

RESEARCH ARTICLE

Seroepidemiological Study of Hepatitis B, C and HIV among Blood Donors in Kerman

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Abstract

Background: Infections transmitted through blood transfusions are the most important issue associated with blood donation. We aimed to provide an assessment of the prevalence of hepatitis B virus (HBV), hepatitis C virus (HCV) and human immunodeficiency virus (HIV) among blood donors in Kerman province of Iran. **Methods:** Between 2014-2016, 99,187 samples were examined in a retrospective study in five blood transfusion centers in Kerman province. Serologic screening for HBsAg, anti-HCV and anti-HIV1/2 was conducted for all samples and positive cases were confirmed. **Result:** The positives with the initial serological screening tests for HBsAg, anti-HCV and HIV 1/2 numbered 524, 409 and 285, respectively, and based on confirmation tests, final results were 196, 72 and 1. The highest prevalences of HBV and HCV were reported as 0.36% in Jiroft city and 0.1% in Rafsanjan city. Co- infection with HBV and HCV was observed in the city of Sirjan. **Conclusion:** Blood-borne viral infections in people with low education levels were more common. The prevalence in Kerman province was low as compared to previous studies carried out in other regions of Iran. Application of standard operating procedures, with updated equipment, as well as planning for the use of molecular methods are necessary for the Iranian Blood Transfusion Organization, to monitor blood-transmitted infections.

Keywords: Blood donors- hepatitis B virus- hepatitis C virus- HIV

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Introduction

Blood transfusion is one of the most important tools in modern medical therapy, and saving patients is its aim. If the safe blood supply is not considered, it can be life-threatening. However, the blood has its potential risks causing serious side effects in the recipients. It is known that bacteria, viruses and parasites can be transmitted through blood transfusions (Malekpour et al., 2012; Soleimani et al., 2016). Choosing healthy donors with low risk of blood contamination is one of concerns around the world. Blood-borne agents especially viruses such as Hepatitis B Virus (HBV), Hepatitis C Virus (HCV) and Human Immunodeficiency Virus (HIV) associated with blood transfusions have been considered as most important viral agents (Malekpour et al., 2012; Motahar et al., 2016). Viral hepatitis infections and HIV are still the main causes of morbidity and mortality in developed countries which are exposed to these viruses (Kafi-abad et al., 2009; Flichman et al., 2014). HBV, HCV and HIV viruses are factors that cause hepatitis B, hepatitis C infections and AIDS. These agents will be able to cause infection with long-term viremia, chronic disorders associated with morbidity and mortality, liver cirrhosis, Hepato cellular carcinoma (HCC) and opportunistic infections (Bagheri et al., 2016). Globally, approximately 170 million people are chronically infected with HCV,

350 million people with HBV and 38 million people are infected with HIV (Khodabandehloo et al., 2013). According to the World Health Organization (WHO) reports, the prevalence of HBV, HCV and HIV varies from 0.008% to 6.08%, 0.004% to 1.96%, and 0.0004% to 2% respectively in different parts of the world (Farshadpour et al., 2016). The prevalence of HBV, HCV and HIV in Iran is 1.7% (Poorolajal and Majdzadeh, 2009), less than 1% and 0.023% respectively in normal population and among blood donors is 0.7%, 0.5%, 0.004% respectively (Poorolajal et al., 2009; Perkins et al., 2010; Taherkhani et al., 2015). Based on the WHO rules for screening tests of HIV, hepatitis B and hepatitis C in blood, in Iran the screening tests for HBV, HIV and HCV on blood donations are mandatory from 1974, 1989 and 1996 respectively (Perkins et al., 2010). Blood-borne infection rate surprisingly dropped in countries which perform screening routinely in blood donors (Chiavetta et al., 2003). Health in structure of blood is based on healthy blood donor selection which is done by qualified physicians with interview and a physical examination. In addition, this aim is depended to the policy criteria such as self-exclusion, increase regular donors, voluntary donation, comprehensive public education on awareness of blood-borne infections and using sensitive serological tests for screening donors for HBV, HCV and HIV (Yildiz et al., 2015). This study evaluated the prevalence of HBV,

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HCV and HIV among blood donors with their feedback features for blood-borne infections, done by Blood Transfusion Organization from 2014 to 2016 in Kerman province of Iran.

Materials and Methods

Kerman province is located in the South East of Iran. Kerman Blood Transfusion Organization with nearly 74,000 units of blood donation in a year is the largest center in South East of Iran which has five fixed centers in Kerman, Rafsanjan, Sirjan, Bam and Jiroft and five mobile blood centers in these cities.

