Research Article

Transfusion Transmitted Infections in Blood Donors of Pakistan Red Crescent Lahore: A Mixed Method Study

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Abstract

Background: According to Punjab Blood Transfusion Authority, blood donors are screened for five "Transfusion Transmitted Infections (TTIs). But lack of adequate screening methods threatens the rapid spread of TTIs.

Objective: This study aimed at adding to the surveillance data about TTIs in Pakistan and explored blood banking phenomenon to find workable ways for minimizing their spread.

Methods: It was a mixed method study, with retrospective cross-sectional design to find out the frequency of TTIs amidst the blood donors of "Pakistan Red Crescent Punjab" during 2015 to 2019, and with phenomenological design to explore reasons for any changes in the trends of TTIs. Records were analysed for descriptive statistics of the five TTIs, and reasons for the observed changes in the trends were explored through semi-structured interviews from the blood bank's managers. The qualitative data was analysed by deductive thematic analysis.

Results: Among 6380 blood donors, 2.19% (n=140) were positive for at least one of five TTIs. Out of total donors, 1.12 % (n= 72) were HCV positive, 0.83 % (n= 53) HBV positive, 0.2 % (n= 13) Syphilis positive, and 0.03% (n = 2) HIV positive, whereas none was positive for Malaria. 61.34% (n= 3914) of donors were males, and 38.65% (n= 2466) were females. Of the total, 86.52% (n= 5520) were mobile blood camp donors, and 13.47% (n= 860) were walk-in donors. The reasons for the observed increasing number of Syphilis cases and other observed trends were found to be due to differences in sensitivity of screening method used and other blood bank processes like Donor recruitment.

Conclusion: TTI prevalence among donors of said blood bank in private sector is more in male donors in comparison to female ones and is more in "mobile blood camp donors" than in "walk-in donors".

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Introduction

Transfusion Transmitted Infections (TTIs) pose great threat of transmission of infections during blood transfusion.[1] Higher prevalence in potential donor pool increases likelihood of spread via unsafe transfusions, because some TTIs like HIV, HBV and HCV have quite long periods of carrier state infectivity[2] and the risk of transmission is increased for patients who must undergo multiple blood transfusions, like patients of Thalassemia, and suggest better screening of donor blood.[3] Hence, it is imperative that blood transfusion

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services implement stringent standard protocols and improved quality procedures.[4]

In affluent countries, blood supply has been protected since long against TTIs and thus only few infections need interventions to be stopped from being transmitting.[5] But in Pakistan, blood safety culture has not yet developed.[6] For safe blood, according to standard operating procedures issued by the Punjab Blood Transfusion Authority (PBTA) in 2015, it was mandatory for blood banking sector to screen out each collected unit for five TTIs, i.e., HCV (Hepatitis-C), HBV (Hepatitis-B), Malaria, "Human Immunodeficiency Virus (HIV)", and Syphilis.[7] The trend of these TTIs in a public or private blood bank can help gain knowledge about the profile and pattern of blood donations in the specific type of blood bank.[8]

A systematic review in 2020 showed combined occurrence of "Hepatitis-B" as 2.04%, of "Hepatitis-C" as 2.44%, of "HIV" as 0.038%, of "Syphilis" as 1.1%, and of "Malaria" as 0.011%, with limited screening for Syphilis and Malaria in Pakistan. It also concluded that the rate of "Voluntary Non-remunerated Blood Donors" (VNRBDs) of Pakistan is only 0.10% to 13%.[9] Other studies conclude that research aimed at filling the gaps in knowledge and management areas is also needed[10]. Therefore, this study not only documented frequency of five TTIs among VNRBDs of a private sector organization, but also explored the phenomenon of blood banking, with respect to the prevalent operational and managerial practices.

