

Original Research Article

The seroprevalence of HIV, hepatitis B, hepatitis C and venereal disease research laboratory test seropositivity in blood donors: a 5-year retrospective comparative study at tertiary care hospital in Mumbai, Maharashtra, India

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ABSTRACT

Background: The high seroprevalence of transfusion-transmitted infectious (TTI) diseases such as HIV, hepatitis B virus (HBV), hepatitis C virus (HCV) and syphilis in India affects the safety of blood for recipients. This study was undertaken with the aim to screen the blood donor's demographic profile and to estimate seroprevalence of HIV, HBV, HCV and VDRL transmissible by blood transfusion in voluntary and replacement male and female blood donors during the last 5 year period.

Methods: The present study was conducted over a period of 5 years (2001-2005) and involved 1,53,020 blood donors including both (voluntary, replacement males and females) who were thoroughly screened and selected for blood donation in blood bank at Departments of Pathology, Seth GS Medical College and KEM hospital, Mumbai, Maharashtra, India.

Results: Total five years seropositivity for all four disease marker in all blood donors was 9150 (5.97%). The incidence of HIV seropositivity was 1995 (1.30%), the seroprevalence of HBV in total blood donor was 4673 (3.05%), HCV consist of 1599 (1.04%), and VDRL seropositivity was least, i.e. 883 (0.57%). Out of total 9150 (5.97%) seropositive blood donors, 24 (0.26%) blood donors showed concomitant seropositivity for more than one of the blood transmissible diseases.

Conclusions: Seroprevalence rate of all the four blood transmissible diseases was higher in replacement donors, and lower in voluntary group of donors. Therefore, it has been evaluated that the voluntary blood donation is safer and promoted for safe blood donation in comparison to replacement blood donation.

Keywords: Blood donors, HIV, Replacement, Seropositive, Voluntary

INTRODUCTION

Blood safety begins with a healthy donor. Blood is one of the most complex fluids and equally valuable for the existence, but this blood is also a very efficient means of transmitting infections. Blood transfusions will always carry certain risks, but infection transmission through

blood transfusion can virtually be prevented. The high seroprevalence of numerous transfusion-transmitted infectious (TTI) diseases such as human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV) and syphilis in India affects the safety of blood for recipients. WHO recommends that all blood donations should be screened for infections prior to

use. Screening should be mandatory for HIV, hepatitis B, hepatitis C and syphilis. Blood screening should be performed according to the quality system requirements.¹

This is the most efficient way of transmission of HIV. Even a small transfusion of infected blood results in virtually 100% seroconversion.¹ Effective technology is available for prevention of viral and bacterial transmission through blood. After the HIV antibody test became available in 1985, the risk of getting HIV infection from blood transfusion was virtually eliminated in developed countries with the establishment of universal screening of blood donations. The risk was further reduced by the development of highly sensitive test kits and by such other means as donor selection, donor deferral and appropriate use of blood. In developing countries, the extent to which blood donations are screened against HIV is determined by the available resources and continuous efforts are being made to improve the coverage.²

Blood transfusion saves lives and improves health, but many patients requiring transfusion do not have timely access to safe blood. Blood should be screened for the presence of diseases causing viruses, bacteria, or other microorganisms, or for the presence of antibodies produced against these agents. Screening of blood has to be done before transfusion to prevent from infection into recipient.³ The group of microbes - viruses, bacteria and protozoa have been reported to be transmitted by blood transfusion, viruses are most commonly transmitted by transfusion such as HIV, Hepatitis B, C, A, G, CMV and EBV. Not all infectious agents can be detected directly in donated blood, but is often screened for previous infections by looking for the presence of specific antibodies raised against the infectious agent.⁴

The safety assessment of the blood supply, the quality of screening procedures, and the risk of transfusion-transmitted infectious diseases in any country can be estimated by review and analysis of the records of blood donors, screening procedures, and the prevalence of serological markers of infectious diseases. The greatest threat to the safety of the blood supply is donation of blood by seronegative donors during infectious window period when the donors are undergoing seroconversion phase.⁴

