

# **Seroprevalence of Hepatitis C Virus Infection among Blood Donors at Madhya Pradesh, India: A Retrospective Study**

## **Abstract:**

### **Background:**

Viral hepatitis is a global health problem with 170 million Hepatitis C Virus (HCV) carriers worldwide, and 12-13 million HCV carriers in India.

Unscreened blood and components play a significant role in transmission of HCV apart from reuse of injection needles, unsterilized surgical equipments and vertical transmission from mother to child. Unsafe blood transfusion not only poses risk to patients, causing significant morbidity and mortality, but also adds to the economical burden on healthcare system.

### **Aims and Objectives:**

Aim of this study is to estimate the seroprevalence of HCV infection among the voluntary and relative donors over a period of 7 years at blood banks of Madhya Pradesh with collaboration of Madhya Pradesh State AIDS control Society (MPSACS) Bhopal, India from 2011 to 2017.

### **Materials and Methods:**

This is a retrospective study of blood donation at blood banks, of Madhya Pradesh, India. Blood units were screened for TTIs from January 2011 To December 2017. HIV, HCV and HBV tests were done by ELISA. Data of HCV was collected and compared statistically by frequency distribution and percentage proportion. Chi Square ( $\chi^2$ ) test was used to determine the significant difference statistically.

### **Results:**

The mean age of donors was  $32.42 \pm 8.63$  years. Major contribution was from male donors (93.8%). Majority of donation was done voluntarily (87.3 %). Out of the total 1,876,219 donors tested for TTIs over 7 years, 1980 (0.11%) were positive to anti HCV ( $p=.000001$ ).

### Conclusion:

The prevalence of HCV infection was 0.11% among blood donors of Madhya Pradesh, with geographic variation among districts. Aiming to provide safe blood to the patients, prevention of transmission of HCV by proper donor counseling and screening of the unit is required.

**Key Words:** *Hepatitis C virus, Blood Donors, Transfusion Transmitted Infection, Retrospective study; India*

## INTRODUCTION

Increasing incidence of viral hepatitis is posing a threat to healthcare in India, almost comparable to the three major communicable diseases i.e. HIV/AIDS, malaria and tuberculosis.<sup>1</sup> Out of the five hepatitis causing viruses, Hepatitis B virus (HBV) and Hepatitis C virus (HCV) have parenteral transmission and are known to cause chronic hepatitis, cirrhosis of liver and hepatocellular carcinoma (HCC). Around 400 million people all over the world suffer from chronic hepatitis and the Asia-Pacific region constitutes the epicenter of this epidemic.<sup>1</sup>

The prevalence of HCV infection varies worldwide and the most affected regions are WHO Eastern Mediterranean and European Regions, with the prevalence of 2.3% and 1.5% respectively. Prevalence of HCV infection in other WHO regions varies from 0.5% to 1.0%.<sup>2</sup> In India, prevalence of HCV infection in general

population is estimated to be around 0.5%–1.5%.<sup>3</sup> The seroprevalence rate of HCV among the blood donors in India is 0.53 to 5.1% .<sup>4</sup>

HCV is a single-stranded hepatotropic RNA virus of family *Flaviviridae*. HCV causes acute hepatitis which is mostly subclinical and gradually evolves into chronic hepatitis in about 80% of those infected.<sup>5</sup> HCV has six major genotypes, with genotype 1 being the most prevalent genotype globally (46%), followed by genotype 3 in 22% and genotypes 2 and 4 in 13% each.<sup>6</sup> Overall, genotype 3 is the predominant genotype (63.85%) followed by genotype 1 (25.72%) in India.<sup>7</sup>

Unscreened blood and components play a significant role in transmission of HCV apart from reuse of injection needles, unsterilized surgical equipments and vertical transmission from mother to child.<sup>8</sup> Unsafe blood transfusion not only poses a risk to patient, causing significant morbidity and mortality, but also adds to the economical burden on healthcare system. Thus National AIDS Control organization (NACO) of India mandates to screen every unit of blood and components for 5 transfusion transmitted infections (TTIs) i.e. HIV, HCV, HbsAg, Syphilis and Malaria.<sup>9</sup>