Methods

Data was from Pakistan Red Crescent Punjab Head Quarters (PRC PHQ) Lahore, Pakistan, which is a prominent Private sector blood bank in a vital location of the capital of the most populated province. It provides TTI-tested, safe blood to many healthcare facilities, including its own and other Thalassemia centres. It receives walk-in donors and conducts mobile blood camps for collection from VNRBDs[11]. A sample size of at least 385 blood donors was calculated by WHO Sample Size Calculator at 95% Confidence Interval. But due to availability of unpublished data for a much larger number of blood donors, data of 6380 donors was analysed. The qualitative data was collected from the same blood bank managers.

It is a mixed method study with Descriptive Cross-sectional design and Phenomenological study design. Similar study designs were used for researching this topic in other countries, like Ethiopia[12,13]. Study population encompassed all the donors of regional blood-bank at PRC PHQ, who had donated blood within the period of January 2015 to June 2019. All 6,380 blood donors were VNRBDs. These donors were selected as per the Donor recruitment criteria given by PBTA[7].

Retrospective data was accessed with permission. Written consent had been given by each of the donors to the blood collection team for utilizing the data. The data was available as manual record only. So, tallied photocopies of the entire data were made, and manual descriptive analysis was conducted. It was expressed as frequencies and percentages and was analysed to establish the trends of rise or fall in the prevalence of all five TTIs during the period. The mean seropositivity among male and female blood donors, and the mean seropositivity among mobile blood camp donors and walk-in donors were compared using statistical t-test. Chi-Square statistical test was applied to find out any association between seropositivity and gender, and association between seropositivity and type of blood donor.

The reasons for the observed trends were explored in qualitative analysis. Semi-structured, in-depth interviews were taken from two blood bank managers working in the blood bank during September 2019 to October 2019 by the principal investigator. They were interviewed about the blood bank processes, implemented standard operating procedures, their perceptions of blood bank management and any suggestions they had. The data was then analysed by "inductive thematic analysis", which is a qualitative method[14]. The data of managers' interviews was converted into clean transcripts, coded by two coders, and then categorized into emerging themes and subthemes. Hence this is a mixed method research of the exploratory sequential type.

Results

A total of 6380 (N) blood donors of PRC PHQ donated blood from January 2015 to June 2019. 100% were VNRBDs. Of the total, 2.19% (n= 140) donors were positive for one or more of five TTIs.

Table 1: *Frequency & Percentage of TTIs (five) among Blood Donors (Jan 2015 to June 2019)*

Year	Total Reactive	HCV Reactive		HBV Reactive		HIV Reactive		Syphilis Reactive		Malaria Reactive	
		Count	%age	Count	%age	Count	%age	Count	%age	Count	%age
2015	33	16	48.48%	17	51.51%	0	0%	0	0%	0	**0%**
2016	21	14	66.66%	7	33.33%	0	0%	0	0%	0	**0%**
2017	28	13	46.42%	8	28.57%	1	3.57%	6	21.42%	0	**0%**
2018	47	26	55.31%	17	36.17%	1	2.12%	3	6.38%	0	**0%**
2019	11	3	27.27%	4	36.36%	0	0%	4	36.36%	0	**0%**
Total	**140**	**72**	**51.42%**	**53**	**37.85%**	**2**	**1.42%**	**13**	**9.28%**	**0**	**0%**

Out of the 6380 donors, 61.34% (n=3914) were male and 38.65% (n=2466) were female. Out of the total reactive cases (n= 140), 82.14 % (n=114) were males, and 17.85 % (n= 26) were females. Out of the total male donors, 2.91% were seropositive, while out of total female donors, 1.05% were seropositive. The mean seropositivity among male donors in five years was 22.8 ± 13.8, while that among female donors was 5.2 ± 3.5. The mean prevalence of TTIs among males was significantly less than or equal to the mean prevalence of TTIs among female donors (p value= 0.0123).