Blood transfusion is a key part of modern health care. It is the responsibility of the national blood program to provide an adequate supply of blood for all patients requiring transfusion and to ensure the quality of blood and blood products for clinical use. All products must be safe, clinically effective and of appropriate and consistent quality.⁴

Aims and objectives

To screen all the blood donors for selective diseases HIV, HBV, HCV and VDRL, transmissible by blood

transfusion during the 5 years period from 2001-2005. To estimate seroprevalence of selected blood transmissible diseases in groups of blood donors. To compare and evaluate seroprevalence of selected blood transmissible diseases in voluntary and replacement blood donors. To compare the incidence and prevalence of diseases per year. To estimate and compare the blood donors by type of donor and gender wise.

METHODS

In this article seroprevalence of 4 blood transmissible infections; HIV, HBV, HCV and syphilis (VDRL positive) and their co-infectivity, if any, is published. However in another publication we had shown the data on demographic parameters of male, female, voluntary and replacement blood donor.

Study design and setting

The present study was conducted over a 5 years period from January 2001-December 2005, in a blood bank at Departments of Pathology, Seth G. S. Medical College and KEM hospital, Mumbai, Maharashtra, India. The Data were obtained from January 2001-December 2005 has been analyzed retrospectively from blood bank resources to find out seroreactivity rates and trends in different groups of blood donors. this is a retrospective study and the data were tabulated annually.

We determined the seroprevalence rate of human immunodeficiency virus (HIV), hepatitis B surface antigen (HBsAg), hepatitis C (HCV) and syphilis among blood donors by their type, gender and to determine association, if any, in the occurrence of the pathogens. Also to determine the seroprevalence trends with in the 5 year period.

Study population

A total of 1,53,020 blood units were screened for HIV 1 and 2 antibodies, anti-HCV, HBsAg, and VDRL. Screening test of blood unit was done, as the primary objective is to ensure safe blood transfusion. Blood collected is screened for HIV, HBsAg, HCV, and VDRL. As per the WHO strategy-I, all HIV screen reactive blood units were discarded. Blood donors were evaluated for seroprevalence of HIV, HBV, HCV and syphilis. The total number of blood donors was evaluated year wise for a period of 5 years and tabulated and documented year wise and also evaluated for total period of five years.

The study population of blood donors was divided in two groups as voluntary donors and replacement donors. A voluntary (non-remunerative) donor is one who is not paid for the donated blood and a replacement donor is again a non-remunerative donor who donates blood for a particular patient admitted in hospital. The replacement donors were family members, friends, or close relatives of the patient. In all these donors seroprevalence of all

four diseases were estimated and compared year wise and also sex wise, both the group of donors are further divided into male and female donors. Care was taken to discourage and exclude professional donors and those with the history of jaundice by taking appropriate history and examination.

Statistical analyses

The result were analyzed by using SAS package utilizing version 9.1.3 and expressed as frequency, percentage, row percentage, and column percentage. Various statistical tests like chi square test, paired t-test, fisher

exact test were applied and the results were considered significant when the p-value was less than 0.05.

RESULTS

Total number of blood donors in five years was 1,53,020 (100%). The overwhelming majority of donors in all years were of male, comprising 1,36,195 (89.0%), While the female donors comprised of 16825 (10.99%). Also, the maximum no. of donors were of male voluntary type 85,225 (55.69%) followed by male replacement 50,970 (33.30%) (Table 1).

Table 1: Five year annual distribution of blood donor types and seropositive reactions.