In recent years, Kerman province has been a bridge for Afghan and Pakistani immigrants to Iran and Europe. This retrospective study was done on the collected data from blood donors referred to Blood Transfusion Organization of Kerman province in two years. From January 2014 to January 2016, 185,870 blood donors were referred to Kerman Blood Transfusion Organization. Before the donation, donors were examined and interviewed for two targets: 1) the blood donation has no harm for donors. 2) The selected blood is healthy and not harmful for recipients. In the medical room, after identification, a physical examination was done by trained physicians. If the blood donation is so harmful for volunteers, they would be exempted permanently or temporarily and people with risky behavior who are infected by HIV and/or hepatitis and who have a history of traveling to endemic malaria areas have been exempted from blood donation. After examination and screening, 148745 persons have been admitted as healthy donors and all blood samples were screened for the HBV, HCV and HIV. In this study, data obtained from all healthy donors, including individual characteristics and serologic evaluation about blood-borne infections collected by Kerman blood transfusion organization. Collected data was used once for each donor, so 99,187 donors have been examined.

Donor eligibility and selection

After examination and interview, the results should be recorded and signed by donors and stamped and signed by a physician. The donor must sign a consent form that summarizes: [(I have read, understood and accepted all the information about HIV and its transmission by blood and plasma. If I am really at risk, I will not donate blood). (I have answered all of the questions honestly and correctly and the doctor answered me all my raised questions with care and satisfaction. I donate my blood voluntarily and for patients and for studies and research)]. A third person controlled all the items in the process of acceptance and admission that was in accordance with the standards of Iranian Blood Transfusion organization.

Screening and confirmatory methods

All donated blood for HBV, HCV and HIV infections were screened according to standard operating procedures that have been received from Headquarters. the Screening test kits in our study were listed in Table 1 . Positive cases confirmed again by standard operating procedure in Kerman blood transfusion organization. In cases in which

confirmatory tests are positive, the donors were called for more consultation and follow-up. The Confirmatory test kits in our study were listed in Table 2. Our criteria blood-borne infections were confirmed tests. According that the positive results in the screening process was caused permanent exemption of blood donors and the negative results were authorized the use of donated blood products, a high-quality kit is used at the screening stage. Healthy person is properly diagnosed. However, if the test is positive or negative, they will be eliminated at the confirmation stage. The goal in the blood transfusion organization is to provide adequate and safe blood. WHO recommended that screening process should be performed using a highly sensitive and specific kits. According to the guidelines of the World Health Organization, each country should monitor blood donations based on the declared policies of the organization and its facilities. The following are mandatory. Screening of all blood donations should be mandatory for the following infections and using the following markers: Hepatitis B: screening for hepatitis B surface antigen (HBsAg) , Hepatitis C: screening for either a combination of HCV antigen antibody or HCV antibodies. Also, according to the WHO guidelines, the complementary or confirmatory test can be Anti-HBc, and the HBV DNA test can also be used for confirmation. (In general, the testing algorithm is based on the WHO guidelines).

Principles of HBV, HCV and HIV tests

An enzyme-linked immunosorbent assay (ELISA) technique is used for detection HBs Ag , HCV antibody and Anti-HIV . ELISA is a plate-based assay technique designed for detecting and quantifying substances such as peptides, proteins, antibodies and hormones. Other names, such as enzyme immunoassay (EIA), are also used to describe the same technology. In an ELISA, an antigen must be immobilized on a solid surface and then complexed with an antibody that is linked to an enzyme. Detection is accomplished by assessing the conjugated enzyme activity via incubation with a substrate to produce a measureable product. The most crucial element of the detection strategy is a highly specific antibody-antigen interaction (Malekpour et al., 2012; Soleimani et al., 2016) .

Statistical analysis

Statistical method was chi-square that used to compare the data. Each donor's information was collected once during the study and SPSS software version-18 was used for statistical data analysis.

Results

Characteristics of donors:

From January 2014 to January 2016, 99,187 donated blood donors in Kerman province were studied. In this study, the population were 55,635, 26,140, 17,412 regular, lapsed and first-time donors respectably and from them, (92,550) 93.3% were male, (6,637) 6.69% were female. All information for donors has been summarized in Table 3.