Table 2: *Frequency and percentage of TTIs in Male donors from Jan 2015 to June 2019*

Year	Total Reactive	HCV Reactive		HBV Reactive		HIV Reactive		Syphilis Reactive		Malaria Reactive	
		Count	%	Count	%	Count	%	Count	%	Count	%
2015	22	11	50%	11	50%	0	0%	0	0%	0	**0%**
2016	16	11	68.75%	5	31.25%	0	0%	0	0%	0	**0%**
2017	23	11	47.8%	6	26%	1	4.34%	5	21.7%	0	**0%**
2018	45	25	55.55%	16	35.55%	1	2.22%	3	6.66%	0	**0%**
2019	8	3	37.5%	3	37.5%	0	0%	2	25%	0	**0%**
Total	**114**	**61**	**53.5%**	**41**	**35.9%**	**2**	**1.75%**	**10**	**8.77%**	**0**	**0%**

Table 3: *Frequency and percentage of TTIs in Female Donors from Jan 2015 to June 2019*

Year	Total Reactive	HCV Reactive		HBV Reactive		HIV Reactive		Syphilis Reactive		Malaria Reactive	
		Count	%	Count	%	Count	%	Count	%	Count	%
2015	11	5	45.45%	6	54.54%	0	0%	0	0%	0	**0%**
2016	5	3	60%	2	40%	0	0%	0	0%	0	**0%**
2017	5	2	40%	2	40%	0	0%	1	20%	0	**0%**
2018	2	1	50%	1	50%	0	0%	0	0%	0	**0%**
2019	3	0	0%	1	33.33%	0	0%	2	66.66%	0	0%
Total	**26**	**11**	**42.3%**	**12**	**46.15%**	**0**	**0%**	**3**	**11.5%**	**0**	**0%**

Of the 6380 donors, 86.52% (n=5520) donated blood in mobile blood camps, and 13.47% (n=860) were walk-in donors. Out of the total reactive cases (n=140), 92.14% (n= 129) were mobile blood camp donors, and 7.85 % (n=11) were walk-in donors. Of the total mobile blood camp donors, 2.34 % were seropositive, while out of total walk-in donors, 1.28 % were seropositive. The mean seropositivity among mobile camp donors in five years was 25.8 ± 11.36, while that among walk-in donors was 2.2 ± 1.16. The mean prevalence of TTIs among mobile blood camp donors was significantly less than or equal to the mean prevalence of TTIs among walk-in donors (p value= 0.00086).

Table 4: *Frequency and percentage of TTIs in Mobile Blood Camp donors from Jan2015 to June 2019*

Year	Total Reactive	HCV Reactive		HBV Reactive		HIV Reactive		Syphilis Reactive		Malaria Reactive	
		Count	%	Count	%	Count	%	Count	%	Count	%
2015	31	15	48.38%	16	51.61%	0	0%	0	0%	0	**0%**
2016	20	13	65%	7	35%	0	0%	0	0%	0	**0%**
2017	24	12	50%	8	33.33%	1	4.16%	3	12.5%	0	**0%**
2018	44	25	56.8%	17	38.6%	1	2.27%	1	2.27%	0	**0%**
2019	10	2	20%	4	44.44%	0	0%	4	44.44%	0	**0%**
Total	**129**	**67**	**51.9%**	**52**	**40.62%**	**2**	**1.56%**	**8**	**6.25%**	**0**	**0%**

Table 5: *Frequency and percentage of TTIs in Walk-In donors from Jan 2015 to June 2019*

Year	Total Reactive	HCV Reactive		HBV Reactive		HIV Reactive		Syphilis Reactive		Malaria Reactive	
		Count	%	Count	%	Count	%	Count	%	Count	%
2015	2	1	50%	1	50%	0	0%	0	0%	0	**0%**
2016	1	1	100%	0	0%	0	0%	0	0%	0	**0%**
2017	4	1	25%	0	0%	0	0%	3	75%	0	**0%**
2018	3	1	33.33%	0	0%	0	0%	2	66.66%	0	**0%**
2019	1	1	100%	0	0%	0	0%	0	0%	0	**0%**
Total	**11**	**5**	**45.45%**	**1**	**9.09%**	**0**	**0%**	**5**	**45.45%**	**0**	**0%**