Year	No. of donors	Voluntary	Replacement	HIV	HBV	HCV	VDRL	Total % seropositive
2001	31,081	19772 (63.61%)	11309 (36.38%)	565 (1.81%)	1086 (3.49%)	67 (0.21%)	246 (0.78%)	1964 (6.29%)
2002	30,961	19359 (62.52%)	11602 (37.47%)	558 (1.80%)	1170 (3.77%)	97 (0.31%)	216 (0.69%)	2041 (6.57%)
2003	29,949	20162 (68.82%)	9787 (32.67%)	292 (0.97%)	1047 (3.49%)	574 (1.91%)	153 (0.51%)	2066 (6.89%)
2004	31,540	21366 (67.74%)	10174 (32.25%)	369 (1.16%)	795 (2.52%)	570 (1.80%)	145 (0.45%)	1879 (5.95%)
2005	29,489	19657 (66.65%)	9832 (33.34%)	211 (0.71%)	575 (1.94%)	291 (0.98%)	123 (0.41%)	1200 (4.06%)
Total	1,53,020	100316 (65.55%)	52704 (34.44%)	1995 (1.30%)	4673 (3.05%)	1599 (1.04%)	883 (0.57%)	9150 (5.97%)

Table 2: Seropositivity rate among voluntary and replacement blood donors in 5 years period.

	Seropositive blood donors		No. of screened donors	
	Voluntary No. (%)	Replacement No. (%)	Voluntary No. (%)	Replacement No. (%)
HIV	1042 (1.03%)	952 (1.80%)	100316 (65.55%)	52704 (34.44%)
HBV	2630 (2.62%)	2031 (3.85%)		
HCV	1030 (0.01%)	569 (1.07%)		
VDRL	390 (0.38%)	493 (0.93%)		

Maximum no. of donors was voluntary blood donors 1,00,316 (65.55%), followed by replacement blood donors 52,704 (34.33%). Total five years seropositivity for all four-disease marker in all donors was 9150 (5.97%). The incidence of HIV seropositivity was 1995 (1.30%), the seroprevalence of HBV in total donor was 4673 (3.05%), HCV consist of 1599 (1.04%), and VDRL seropositivity was least 883 (0.57%). Maximum seropositivity was observed for HBV followed by HIV (Figure 1).

Graph indicates the seropositivity of all 4 disease markers HIV, HBV, HCV and VDRL from year 2001-2005, which is declining from 6.29% to 4.06%. Seropositivity for HBV was reduced to 1.94% in year 2005 from 3.49% in year 2001. Seropositivity for HIV was decreased from 1.81% in year 2001 to 0.71% in year 2005. Seropositivity for VDRL was reduced from 0.78% in year 2001 to 0.41% in year 2005. Seropositivity for HCV was increased from 0.21% in year 2001 to 0.98% in year 2005. Seroprevalence rate of all the four blood transmissible diseases was higher in replacement donors, and lower in

voluntary group of donors. Although the percentage of blood donors was higher in voluntary blood donor group (Table 2).

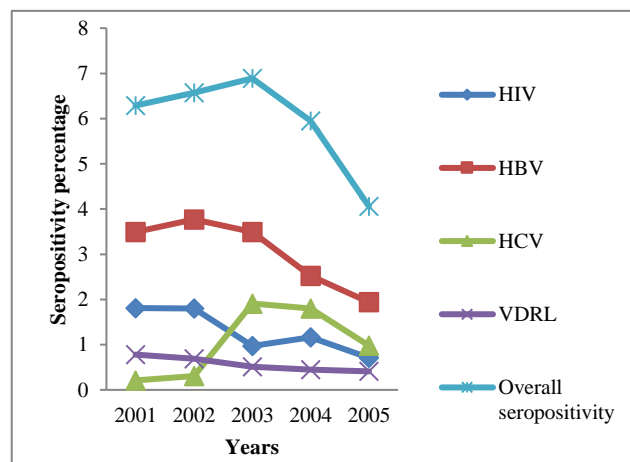


Figure 1: Seroprevalence of HIV, HBV, HCV, VDRL in 2001-2005 years period

In this 5 year study seropositive rate for males were (6.24%) and that for females it was (3.80%). Seropositivity rates were observed more in male donors. (Table 3).