Table 1. Screening Tests in This Study

HBsAg	Sensitivity	Specificity	HIV antigen/ antibody	Sensitivity	Specificity	Anti-HCV	Sensitivity	Specificity
Enzygnost HBSAg 6 Siemens	100%	99.90%	EIAgen Detect HIV 4 Total Screening Adaltis	100%	99.70%	Murex anti HCV Ab V4	100%	99.88%
Murex HBsAg Version 3 Diasorin Siemens	100%	99.97%	Murex HIVAg,Ab Combination	100%	99.78%	EIAgen HCV Ab v4 Adaltis	100%	99.80%

Table 2. The Confirmatory Test Kits in This Study

HBV	Sensitivity	Specificity	HIV	Sensitivity	Specificity	Anti-HCV	Sensitivity	Specificity
Enzygnost anti-HBc monoclonal	99.00%	99.60%	HIV BLOT 2.2 (MP Diagnostics)	100%	96.48%	HCV BLOT 3.0 MP Diagnostics	> 99.9%	96.50%

Table 3. Demographics Characteristics of Blood Donors (n = 99187) (2014-2016)

	Parameter	Number of Donors	%Percent of Donors
Gender	Male	92,550	93.3
	Female	6,637	6.69
Age groups (years)	≤25	16,420	16.55
	26-35	39,798	40.12
	36-45	25,535	25.74
	46-55	14,078	14.19
	≥56	3,356	3.38
	First- time	17,412	17.55
Donation status	Lapsed	26,140	26.35
	Regular	55,635	56.09
Marital status	Single	20,973	21.14
	Married	78,214	78.85
Educational Level	Illiterate	848	0.85
	Primery school	25,327	25.53
	High school	40,514	40.84
	University level	32,498	32.76

Table 4. The Screening Test Results in This Study

Total Samples in Kerman Province	HBS Ag Positivity		Anti – HCV positivity		Anti – HIV- 1/2 Positivity	
	%	Number	%	Number	%	Number
99,187	0.52	524	0.41	409	0.28	285

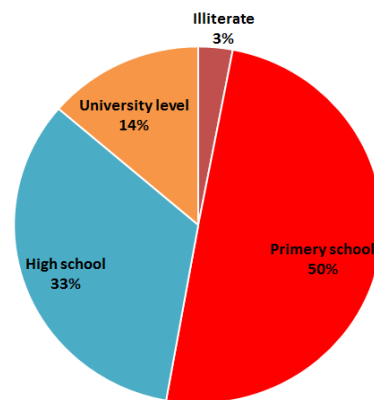


Figure 1. Educational Level of Blood Donors Population in Two Years 2014-2016

Prevalence of blood-borne infections among blood donors

In this study, 99187 samples were examined. The screening test results were 1218 positive samples, of which 269 samples were confirmed (Table 4). The prevalence of HBV, HCV and HIV were 0.19%, 0.07%, is 0.001% respectively. In one case, HBV and HCV was observed co-infection in the city of Sirjan. The highest prevalence of HBV was reported in blood donors of Jiroft city and the highest prevalence of HCV was related

to blood donors of Rafsanjan city. All data related to the prevalence of the province of Kerman have been summarized in Table 5 .In this study 22.67 percent of positive donors was observed with a history of regular blood donation.

Feedback of donors' demographic data on the prevalence of blood-borne infections

In the present study, demographic feedback on blood

Table 5. The Confirmatory Tests Results in Different Cities of Kerman Province in This Study

	Number of samples	HBV		HCV		HIV- 1/2	
		%	Number	%	Number	%	Number
Kerman Province	99,187	0.19	196	0.07	72	0.001	1
Kerman	51,730	0.18	97	0.07	37	0.0019	1
Rafsanjan	13,868	0.12	18	0.1	15	0	0
Sirjan	15,202	0.1	16	0.07	11	0	0
Jiroft	10,812	0.36	39	0.05	6	0	0
Bam	7,575	0.34	26	0.03	3	0	0

transmitted infections was investigated. Sex and age (mean age 40 years) of donors had no significant effect for the risk of hepatitis B and C infection. The relationship between education and infection with HBV and HCV were remarkable and most positive cases have been observed in donors with primary education level (Figure1).