The methods used to identify the presence of HCV employ the following screening targets:

1. Serological markers:
  - HCV antibody
  - HCV Core antigen
2. Viral nucleic acid:
  - HCV RNA.

HCV antibody becomes detectable approximately 30 to 60 days after infection. Viral RNA appears followed by viral antigen between 0 and 20 days. Antibody can

be detected between 10 and 40 days after antigen is first detected. Hepatitis C virus RNA is normally detectable within a few weeks of infection and persists for 6–8 weeks prior to antibody seroconversion. The detection of HCV RNA may further reduce the risk of HCV transmission through the transfusion of infected blood donated during the window period of antigen and antibody assays. However, any benefit is dependent upon HCV incidence and the actual number of donations that may be collected in the window period.<sup>10</sup>

To minimize the risk of HCV infection through the route of transfusion, WHO (World health organization) 2010 recommends:<sup>10</sup>

1. Screening should be performed using a highly sensitive and specific HCV antibody immunoassay or a combination HCV antigen-antibody immunoassay (EIA/CLIA). The assay should be capable of detecting genotypes specific to the country or region.
2. Screening using a highly sensitive and specific HCV antibody rapid assay may be performed in laboratories with small throughput, in remote areas or emergency situations [10].

Aim of this study is to estimate the sero-prevalence of HCV among the voluntary and relative donors over a period of 7 years at blood banks of Madhya Pradesh with support of Madhya Pradesh State AIDS control Society (MPSACS) Bhopal, India. The observations were also compared with the other relevant studies in India and abroad.

## **MATERIALS AND METHODS**

**Place of work** - Present study was carried out at National AIDS Control Organization (NACO) supported blood banks and MPSACS (Madhya Pradesh State Aids Control Society) Bhopal, Madhya Pradesh, India. Donors were screened

by trained personnel after satisfactory answering the donor's questionnaire, their physical examination and hemoglobin (Hb %) estimation.

**Sample size and study duration** - A total of 1,876,219 blood units from the selected donors were collected during the period of 7 years (1st January 2011 to 31st December 2017).

**Donor selection** - These were either Voluntary Donors (VD) or Replacement/relative Donors (RD). Replacement donors were those donors who donated blood for ailing patients and were family members, close relatives and friends of recipient. The voluntary donations were obtained from walk in donors or in blood donation camps. Professional and paid donors were carefully eliminated.

**Donor screening** - Three ml blood in plain vial and 2 ml blood in EDTA (ethylene diamine tetra acetic acid) vial taken from the satellite bag. All samples were screened for HCV and other TTIs. Tests for HCV were performed with commercially available Enzyme immune assay kit (Merilisa HCV by Meril diagnostics) for antibodies against HCV.

**Compilation of data** - The HCV data of last 7 years of Madhya Pradesh was collected, summarized and compared statistically by frequency distribution and percentage proportion. Chi Square ( $\chi^2$ ) test was used to determine significant difference statistically.

## RESULTS

Blood from 1,876,219 apparently healthy donors aging 18 - 65 years was collected during the study period. The mean age of donors was  $32.4 \pm 8.63$ . Most of the donors were male (93.8%), females comprising only 6.2%. Majority of donation