Table 6: *Quantitative Analysis for Donor Characteristics and Seropositivity*

Donor Characteristic	No. of Donors	Seropositive donors
Gender		
Male	3914	114
Female	2466	26
p-value		0.0123
Chi-square for association of Gender and Seropositivity		24.3 ($p < 0.001$)
Type of Donor		
Mobile Blood Camp Donor	5520	129
Walk-in Donor	860	11
p-value		0.00086
Chi-square for association of Type of Donor and Seropositivity		3.91 ($p < 0.05$)

A Chi-Square value of 24.3 revealed that there is highly significant association ($p<0.001$) between seropositivity and gender, and Chi-Square value of 3.91 indicated that there is significant association (p value < 0.05) between seropositivity and type of blood donors.

"Participant#1" was a 36 years-old female with the designation of "Blood bank Officer In-Charge" and relevant work experience of eight year, with six years at the blood bank. And "Participant#2" was a 64-years-old male, designated as "Clinical Pathologist", having relevant experience of twenty years, and employed in the blood bank for previous two years. After taking the two interviews, the data was converted into a transcript, which was colour-coded, collated and grouped into themes and subthemes after an iterative process. As a result of the thematic analysis, the themes and their respective findings are summarized in Table 7 and are described below.

Blood Banking Processes: The blood bank processes included blood collection, transportation, component preparation, screening, grouping, storage, and issuance.

"The processes in a standard blood bank are Blood collection, Blood Transport and storage, Blood component preparation, Blood grouping, Blood screening and Blood Issuance _ mostly in this order."

a. Significance of Screening Method: The blood bank used Immuno-Chromatography Technique (ICT) exclusively in the first two and a half years of collected data and sometimes in the later period, when CLIA with up to 98% sensitivity, was used mainly. One manager said:

"Since ICT only ensures around 80%-85% sensitivity, there is almost always a chance of around 15% to 20%, of infection transmission even after the unit has been labelled safe."

Use of less sensitive method may lead to issuance of a blood unit which might have a TTI, and this could be especially true for patients who require repeated trans-

Table 7: *Summary of Findings of Thematic Analysis*

Themes / Subthemes	Findings
Blood Banking Processes **a. Significance of Screening method**	Blood collection, transportation, component preparation, screening, grouping, storage, and issuance. a. Less sensitive methods of screening like ICT device method may lead to issuance of a blood bag which might have any TTI. This is more likely in case of patients who need repeated transfusions, such as Thalassemia patients. More sensitive methods, like CLIA, should be used to minimize the possibility of missed detection of TTIs.
Sources of Blood Collection **a. Relationship of sources and TTIs**	PRC Blood bank collected blood from mostly educational institutions or established organizations, predominantly from younger donors. a. A donor pool who is educated and young might be less prone to having some TTIs, and thereby transmitting them.
Types of Blood Donors **a. Relationship of type of donor and TTIs**	Two types of blood donors donated blood to the blood bank: i) Mobile Blood Camp Donors , and ii) Walk-in Donors a. During Mobile Blood Camps, pre-donation screening is not possible. Whereas it is possible in case of Walk-in patients so there is less chance of collecting blood containing TTIs
Possible reasons for observed quantitative results	• The detection of a greater number of TTIs like Syphilis, HIV and HCV in 2017 and onwards is most likely due to the positive changes in blood management practices such as introduction of the more sensitive screening method of CLIA and strict observance of SOPS. • Special Prevention programs in the province for Malaria and HCV may have led to a decrease of these TTIs in the blood bank's donor population . • The detection of no case of Malaria in the blood bank's donors might be since for Malarial parasite, the more sensitive test of microscopy was never performed here for screening purposes.
Control of spread of TTIs **a. Steps blood bank managers can take to control spread of TTIs** **b. Other steps for control of TTIs spread**	• Promote VNRBD • Observe SOPs • Establish Hemovigilance • Better management practices, like in-house trainings and ensuring quality control • Policies and SOPs revision by blood transfusion authorities • Development of technical resources and provision of better screening methods to non-affording blood banks by authorities

fusions for survival, like Thalassemia patients.