Table 3: Seroprevalence rates: male versus female blood donors.

Year	Seropositive donors		Total donors screened	
	Male No. (%)	Female No. (%)	Male No. (%)	Female No. (%)
2001-2005	8505 (6.24%)	641 (3.80%)	1,36,195 (89.0%)	16,825 (10.99%)

This study found total 15 (0.16%) seropositive blood donors with HIV and HBV concomitance and association between HIV and VDRL was 9 (0.09%) blood donors were observed. Higher seropositivity was observed in male replacement donors for both the seromarkers (Table 4).

Table 4: Concomitant seropositivity in voluntary and replacement blood donors in a 5 year period.

Tests	Voluntary		Replacement		Total	
	Male No. (%)	Female No. (%)	Male No. (%)	Female No. (%)	Male No. (%)	Female No. (%)
HIV and HBV	3 (0.03)	2 (0.02)	8 (0.08)	2 (0.02)	11 (0.12)	4 (0.04)
HIV and VDRL	2 (0.02)	1 (0.01)	4 (0.04)	2 (0.02)	6 (0.06)	3 (0.03)

DISCUSSION

The present study was conducted over a period of 5 years, retrospectively (2001-2005) and involved 1,530,20 blood donors both (voluntary and replacement types) who were screened and selected for blood donation at blood bank KEM hospital.

Study by Singh B et al showed the seropositive prevalence rate was (3.1%) in Delhi, India in year 2003.⁵ MUHS Tanzania, year 2004-2005 showed an unexplained sharp rise of seropositive rates of all four diseases was (15.9%). Nanu A et al showed the seropositive rate from North India in year 1989-1996 was 2.19% in 1989 and increased to 2.59%, and in 1996 it was (3.04%).⁷ With the addition of HCV screening in 1996, the ratio increased to (4.68%). Compared to the two studies i.e. (1 and 3), our study showed a comparatively higher seropositive rate, but compared with study done in Tanzania, our seropositive rate was quite low (Table 5).

Studies by Nanu A et al and Munde Y Thailand showed significantly higher seropositive prevalence rates in replacement donors as compared to voluntary donors.^{7,8}

However, present study showed higher seropositive rates in replacement donors, and lower in voluntary donors.

Table 5: Overall seropositive prevalence rates in blood donors.

	Seropositive donors No. (%)	Donors screened No. (%)
Singh B ⁵	2365 (3.1%)	76089 (100%)
MUHS ⁶	254 (15.9%)	1599 (100%)
Nanu A ⁷	2468 (3.04%)	81120 (100%)
Present study	9150 (5.97%)	1,53,020 (100%)

In present study seropositivity rate for males were (6.24%) and that for females it was (3.80%). Seropositivity rate was observed more in male donors. Although, there was no traceable reference documents on the same (Table 6).

Table 6: Seropositive prevalence rates: voluntary versus replacement donors.

Studies	Seropositive donors		Donors screened
	Voluntary No. (%)	Replacement No. (%)	Total
Nanu A ⁷	334 (2.8%)	1140 (4.3%)	38,166
Munde Y ⁸	1095 (1.9%)	1316 (4.1%)	1,01,764
Present study	5101 (5.08%)	4045 (7.67%)	1,53,020

Nanu A et al found seropositivity for VDRL, HBV, and HIV to be significantly higher I replacement donors while HCV seropositivity was almost similar in both types of donors.⁷ In present study the seroprevalence was higher in replacement group for all four blood transmissible diseases. But in contrast to the HCV seropositivity in reference study, this study showed statistical significant difference with higher seropositivity in replacement donors.