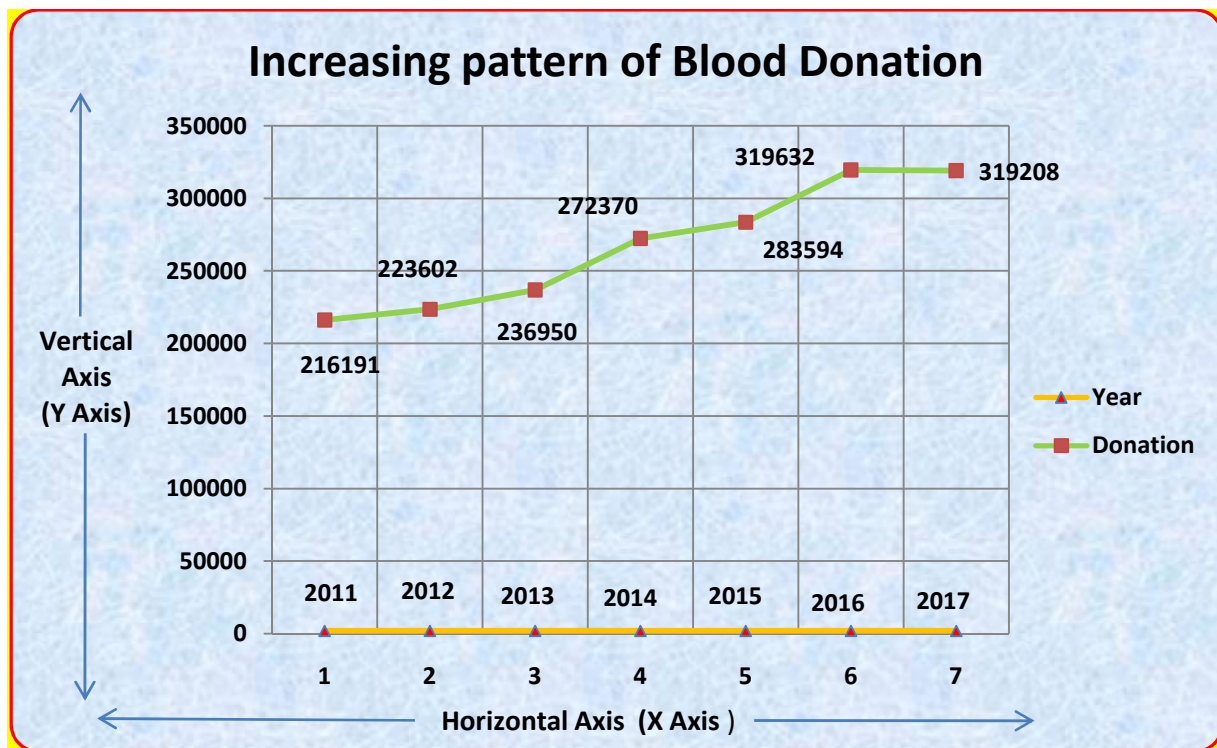
was done voluntarily in blood donation camps or walk in donors 1637939, (87.3%), while 238278 (12.7 %) donations were done by donors for ailing relatives. Testing for TTIs showed sero-positivity for anti HCV infection in 1980 (0.11%) blood units. Table 1.

**Table 1 Donor demographics and HCV seropositivity in the study**

	<b>Total Donation</b>	<b>HCV reactive</b>	<b>HCV non reactive</b>	<b>P value</b>
<b>Gender</b>				
<b>Male</b>	1759893 (93.8%)	1864 (0.11%)	1758029 (99.9)%	<i>P=0.000001</i>
<b>Female</b>	116324 (6.2%)	116 (0.10%)	116208 (99.9%)	<i>P=0.000001</i>
<b>Type of donation</b>				
<b>Voluntary</b>	1637939 (87.3%)	1725 (0.10%)	1636214 (99.9%)	<i>P=0.000001</i>
<b>Relative/Exchange</b>	238278 (12.7 %)	255 (0.11%)	238023 (99.9)%	<i>P=0.000001</i>
<b>HCV status of donors from 2011-2017</b>				
	<b>1871547 (100%)</b>	1980 (0.11%)	1869567 (99.89%)	<i>P=0.000001</i>

Increasing trend in blood donation was reported from the year 2011 to 2017, depicted in **Figure 1** and increasing pattern of voluntary blood donation is shown

in **Table 2** , which was steady and was found to be statistically insignificant (p value= 0.94).



**Figure 1: Trend of blood donation from 2011 to 2017**

**Table 2. Yearly distribution of voluntary donation at blood Banks of Madhya Pradesh, India**

Year	Total donations	Voluntary Donation	Percentage (%)	P value
2011	216191	174033	80.5	<b>P = 0.94</b>
2012	223602	182906	81.8	
2013	236950	202118	85.3	
2014	272370	240230	88.2	
2015	283594	256085	90.3	
2016	319632	293102	91.7	
2017	319208	297821	93.3	
<b>Total</b>	<b>1871547</b>	<b>1646295</b>	<b>87.3</b>	

A decline in seropositivity for HCV was noted from year 2011 to 2015 with an increase in year 2016 and 2017. Seroprevalence of HCV is statistically significant (p value = 0.000001) (Table 3).

