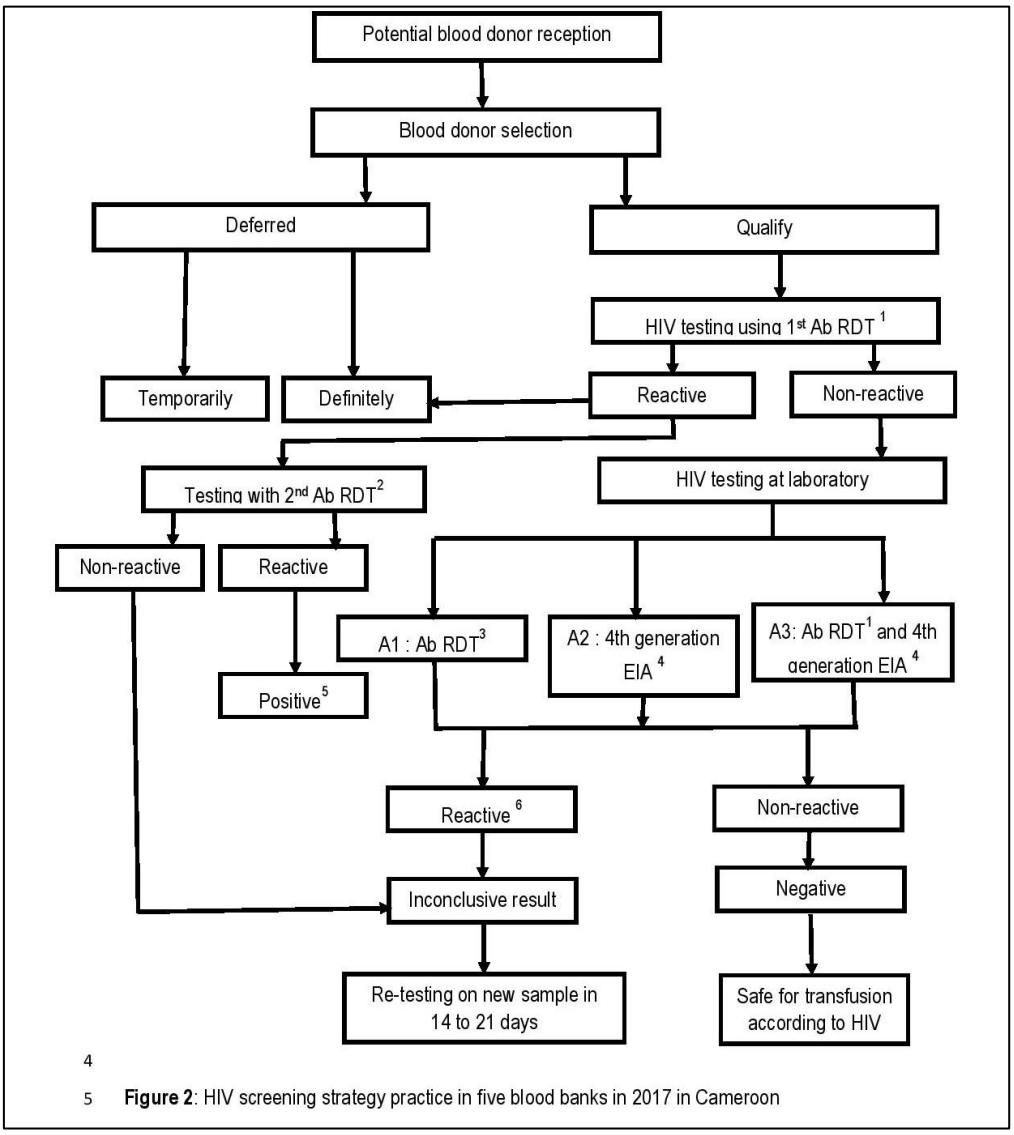
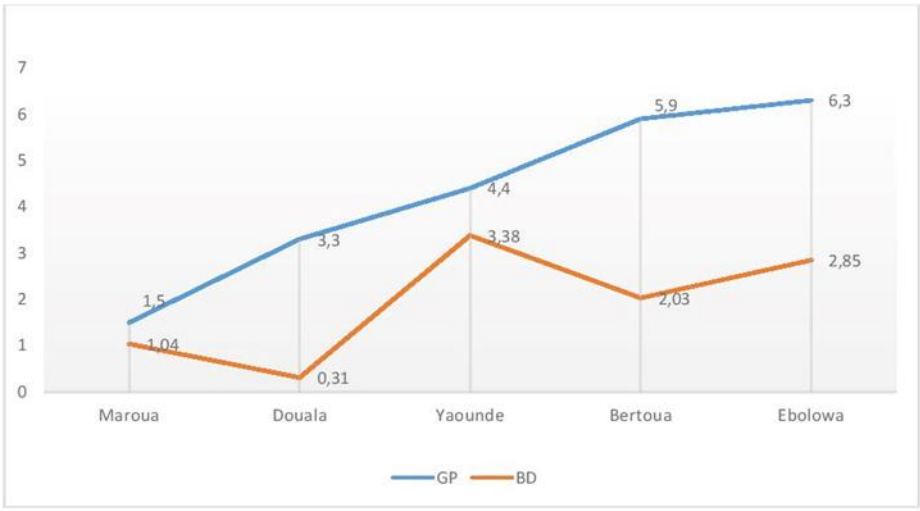



**Figure 2**: HIV screening strategy practice in five blood banks in 2017 in Cameroon

**Notes**: **1**-Alere Determine HIV1/2 (Alere Medical Co.Ltd.); **2**- Diagnostic kit for HIV (1+2) antibody, Shanghai Kehua Bio-engineering Co., Ltd; Abbott Laboratories (KHB) or Oraquick HIV1/2 (OraSure Technologies Bethlehem, PA) **3**- Rapid Test- Cassette CTK Biotech simplifying diagnostics or Shanghai Kehua Bio-engineering Co., Ltd; Abbott Laboratories (KHB) or Oraquick HIV1/2 (OraSure Technologies Bethlehem, PA) **4**-Fortress HIV Ag/Ab (Fortress diagnostics limited Antrim, UK) or Murex HIV Ag/Ab (DiaSorin S.p.A UK Branch) or Architect HIV combo (Abbott Laboratories); **5**-Before announcing the positive result, on the same day, repeat both tests following the same algorithm on the same sample with a different technician; **6**- the blood bag is discarded. **A1** strategy in use in 2017 at MRH and BRH; **A2** strategy in use in 2017 at ERH and YCH, **A3** strategy in use in 2017 at DLH. 1and 2 constitute the HIV national algorithm with RDT.




Legend: GP = general population BD= blood donors

**Figure 3**: Comparison of HIV prevalence per region between blood donors and general population from the 1st January to the 31st December 2017 [4]

**CONCLUSION**

The residual risk of HIV transmission remains high in Cameroon and varies according to the screening strategies. Adoption of WHO guidelines for testing in low setting prevalence may significantly reduce the rate of inconclusive results. There is a need to revise the HIV testing strategy and implement an existing plan to recruit and retain voluntary and regular blood donors.

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**Authorship contributions**

**Conceived the study**: GDE; ZD; DSN; NAL; NAJ; FJ;

**Drafted the manuscript**: GDE; ZD; DSN; NAL; FJ; NAJ, AN; TTCB;

**Approved the final version of the submitted manuscript**: All.

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