Thus, study by Nanu A et al found increasing trend in VDRL and HIV seropositivity, though they were not statistically significant.⁷ For HBV the seropositivity is decreasing. HCV seropositivity was observed in 1996 which is 1.45%. Study by Makroo et al showed that the seropositivity was higher in replacement blood donors than voluntary blood donors and there was an increase in seropositivity trends in both the groups of blood donors in 5 years period.⁹ In contrast, present study found statistically significant decline in HIV, HBV and VDRL seropositivity rate from year 2001 to 2005. Also observed increase in seropositivity rate in HCV positive blood donors. However in contrast to Makroo et al study, present study showed decrease seropositivity in HIV along with HBV and VDRL.⁹ Higher seropositivity in replacement blood donors was comparable with the given study. Study by Nanu A et al also found concomitant HBV and VDRL seropositivity in 4 donors (0.8%) in 1994 and 1 donor (0.1%) in 1995-96; while our study

found 15 (0.16%) seropositive donors with HBV and HBV concomitance, and association between HIV and VDRL was 9 (0.09%) observed.⁷ Total seropositivity was 9150 (5.97%) (Table 7).

Table 7: Concomitant seropositivity in donors.

	HIV and HBV No. (%)	HIV and VDRL No. (%)	No. of seropositive donors
Nanu A et al ⁷			
1994	3 (0.6%)	-	471
1996	3 (0.4%)	1 (0.1%)	791
Sawanpanyalert et al ¹³	20 (19.04%)	5 (4.8%)	105
Kagu MB et al ¹⁴	1 (0.4%)	-	254
Present study	15 (0.16%)	9 (0.09%)	9150 (5.97%)

Study by Sharma RR et al showed that the proportion of voluntary donors increased from 47% to 56% during the study period.¹⁵ The prevalence of HIV showed a steady increase from 0.16% in 1996 to 0.3% in 2002. The prevalence of hepatitis B surface antigen decreased from 1.55% to 0.99%. VDRL reactivity did not show any trend and ranged between 0.11% and 0.66%. Hepatitis C virus antibodies showed a prevalence of 0.4%. The prevalence of all markers was significantly less in voluntary donors.

Present study, showed voluntary blood donation was increased from 63% to 67% during the study period. But in contrast, our study showed decrease in seropositivity rates of HIV, HBV and VDRL seropositivity for HCV increases. The prevalence of all markers was significantly less in voluntary donors.

Study by Garg S et al from Dr. S N Medical College, Jodhpur, Rajasthan, India from year 1994-1999, showed that the total 46,957 donors were tested, out of which 42,291 (90.1%) were replacement donors and 4666 (9.0%) were voluntary donors.¹⁰ The incidence of HIV was 0.44% in total donors, more in replacement (0.46%) as compare to voluntary (0.27%). The seroprevalence of HBV in total donor was (3.44%). The replacement donors had high incidence (3.52%) as compared to voluntary donors (2.57%). The incidence of HCV seropositivity was (0.28%) (5-month data), all were replacement donors (0.32%). The seroprevalence of VDRL in total donor was (0.22%), more in replacement donor (0.23%) as compare to voluntary donors (0.12%).

Present study, in contrast showed majority of donors were of voluntary type (65.55%), incidence of HIV was (1.30%) in total donors, more in replacement (1.80%) than voluntary donors (1.03%). The seroprevalence of HBV and HCV in total blood donors was (3.05%) and (1.04%) respectively. The replacement blood donors had high incidence of HBV (3.85%) and HCV (1.07%) as compared to voluntary blood donors' incidence of HBV (2.62%) and HCV (0.01%). The seroprevalence of VDRL

in total donor was (0.57%), more in replacement donor (0.93%) as compared to voluntary donors (0.38%).

Study by Kapoor D et al year 1995-96 G B Pant Hospital, New Delhi, India showed that the majority (58%) of donors in these blood banks were replacement donors, followed by voluntary (39.3%) donors.¹⁶ In contrast, present study showed the majority (65.55%) blood donors were voluntary and (34.44%) blood donors were replacement type.