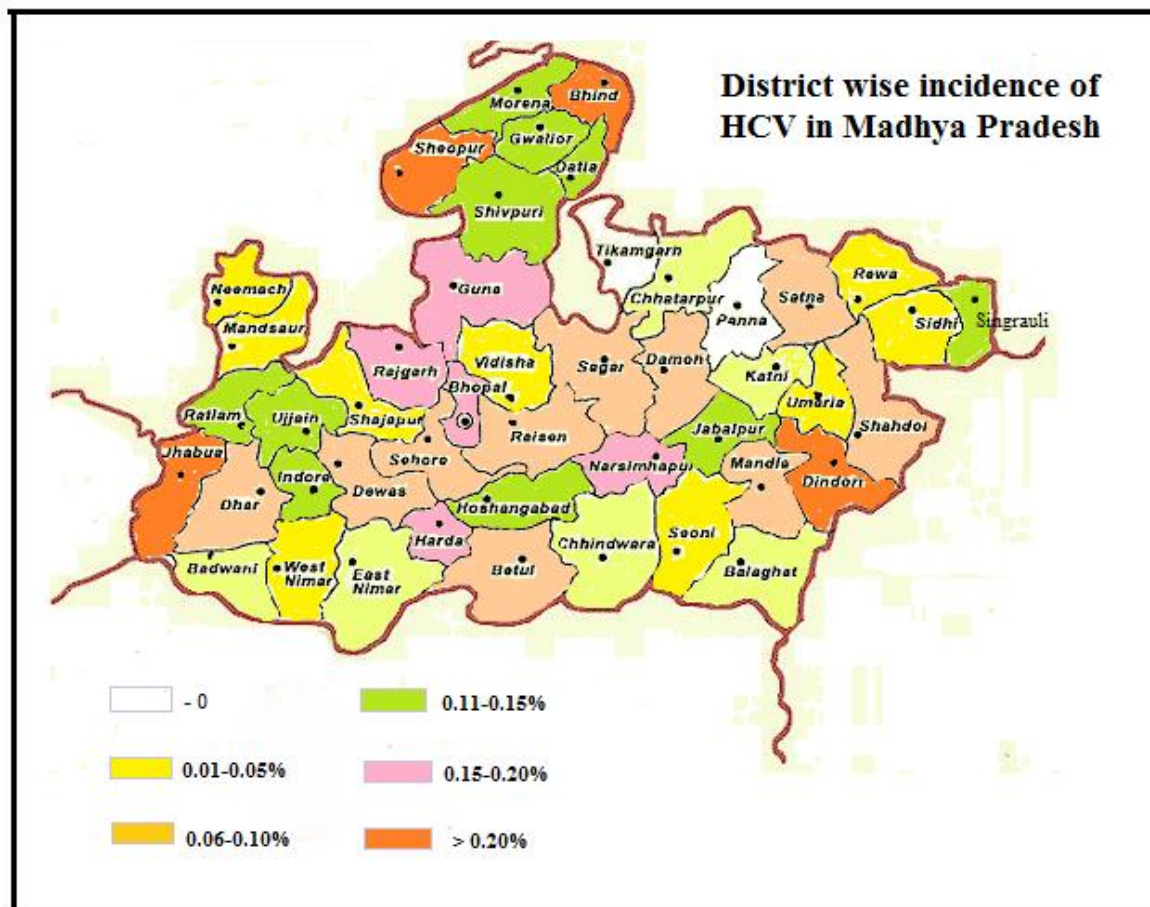
**Table 3. HCV reactivity in blood donors from 2011-2017**

<b>Year</b>	<b>Total donations</b>	<b>HCV reactive</b>	<b>Prevalence (%)</b>	<b>p value</b>
2011	216191	303	0.14	0.000001
2012	223602	294	0.13	0.000001
2013	236950	286	0.12	0.000001
2014	272370	292	0.11	0.000001
2015	283594	191	0.07	0.000001
2016	319632	272	0.09	0.000001
2017	319208	342	0.11	0.000001
<b>Total</b>	<b>1871547</b>	<b>1980</b>	<b>0.105</b>	<b>0.000001</b>

District wise prevalence of HCV infection among blood donors and geographical distribution in state of Madhya Pradesh is shown in Table 4 and Figure 2 respectively. Highest HCV seropositivity was noted in districts Bhind (0.68%), Sheopur (0.54%), Jhabua (0.48%) and Dindori (0.48%). Geographically all these 4 districts adjoin the borders of surrounding states. While no case was reported from district Tikamgarh and Panna. Few new districts are grouped in East and West Nimar.