"Most of our screened blood units are issued to Thalassemia center so we tend to be extra cautious about use of screening method with good sensitivity."

Use of more sensitive screening methods like CLIA should be ascertained, but a manager opined that:

"Due to its high running costs, CLIA/ELISA is not used in majority of blood banks in Pakistan, like it should be."

Sources of Blood Collection: The blood bank collected blood mainly through mobile blood camps from educational institutions, factories, and established organizations. And received walk-in donors.

"In addition to taking blood from youth of educational institutes and other organizations, we also get walk-in donors who come to our office to donate blood whenever they feel like it."

a. Relationship of sources and TTIs: If the donor pool which is the source of blood is younger and educated, it is thought that they might be less likely to have procured a TTI.

"The source of collection matters a lot because the more at-risk a potential donor pool is, the more chances there are of higher prevalence of TTIs among the donors.

Types of Blood Donors: The blood bank received blood

mostly by arranging Mobile Blood camps at various sites, but also received walk-in donors.

a. Relationship of type of donor and TTIs: The mobile blood camp donors have to be persuaded by the blood bank's team to donate blood. Such donors are generally less conscious of their health status and may have gotten TTIs inadvertently. Whereas walk-in patients are less likely to have and therefore transmit TTIs.

"Walk-in patients are generally more motivated to donate blood and tend to be people who already have a healthier lifestyle and are aware of their Health status. Such people are not only way less likely to procure any TTI but are also more likely to have an earlier diagnosis if they accidentally do get any TTI."

Possible reasons for observed quantitative results: Quantitative data reveals a greater number of Syphilis, HIV and HCV cases in 2017 and onwards. One possible reason for this can be more stringent management practices and use of more sensitive method CLIA for screening in the blood bank during those years.

"The devices or machines used now since mid-2017 are more sensitive to pick a positive case than the previous years. There has also been more stress on standardization and SOPs than ever before."

Prevention programs for infections like Malaria and HCV were prevalent in Punjab, which may have caused less prevalence of TTIs in Punjab's donor population generally. And since no case of Malaria was found by the blood bank, one manager wondered if it might be because the more sensitive test of microscopy was never performed to screen Malaria in blood donors there.

"This could be because Malaria screening is only done on ICT device method as a routine, and not on microscopy."

Control of spread of TTIs: Possible negligence during donor selection, substandard equipment like bags containing pinholes, pre-analytical, analytical, and post-analytical errors during screening and reporting procedures, careless disposal of infected blood bags or accidental infected-blood issuance could be reasons for spread of TTIs through a blood bank. Through responsible administration of blood banking processes and proper management as a whole, TTIs spread through transmission of blood can be controlled.

a. Steps blood bank managers can take to control spread of TTIs: The managers were aware of hemovigilance protocols but admitted that there was no established mechanism or coordination for tracing accidental transmissions. Blood bank managers can help control spread of TTIs by promoting the principle of VNRBD (Voluntary Non-Remunerated Blood Donation), establishing hemovigilance and proper record keeping, especially in case of Thalassemia patients which also take blood from other blood banks. Observance of SOPs and better management practices are also crucial for this.

"Donor selection criteria, pre-donation screening, when possible, proper labelling of bags, optimum transport and storage, skilled staff to perform procedures are among the SOPs which if followed strictly, indirectly lead to control of TTIs. Updating skills of your staff by continual trainings is absolutely important."

b. Other steps for control of TTIs spread: Current local regulations consider ICT method to be the minimum standard for screening because more sensitive methods like CLIA or NAT are too expensive. National and Provincial Blood Regulation Authorities which regulate blood banks across the country should conduct more research for possible revision of SOPs and strive for allocation of more funds for Public sector blood banks, beyond their administrative functions.

c. "There should be more resources for uniform introduction of screening methods which have the most possible sensitivity to pick any TTI."

"The regulation is primarily about the insurance that each blood bank is registered, and all approved SOPs are being implemented in actual practices in all blood banks."