Study by Singhvi A from CMC, Vellore Tamilnadu, India in year 1986-1988 showed that the hepatitis B surface antigen was found in 1.37% and 2.96% of voluntary and replacement donors respectively.¹⁷ Anti-HIV antibodies were found in 1.9/1000 donors. This shows an increasing prevalence of HIV infection in the Indian donor population not reported earlier. In contrast, our study showed that the hepatitis B surface antigen was found in (2.62%) and (3.85%) of voluntary and replacement blood donors respectively, however for anti-HIV antibodies there was a decline in seropositivity rates.

Study by Sarkodie F et al from Teaching Hospital, Kumasi, Ghana (west Africa) in year 2000-2001 showed that the HBsAg was present at an equally high frequency (15%) in young volunteer (median age 18 years) and older replacement (median age 33 years) blood donors.¹⁸ In contrast, the prevalence of anti-HIV and anti-HCV was significantly higher in replacement blood donors (2.4 and 0.3%, respectively, P<0.001). In contrast, our study showed higher seropositivity rates for all the 4 blood transmissible diseases, HIV (1.80%), HBV (3.85%), HCV (1.07%) and VDRL (0.93%) in replacement blood donors than voluntary blood donors, HIV (1.03%), HBV (2.62%), HCV (0.01%) and VDRL (0.38%).

Study by Arya DR et al from S. P. Medical College Bikaner, India in year 1993-2003, showed that a total of 102980 blood units were collected and tested for HIV infection.¹⁹ Amongst of these blood units 95261 were collected from replacement donors and 7359 were from voluntary donors. The overall HIV positivity was (0.25%) and (0.26%) in replacement donors, while the seropositivity of HIV infection was only (0.02%) in voluntary donors.

Present study, in contrast showed the majority of donors was voluntary type. The HIV seropositivity was higher in replacement donors (1.80%) and lower in voluntary (1.03%) blood donors.

Study by Patel Y et al from BSES MG Hospital, SV Rd, Mumbai, India in year 1994-1999 showed that during a six year period from 1994 to 1999 (60780 donors) prevalence of HCV, HIV and HBsAg was reported to be 0.78%, 0.26% and 1.7% respectively. Present study, in contrast showed the higher seropositivity rates of HCV, HIV and HBsAg to be 1.04%, 1.30% and 3.05% respectively. Also, Study by Singh B et al the percentage

of seropositivity for HIV and VDRL was significantly higher in replacement donors ($P < 0.001$).⁵ In this study seropositivity of replacement donors for HIV was (0.56%), and for voluntary donors it was (0.40%), and total seropositivity for three years was (0.54%). For VDRL seropositivity in replacement donors was (2.8%) and for voluntary it was (1.4%), and total is (2.6%) VDRL seroprevalence rate.

In contrast to this, our study showed that the seroprevalence of HIV is higher in voluntary and replacement group was (1.03%) and (1.80%), respectively and total is (1.30%). For VDRL seropositivity in voluntary donors it was (0.38%) and for replacement it was (0.93%), and total is (0.57%) VDRL seroprevalence rate.

In Ethiopia, the seroprevalence of antibody to syphilis among blood donors was (12.8%). A similar prevalence rate (12.7%) of syphilis antibodies has been reported in blood donors from Dar-es-salam, Tanzania. A seroprevalence rate of 7.5% for syphilis was found in Accra, Ghana. In contrast to our study, the 5 year seroprevalence rate for syphilis (VDRL) in blood donors was (0.57%), there was a continuous decreasing trend in seropositivity rate from year 2001 (0.78%) to 2005 (0.41%). Approximately 50% reduction in seroprevalence in 5 years was observed.⁶

Henceforth, it has been observed that the voluntary blood donation is safer and advocated as compared to replacement donation, as high incidence of HIV, HBV, HCV and Syphilis were observed in replacement blood donors.

So, present study again confirms that blood/components from healthy voluntary blood donors are safer as compared to replacement blood donors. So we should achieve a 100% target of voluntary blood donation to prevent the blood transfusion related infections.