Discussion

In this study, the prevalence of hepatitis B, hepatitis C and HIV among blood donors of Kerman province was obtained in 2014-2016. Because previous studies of the prevalence of the infection have not been performed in Kerman, it is expected that this study solve the lack of information about the Kerman province. The results of the present study compared to other regions of Iran and the world and it is estimated that 100 million units of blood are donated worldwide (Dwyre et al., 2015). Especially for the past 50 years considerable progress has been achieved in the field of blood safety and blood transfusion and surprisingly transmitted infections has declined in the world (Chiavetta et al., 2003). In Iran, serological screening of donated blood for HBV, HCV and HIV is mandatory. The results of the present study showed that the prevalence of blood-borne viral infections in Kerman is less than other provinces of Iran (Soleimani et al., 2016). In our study the prevalence of HBV was 0.19% which is less than 3.4% reported in 1979 (Sultan et al., 2007), 1.79% in 1998 (Perkins et al., 2010), 0.38% in 2005 to 2011 (Mohammadali, 2014) and more than 0.15% reported in 2014 (Bagheri et al., 2016). Our results are probably due to differences of social demographics, lifestyle, geographical distribution of different viral infections and economic situation in different regions of Iran. Other factors, including the sensitivity of doctors in choosing a healthy donor and giving the necessary advice to donors before blood donation which is done in Kerman center, can have a significant impact on reducing positive cases in blood donations (Malekpour et al., 2012). The reported prevalence of HBV in this study was lower than China (0.87%) (Song et al., 2014), Pakistan (2.99% -1.46%) (Sultan et al., 2007) and was more than Australia (0.01%) (Polizzotto et al., 2008), Italy (0.0069%) (Gonzalez et al., 2005) and Canada (0.065 to 0.007%) (O'Brien et al., 2008). The prevalence of HBV in blood donors was 0.19% which is much less than the estimated amount of the public population (1.3% in the general population) (Salehi-Vaziri et al., 2016). It is expected that, this difference is due to the public awareness about forbidden HBV positive blood donation. Counseling and checking before blood donation in Kerman blood Center is useful in order to exclude donors with risk factors such as intravenous drugs, risky behavior and a person with HBV in the family that eventually led to prohibit the donation of blood or self-exclusion (Farshadpour et al., 2016). In fact, HBV vaccination program for all newborn babies from 1993, as well as vaccination of adolescents between 13 to 19 years and groups at risk for HBV infection since 2006, have had a significant role in reducing the spread of HBV in Iran (Bagheri et al., 2016). Our results also showed the relationship between

education level and the risk of HBV infection. 86.3% of infected people had no college education, which may be due to a lack of awareness of transmission of HBV. In our research, the prevalence of HCV was 0.07% which is lower than previous reports from Iran 0.1% in 2003-2005 (Khedmat et al., 2009), 0.13% in 2004-2007 (Perkins et al., 2010), 0.17% in 2009 (Bozorgi et al., 2012), 0.11% in 2005-2011 (Mohammadali et al., 2014) and 0.1% in 2014 (Bagheri et al., 2016). The rate of HCV prevalence in our study is less than other countries such as Pakistan 3.01% to 4.99% (Sultan et al., 2007), China 0.86% (Song et al., 2014) and Egypt 5-25% (Bozorgi et al., 2012) and more than Australia 0.01% (Polizzotto et al., 2008) and Italy 0.0016% (Gonzalez et al., 2005). This difference in prevalence in different parts of the world reflects the risks in population, health, risky behaviors, public awareness and screening of blood donors in these areas (Ganczak and Szych, 2017). The highest prevalence of HCV was seen in Rafsanjan city (0.1%) and all positive HCV cases in Rafsanjan had no college education. It could be related to lack of awareness for viral infection and transmission by abusing drug via injection. Using drugs by injection is the most prominent of HCV infection in Iran (Doosti-Irani et al., 2017). In Iran the prevalence of HCV infection among drug users is 50% -75 % and similar results have been reported in previous studies (Taherkhani et al., 2015). In our study, the prevalence of HIV infection among blood donors were 0.001% which is less than China (0.31%) and Nigeria (1.4%) and more than Australian (0.0003%) and Italy (0.00019%) (Salehi et al., 2015; Yildiz et al., 2015; Moayedi-Nia et al., 2016). This variation in HIV prevalence could be due to differences in high-risk behavior, training programs, prevention methods, using appropriate and safe methods in blood transfusion centers in different countries (Ramezani et al., 2014). The reported HIV prevalence in this study is also lower than the previous studies done in Iran (0.004%), (0.0054%) and 0.004% (Mohammadali et al., 2014; Moayedi-Nia et al., 2016). In our survey, the most viral infection transmitted through blood was observed in those with low education level. In this population, low education and low information for viral transmission and risk factors can be the main factors (Gonzalez et al., 2005). On the other hand people with low levels of education are in poor economic and cultural conditions which cause them susceptible for viral infections. Given the cost of testing in hospitals or private laboratories, patients prefer to know their status by blood donation (Khedmat et al., 2009). So blood transfusion centers should be more informative to people with low education and provide free viral tests for people who want to check their status (Foroughi et al., 2016). This requires further investigation to know what the motivation of blood donation for donors is. In this investigation, the prevalence of HBV was seen more than HCV and HIV showing similar results from previous studies in Iran. Given the same transmission routs, higher prevalence of HBV can be related to contagious form of HBV infection compared with HIV and HCV viruses, which has been mentioned in other studies.