Similarly, standardization and free trainings for development of professionals in this field should be investigated by the authorities.

Discussion

The study presented the frequency of TTIs among blood donors of PRC PHQ blood bank from 2015 to 2019 and explored reasons rooted in blood bank management for the observed trends. Both quantitative and qualitative data overall indicated adequate following of SOPs and fair blood bank management but a lack of resources

and training creating a barrier to improvement of TTI screening. The method of TTI screening was in accordance with blood bank regulations but was not the most sensitive method, which lead to missed cases of TTIs and possible accidental transmissions. It was found that 2.19% (n =140) of the blood donors were positive for one or more of TTIs. Such results indicate that prevalence of TTIs in the blood bank was lower than in a blood bank of Eritrea where between 2010 and 2016, 3.6% of donors in one study were positive for at least one of five TTIs.[15]

Analysing trend of total reactive findings of all TTIs, it came to light that during 2018, frequencies and percentages of the overall positive cases was more than two times in comparison to preceding years. Total positive cases from 2015 to 2018 and in 2019 were 33(1.96%), 21(1.66%), 28(1.82%), 47 (3.51%), and 11(1.94%) in respective years. The reason found was that in 2018, CLIA was used for screening in comparison to other years whilst screening conducted was only via ICT method. So, when units were screened not through a more-sensitive method, such as CLIA, about half the number of positive units as detected via ICT may not have been picked and ultimately may have spread in the transfused. Such findings absolutely necessitate the use of higher sensitivity methods of screening.

We found that 72(1.12%) of the total donors were positive for HCV while another research in Islamabad Pakistan conducted during 2008 to 2019 showed Hepatitis-C prevalence in donors as 1.5%.[16] HCV positive cases made up to 51.42% of the total reactive cases in our study. A study in India reflected a rising trend of HCV prevalence over the years.[16] In our study, observance of HCV trend among the blood bank's donor population revealed that whilst CLIA was used in later years, number of reactive cases detected increased because of a higher sensitivity of CLIA. The frequency of HBV in our donors was found to be 0.83% (n=52), which made up 37.85% of the total reactive cases. In contrast to this, another study conducted in Lahore Pakistan showed HBV prevalence in donors to be 1.65% during 2016 and 2017.[17] Our study indicated that only 2 (0.03%) donors were HIV positive, which made up 1.42% of total positive cases. A recent study conducted in a blood bank from Balochistan Pakistan revealed HIV prevalence among donors to be 0.001% in first six months of 2022.[18] In comparison, in a study conducted in National centre of Yemen, HIV prevalence in donors was 0.2%, which is quite high.[19]

Syphilis prevalence in Pakistan according to available literature is much less than the trend found in this study. We found HIV positivity in blood donors as 0.2%, while Syphilis (n=13) cases composed 9.28% of reactive cases (n=140). Although Syphilis in less developed countries like Nigeria was around 3.1%[19] the frequency of Syphilis was unexpectedly high in participants of this study from 2015 to 2017, and the reasons were the possible increase in STDs, and the use of more sensitive ICT screening devices over the years. A meta-analysis concluded that Malaria is still one of the significant TTIs prevalent in regions like Africa.[20] In a study in Peshawar Pakistan, 0.577% of total blood donors were found reactive for malarial parasite.[21] No case of Malaria was reported in our study result. The overall trend of TTIs amidst the blood donors of PRC PHQ blood bank was rising as per this study, and there were more of these infections in the male donors than in females, and more in the "mobile blood camps donors" than in walk-in donors. The apparent rise in Syphilis cases could be worrisome though.