CONCLUSION

A total of 1,53,020 blood units were screened for HIV, anti-HCV, HBsAg and VDRL as per the WHO strategy-1 during the 5 years period. All the anti-HIV, HBsAg, anti-HCV and VDRL screen reactive blood units were discarded. Screening tests for blood unit is done with the primary objective to ensure the safe blood transfusion.

A total of 9150 (5.97%) donors out of total 1,53,020 were found to be seropositive for any one of the four blood transmissible disease. The seropositivity rate among voluntary blood donors for HIV, HBV, HCV and VDRL was 1.30%, 2.62%, 0.01% and 0.38% respectively. Among replacement blood donors the seropositivity rate for HIV, HBV, HCV and VDRL was 1.80%, 3.85%, 1.07% and 0.93%. There was a statistical significant difference observed between the two groups of voluntary and replacement blood donors ($P < 0.05$).

The seropositive prevalence rates in male blood donors (6.24%) and female blood donors (3.80%) shows statistical significant difference ($p < 0.05$). The overall seropositive prevalence rates for HIV, HBV, HCV and VDRL was 1.30%, 3.05%, 1.04% and 0.57% respectively among all blood donors. The total seropositivity in year 2001 for all four blood transmissible diseases was 1964 (6.29%), which was reduced to 1200 (4.06%) in year 2005, after five years. Total seropositivity for anti-HIV in 5 years was 1995 (1.30%) in year 2001, however in year 2001 this seropositivity was 565 (1.81%), which was continuously decreased and becomes 211 (0.71%) in year 2005. There was a statistical significant difference observed ($p < 0.05$). The percentage of seropositive blood donors for hepatitis B (HBsAg) in year 2001 was 1086 (3.49%) which further reduced to 575 (1.94%) in year 2005. The overall seropositivity in 5 years period for HBsAg was 4673 (3.05%). There was a statistical significant difference observed ($p < 0.05$).

The observed total HCV (anti-HCV) seropositivity in 5 years period was 1599 (1.04%) in year 2001 this seropositivity was in 67 (0.21%) blood donors, after 5 years period this seropositivity was increased to 291 (0.98%) in year 2005. There was continuous increase in anti-HCV seroreactivity observed. There was observed statistical significant difference only in year 2004 ($p < 0.05$). The total 5 years VDRL seropositivity was 883 (0.57%) observed. In year 2001 this was 246 (0.78%), which is decreased to 123 (0.41%) in year 2005. Decline in seropositivity was observed statistical significant ($p < 0.05$).

In year 2001-05, the seroprevalence rates of HIV, HBV and VDRL showed significant decrease, however only HCV showed a significant increase trend. Out of total 9150 (5.97%) seropositive blood donors, 24 (0.26%) blood donors showed concomitant seropositivity for more than one of the blood transmissible diseases. The highest association was found in HIV and HBV 15 (0.16%), followed by HIV and VDRL 9 (0.09%).

Recommendations

- At blood donation camps, appropriate attention shall be paid on blood donor's enrolment and screening in accordance with national standards instead of focusing on the number of blood units to be collected.
- A medical counselor in each blood donation center shall be appointed for pre and post blood donation counselling.
- Should promote campaign using all channels of communications including the mass media for promotion of voluntary blood donation and creating of awareness regarding dangers of getting blood from paid blood donors and procurement of blood from unauthorized blood banks/laboratories.
- Blood transfusion should be used only when necessary. Blood and blood products shall be

transfused only to treat conditions associated with significant morbidity and mortality which cannot be prevented or treated effectively by other means.

- Short orientation training cum advocacy programs on blood donor's motivation and recruitment shall be organized for Community Blood Organizations (CBOs) and NGOs who wish to participate in voluntary blood donor recruitment program.
- Convert one time replacement blood donor to a voluntary blood donor, convince and motivate the voluntary blood donor for the next time to come with one more person for voluntary blood donation.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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