**Table 4. District wise Prevalence of HCV in Madhya Pradesh**

Districts	No. of Donors	HCV reactive	Percentage (%)	Districts	No. Of Donor	HCV reactive	Percentage (%)
Alirajpur	2972	1	0.03	Mandla	20534	15	0.07
Balaghat	35217	17	0.05	Mandsaur	46384	44	0.09
Barwani	59476	29	0.05	Morena	20942	30	0.14
Betul	29789	17	0.06	Narsimhapur	26474	56	0.21
Bhind	6471	44	0.68	Neemuch	61039	24	0.04
Bhopal	167956	332	0.20	Panna	7323	0	0.00
Burhanpur	16934	4	0.02	Raisen	4510	3	0.07
Chhatarpur	30828	8	0.03	Rajgarh	18453	38	0.21
Chhindwara	87785	7	0.01	Ratlam	52326	61	0.12
Damoh	10762	10	0.09	Rewa	46041	13	0.02
Datia	7261	8	0.11	Sagar	50890	45	0.09
Dewas	15046	9	0.06	Satna	92128	61	0.07
Dhar	25478	23	0.09	Sehore	23587	23	0.10
Dindori	1875	9	0.48	Seoni	24416	5	0.02
Guna	38812	95	0.24	Shahdol	56878	36	0.06
Gwalior	171278	229	0.13	Shajapur	21065	10	0.05
Harda	11621	25	0.22	Sheopur	8446	46	0.54
Hoshangabad	26305	40	0.15	Shivpuri	26900	33	0.12
Indore	152917	196	0.13	Sidhi	11336	1	0.01
Jabalpur	116234	150	0.13	Singrauli	10728	14	0.13
Jhabua	11277	54	0.48	Tikamgarh	10233	0	0.00
Katni	24352	3	0.01	Ujjain	48746	66	0.14
Khandwa	38321	30	0.08	Umaria	4083	2	0.05
Khargone	63168	12	0.03	Vidisha	30622	2	0.01
Total					1876219	1980	0.11



**Figure 2: District wise incidence of HCV in blood donors in Madhya Pradesh, India from year 2011 -2017**

## DISCUSSION

The current study is conducted in sequence of a larger study conducted in 2018, elaborating the incidence of various transfusion transmitted **infections (TTIs)** in state of Madhya Pradesh.<sup>11</sup> A need of research upon individual TTIs i.e. HIV, HBV, HCV, syphilis and malaria arose which led to publication of trends of HIV and HBV in 2018, and continuing the process, the present study on HCV infection.

A slight difference was noted with respect to HCV reactivity in males and females. Males showed slightly higher HCV reactivity possibly attributed to more propensities for high risk behavior. However the difference was not found to be statistically significant similar to result of study by Makroo et al (2015).<sup>12</sup> Voluntary blood donor showed slightly lesser HCV reactivity than relative/exchange donor because, voluntary blood donors are more likely to answer the questionnaire honestly in contrast to relative/exchange donors, who because of dire need and urgency of requirement of blood for the patient are more likely to hide the fact of high risk behavior. This has been advocated by WHO stating that “The safest blood donors are voluntary, non-remunerated blood donors from low-risk populations”.<sup>13, 14</sup>