In blood donors of PRC PHQ, 61.34 % of the donors were male, whereas 38.65% were female, whereas among the total reactive cases, 81.42% (n= 114) were males and only 18.57% were females. So, more males were found to have TTIs than female donors. In another Pakistani study in which there were 97.05% males, more male than female donors had HBV and HCV infections.[22] In another study in Pakistan during 2008-2019, HCV was found to be the commonest TTI among male donors.[23] Among the reactive cases in male donors of our study, the highest prevalence was of Hepatitis-C (53.5%), followed by Hepatitis-B (35.9%), Syphilis (8.77%) and then HIV (1.75%). Similarly, among the reactive cases in female donors of our study, the highest prevalence was of Hepatitis-B (46.15%), followed by Hepatitis-C (42.3%), and then Syphilis (11.5%). No cases of HIV were found among female blood donors.

In our study, 13.47% of total donors were walk-in donors whereas 86.52% were mobile camp donors. Among all reactive cases, only 7.85% were found in walk-in donors whereas way more (84.9%) was among mobile blood camp donors. This delineated that risk of TTIs being spread may be less if an increased number of

"walk-in blood donors" were motivated for regular blood donation. Among the positive cases in "walk-in donors" of the study, highest prevalence was of Hepatitis-C and Syphilis (45.45% each), followed by Hepatitis-B (9.09%). In comparison, in a study in Kenya where 3,690 walk-in donors' data was reviewed, prevalence of "HIV, Hepatitis, C, Hepatitis B, and Syphilis" was found to be "2.4%, 2.3%, 3.1% and 1% respectively".[24] Similarly, among the reactive cases in mobile blood camp donors of our study, the highest prevalence was of Hepatitis-C (51.9%), followed by Hepatitis-B (40.62%), Syphilis (6.25%) and then HIV (1.56%).

The qualitative part of the study highlighted various themes related to blood bank management and processes, the possible reasons of the observed trend of TTIs and suggestions from the blood bank managers, who emphasized on control of TTI spreading. Recommendations by the participants were to improve the screening methods and recruitment of more VNRBDs. Research in India also concluded that TTI prevalence was more in male replacement donors,[25] and extensive selection criteria and proper screening procedures can help further improve blood safety.[26] Hence, the improvement of blood banking processes in terms of technique and technology would lead to controlling accidental transmission of TTIs. The results of the study may be used during evidence-based policy making and distribution of resources by the local Blood Transfusion Authorities. It will also add to the existing database about TTI frequency and trends, which may give a sketch about TTI screening and prevalence in a private sector blood bank of Punjab. Moreover, this study has explored the TTI frequency more with respect to blood bank management and regulation than with respect to traditional aspects. In future, the study may prompt further investigation and investment into blood banking processes and management to lessen the burden of communicable diseases, other than TTIs as well.

Time and other resources were limited for the exploration of phenomenon of blood banking. And since the blood bank had policy to collect blood only from VNRBDs, no comparison could be made between the TTIs in VNRBDs and in replacement donors.

Conclusion

This study of a private blood bank's donors in Lahore revealed that there was higher prevalence of TTIs among its male blood donors than female donors, that there was higher number of "Hepatitis-C" and "Hepatitis-B" cases than other TTIs, and a rise in trend of Syphilis positivity in donors was observed. It also showed that walk-in donors were less likely to have a TTI than mobile camp donors. It may be concluded that the significance of blood banking processes, especially screening process, and of blood banking management is undeniable for the control of spread of TTIs. During donor recruitment, more female donors, walk-in donors, and other lowest-risk groups should be motivated to donate more blood regularly and voluntarily, so that a safe and sustainable donor pool can emerge. Hemovigilance must be facilitated. The revision of screening regulations and introduction of more resources to private blood banking sector may aid to attain ultimately the Sustainable Development Goals regarding communicable diseases in Pakistan. Introduction of standardized procedures and integration of data on a national level should also be ensured, and management training of blood bank managers and their inclusion in relevant policy making and implementation should be done.

Ethical Approval: The Institutional review committee approved the study vide letter No. Ref:PHQ/RBDC/-177

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Authors' Contribution:

UA: Conception, design, data collection, quantitative & qualitative analysis, drafting

AG: Qualitative Analysis and final approval of publishable version

FA: Editing and critical revision

MH: questionnaire development and administration, management related intellectual input

MN: Management-related analysis and training interviewer

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