In conclusion, our results proved the effect of standard protocols related to the screening and selection of donors.

The effect of used laboratory methods in Kerman Blood Transfusion Organization has been proved. If screening tests cannot detect viral infections, these agents are transferable during window period, asymptomatic and latent phase (Fessehaye et al., 2011; Doosti-Irani et al., 2017). According to the higher prevalence of infection in some parts of Iran, standard operating procedures with high sensitivity should be used to identify infected donors in window period, asymptomatic and latent phase. In Iran, all blood transfusion centers screen blood donors with serologic methods, so it is needed to use updated and more sensitive methods and all kits and laboratory methods should be monitored constantly. In addition, public awareness about blood-borne diseases should be increased especially in citizens with low level of education and free experiments should be set up for patients with low income levels.

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References

- Bagheri Amiri F, Mirzazadeh ME (2016). A HIV, HBV and HCV coinfection prevalence in Iran-A systematic review and meta-analysis. *PLoS One*, **11**, 120-4.
- Bozorgi SH RH, Nooranipour M, Ahmadi M, Baghernejad A, Mostajeri A (2012). Risk factors of viral hepatitis: yet to explore. *Transfus Apher Sci*, **47**, 145-9.
- Chiavetta JA EM, Newman A, He Y, Driezen P, Deeks S (2003). Incidence and estimated rates of residual risk for HIV, hepatitis C, hepatitis B and human T-cell lymphotropic viruses in blood donors in Canada, 1990-2000. *Can Med Assoc J*, **169**, 767-73.
- Doosti-Irani A, Mokhaeri H, Chegini Sharafi A, et al (2017). Prevalence of HIV, HBV, and HCV and related risk factors amongst male homeless people in Lorestan province, the West of Iran. *J Res Health Sci*, **17**, 1-6.
- Dwyre DM FL, Holland PV (2015). Hepatitis B, hepatitis C and HIV transfusion-transmitted infections in the 21st century. *Vox Sang*, **100**, 92-8.
- Farshadpour F TR, Tajbakhsh S, Gholizadeh Tangestani M, Hajiani G, Sharifi N (2016). Prevalence and trends of transfusion-transmissible viral infections among blood donors in south of Iran: An eleven-year retrospective study. *PLoS One*, **6**, 175-80.
- Fessehaye N ND, Fessehaye T (2011). Transfusion transmitted infections - a retrospective analysis from the national blood transfusion service in Eritrea. *Pan Afr Med J*, **9**, 40.
- Flichman DM BJ, Livellara BI, Re VE, Bartoli S, Bustos JA (2014). Prevalence and trends of markers of hepatitis B virus, hepatitis C virus and human Immunodeficiency virus in Argentine blood donors. *BMC Infect Dis*, **14**, 218-23.
- Foroughi M, Moayedi-Nia S, Shoghli A, et al (2016). Prevalence of HIV, HBV and HCV among street and labour children in Tehran, Iran. *Sex Transm Infect*, **14**, 236-42.
- Ganczak M, Szych Z (2017). HBV, HCV, and HIV infection prevalence among prison staff in the light of occupational risk factors. *Med Pr*, **12**, 456-62.
- Gonzalez M RV, Piccinini V, Vulcano F, Giampaolo A, Hassan HJ (2005). Residual risk of transfusion-transmitted human immunodeficiency virus, hepatitis C virus, and hepatitis B virus infections in Italy. *Transfusion*, **45**, 1670-5.
- Kafi-abad SA RH, Abolghasemi H, Talebian A (2009). Prevalence and trends of human immunodeficiency virus, hepatitis B virus, and hepatitis C virus among blood donors in Iran, 2004. *Transfusion*, **49**, 2214-20.