In the current study, we observed a steady increase in voluntary blood donation with an average of 87.3 % of total blood units generated by voluntary blood donation in 7 years. In the annual reports of Department of AIDS Control, Ministry of Health and Family Welfare, Government of India, in the data collected from NACO supported blood banks all over India, during the year 2010-11, the percentage of Voluntary blood donation was 79.4% against the target of 80% which steadily increased to 77% in 2016-2017.<sup>15, 16</sup> In our study prevalence of HCV was 0.11% while other studies like Giri et al<sup>17</sup> 0.74%, Pandit et al<sup>18</sup> 0.21%, Meena et al<sup>19</sup> 0.57%, Gupta et al<sup>4</sup> 1.45% and Narayankar et al<sup>20</sup> 1.49% noted higher prevalence. The prevalence of HCV infection in healthy blood donors was reported to be 1.09% in Punjab, 1.57% in Delhi, 0.75% in Madurai.<sup>21</sup> HCV seroprevalence in Maharashtra among blood donors is 0.7%.<sup>18</sup>

In the United States seroprevalence in HCV of blood donors was estimated to be 0.3 percent.<sup>22</sup> In Greece also, a low prevalence (0.2 to 0.4%) of antibodies to HCV has been reported and a similarly low rate (0.13%) was also reported from Iran. Lower rates of anti-HCV antibodies have also been reported in blood donors of

Turkey (0.07%), Saudi Arabia (0.4%), Mexico (0.84%) and Kenya (0.9%).<sup>22</sup> HCV is globally distributed, with anti-HCV prevalence among donors ranging from 0.3 to 0.5% throughout the world.<sup>18</sup> Prevalence of HCV in blood donors calculated in our study is found to be lower than most other incidence studies all over India (0.11 % vs. 0.53 to 5.1%).<sup>4</sup> The low prevalence of HCV in blood donors in Madhya Pradesh may be due to proper screening of donors and strict follow up of donor questionnaire which eliminated the high risk donors. When analyzed year wise, a decrease in HCV reactivity among blood donors was reported from 2014 to 2015. This change was attributed to proper donor selection with counseling and filling up of questionnaire. In 2017 a slight increase was noted in HCV incidence which most likely occurred due to introduction of advanced technique for detection which curtail the false negative results observed in the window period and increased sensitivity.

In the 4 districts where HCV reactivity was reported to be more than 0.2%, which may be possible due to prominent tribal rural population with limited health awareness [23].

HCV transmission is attributed to high risk sexual behavior, unsafe healthcare practices like reuse of needles and unsterilized equipments, and transfusion of unscreened blood and blood products. Safe medical practices and public awareness, and concept of safe blood components to the patients can curb the transmission of HCV and TTIs.

## CONCLUSION

It can be concluded that there is an increasing trend in blood donation specifically voluntary blood donation with a male predominance. It can also be seen from the above data that there is a strategic fall in the prevalence of HCV infection from 2008-2017 which is due to the various awareness, educational programs and

campaigns run by the Government of India. Introduction of more specific and highly sensitive tests like NAT (Nucleic acid amplification testing) in transfusion services in India is the need of hour.

## **ETHICAL APPROVAL**

All author(s) hereby declare that all procedure have been examined and approved by the appropriate ethics committee of MPSACS via No.798 (A) / 2018 / Dated:13/03/ 2018, Bhopal, India and research have therefore been performed in accordance with the ethical standards laid down in the 1964 declaration of Helsinki.

## **Consent:**

Written and informed consent from the donor was taken before donation and was reserved by the author.

## REFERENCES

1. Locarnini S., Chen D.-S., Shibuya K. No more excuses: viral hepatitis can be eliminated. *Lancet*. 2016; 387(10029):1703–1704.
2. Hepatitis C (2018) - World health organization. <https://www.who.int/news-room/fact-sheets/detail/hepatitis-c>
3. Christdas J, Sivakumar J, David J, Daniel H, Raghuraman S, et al. (2013) Genotypes of hepatitis C virus in the Indian subcontinent: A decade long experience from a tertiary care hospital in South India. *Indian J Med Microbiol* 31:349-353.
4. Gupta S, Kumar R, Kaur A. Prevalence of Hepatitis C Virus Seropositivity among Blood Donors in a Tertiary Care Hospital. *Int. Res. J. Medical Sci.*3(2), February 2015, 22-24
5. Forman MS, Valsamakis A, Versalovic J, Carrol KC, Funke G (2011) Hepatitis C virus. In: *Murray's Manual of Clinical Microbiology*. 10th ed. Washington: American Society of Microbiology Press 1437–1455.

6. Gower E., Estes C., Blach S., Razavi-Shearer K., Razavi H. Global epidemiology and genotype distribution of the Hepatitis C virus infection. J Hepatol. 2014; 61(1 suppl):S45–S57. [[PubMed](#)] [[Google Scholar](#)]
7. Christdas J, Sivakumar J, David J, Daniel H, Raghuraman S, et al. (2013) Genotypes of hepatitis C virus in the Indian subcontinent: A decade long experience from a tertiary care hospital in South India. Indian J Med Microbiol 31:349-353.
8. Hepatitis C Virus: Molecular Pathways and Treatments Edited by: Dr. Oumaima Stambouli Published by OMICS Group eBooks 731 Gull Ave, Foster City. CA 94404, USA. June 2014
9. Guidelines for Blood Donor Selection and Blood Donor Referrals-NACO, October 2017. [naco.gov.in/.../Letter%20reg.%20%20guidelines%20fo...](http://naco.gov.in/.../Letter%20reg.%20%20guidelines%20fo...)
10. <https://www.who.int/bloodsafety/ScreeningDonatedBloodforTransfusion.pdf> (Annual Report | 2017- 2018)
11. Yadav UC, Sharma DC, Arya A and Kumar U. Prevalence of Transfusion Transmitted Infections among Blood Donors in Madhya Pradesh, a Central State of India. International Blood Research & Reviews, Vol.: 8, Issue: 1 pp 1-10. DOI: 10.9734/IBRR/2018/41271
12. Makroo RN, Hegde V, Chowdhry M, Bhatia A, Rosamma NL. Seroprevalence of infectious markers and their trends in blood donors in a hospital based blood bank in North India. Indian J Med Res. 2015;142:317–22
13. [https://www.who.int/bloodsafety/voluntary\\_donation/en/](https://www.who.int/bloodsafety/voluntary_donation/en/)

14. Nair SC and Mammen JJ Repeat voluntary non-remunerated blood donor is the best quality indicator for blood safety Indian J Med Res. 2015 Jun; 141(6): 749–752. doi: 10.4103/0971-5916.160687
15. Annual Reports 2010-2011. Department of AIDS Control, Ministry of Health and Family Welfare, Government of India. [Last accessed on 2019 May 31]. Available from: <http://www.nacoonline.org>
16. Annual Reports 2016-2017. Department of AIDS Control, Ministry of Health and Family Welfare, Government of India. [Last accessed on 2019 May 31]. Available from: <http://www.nacoonline.org>
17. Giri P A, Deshpande J D, Phalke D B, Karle L B. Seroprevalence of transfusion transmissible infections among voluntary blood donors at a tertiary care teaching hospital in rural area of India. J Family Med Prim Care. 1(11), 2012 Jan-Jun, 48–51.
18. [6]. Pandit DP, MPP Chaudhury N. Prevalence of Antibodies to Hepatitis C Virus in Voluntary Blood Donors: Are Women Better Donors? J Clin Diagn Res., 8(4), 2014 Apr, DC20–DC23
19. [7]. Meena M, Jindal T, Hazarika A. Prevalence of hepatitis B virus and hepatitis C virus among blood donors at a tertiary care hospital in India: a five-year study. Transfusion. 51(1), 2011 Jan; 198-202.
20. [9]. Narayankar SL, Maindad VC (2016). Prevalence of Hepatitis C among Voluntary Blood Donors in Mumbai, 04(11), 13717. <https://doi.org/10.18535/jmscr/v4i11.35>
21. Ramya SR , Kulkarni M. Hepatitis C Virus- Epidemiology and Genotyping. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) e-ISSN: 2279-0853, p-ISSN: 2279-0861. Volume 14, Issue 3 Ver. VIII (Mar. 2015), PP 29-34

22.Makroo RN, Walia RS, Chowdhry M, Bhatia A, Hegde V, Rosamma NL.

Seroprevalence of anti-HCV antibodies among blood donors of north India.

Indian J Med Res.138(1), 2013 Jul; 125–128.

23. World Health Organization. (2010). *Screening donated blood for transfusion-transmissible infections: recommendations*. World Health Organization.

UNDER PEER REVIEW