- Khedmat H AS, Miri SM, Amini M, Abolghasemi H, Hajibeigi B (2009). Trends in seroprevalence of hepatitis B, hepatitis C, HIV, and syphilis infections in Iranian blood donors from 2003 to 2005. *Hepat Mon*, **9**, 24-8.
- Khodabandehloo M RD, Sayehmiri K (2013). Prevalence and trend of hepatitis C virus infection among blood donors in Iran: A systematic review and meta analysis. *J Res Med Sci*, **18**, 674-82.
- Malekpour R MH (2012). Detection of HBV resistance to lamivudine in patients with chronic hepatitis B, using zip nucleic acid probes, Kerman, Southeast of Iran. *Asian Pac J Cancer Prev*, **13**, 1-4.
- Malekpour R MH (2012). Use of ALLGIO probe assays for detection of HBV resistance to adefovir in patients with chronic hepatitis B, Kerman, Iran. *Asian Pac J Cancer Prev*, **13**, 5463-7.
- Moayedi-Nia S, Bayat Jozani Z, Esmaeeli Djavid G, et al (2016). HIV, HCV, HBV, HSV, and syphilis prevalence among female sex workers in Tehran, Iran, by using respondent-driven sampling. *AIDS Care*, **28**, 487-90.
- Mohammadali F PA (2014). Changes in frequency of HBV, HCV, HIV and syphilis infections among blood donors in Tehran province. *Arch Iran Med*, **17**, 613-20.
- Motahar M AS, Mollaei HR, Iranmanesh Z, Nikpour N, Soleimani F (2016). Evaluation of HBV resistance to tenofovir in patients with chronic hepatitis B using ZNA probe assay in Kerman, southeast of Iran. *Asian Pac J Trop Dis*, **6**, 513-6.
- O'Brien SF XG, Fan W, Yi QL, Fearon MA, Scalia V (2008). Epidemiology of hepatitis B in Canadian blood donors. *Transfusion*, **48**, 2323-30.
- Perkins HA BM (2010). Transfusion-associated infections: 50 years of relentless challenges and remarkable progress. *Transfusion*, **50**, 2080-99.
- Polizzotto MN WE, Ingham H, Keller AJ (2008). Reducing the risk of transfusion-transmissible viral infection through blood donor selection: the Australian experience. *Transfusion*, **48**, 55-63.
- Poorolajal J, Majdzadeh R (2009). Prevalence of chronic hepatitis B infection in Iran: a review article. *J Res Med Sci*, **14**, 249-58.
- Poorolajal J MR (2009). Prevalence of chronic hepatitis B infection in Iran: a review article. *J Res Med Sci*, **14**, 249-58.
- Ramezani A, Amirmoezi R, Volk JE, et al (2014). HCV, HBV, and HIV seroprevalence, coinfections, and related behaviors among male injection drug users in Arak, Iran. *AIDS Care*, **26**, 1122-6.
- Salehi-Vaziri M SF, Almasi Hashiani A, Gholami Fesharaki M, Alavian SM (2016). Hepatitis B virus infection in the general population of Iran: An updated systematic review and meta-analysis. *Hepat Mon*, **16**, 35577-80.
- Salehi A, Naghshvarian M, Marzban M, et al (2015). Prevalence of HIV, HCV, and high-risk behaviors for substance users in drop in centers in Southern Iran. *J Addict Med*, **9**, 181-7.
- Soleimani F AS, Mollaei HR, Iranmanesh Z, Nikpour N, Motahar M (2016). Evaluation of the frequency of precore/core mutation in patients with chronic hepatitis B, Kerman, Southeast of Iran. *Asian Pac J Trop Dis*, **6**, 603-7.
- Song Y BY, Petzold M, Ung CO (2014). Prevalence and trend of major transfusion-transmissible infections among blood donors in Western China. *PLoS One*, **9**, 94528-35.
- Sultan F MT, Mahmood MT (2007). Infectious pathogens in

volunteer and replacement blood donors in Pakistan: a ten-year experience. *Int J Infect Dis*, **11**, 407-12.

Taherkhani R FF (2015). Epidemiology of hepatitis C virus in Iran. *World J Gastroenterol*, **21**, 10790-810.

Yildiz SM CA, Kibar F, Karaboga G, Turhan FT, Kis C (2015). Hepatitis B, Hepatitis C, Human immunodeficiency virus and syphilis frequency among blood donors. *Transfus Apher Sci*, **53**, 308-14.