Int J Infect. 2017 January; 4(1):e39008. doi: 10.17795/iji-39008.

Published online 2016 August 8. **Research Article**

The Prevalence of Hepatitis B and C Viruses Among Blood Donors Attending Blood Bank in Duhok, Kurdistan Region, Iraq

Nawfal Rasheed Hussein,[1,*] Sefar Mohamad Haj,[1] Lokman Amin Almizori,[1] and Ali Ahmed Taha[2]

[1]Department of Internal Medicine, School of Medical Sciences, Faculty of Medicine, University of Duhok, Duhok, Iraq
[2]The Department of Infection Control, General Directorate of Health-Duhok, Duhok, Iraq

[*]*Corresponding author*: Nawfal Rasheed Hussein, Department of Internal Medicne, School of Medicine, Faculty of Medical Sciences, University of Duhok, Duhok, Iraq. E-mail: Nawfal.Hussein@yahoo.com

Received 2016 May 07; **Accepted** 2016 May 09.

Abstract

Background: The prevalence of blood borne viral infection is escalating worldwide. Screening blood donors is needed to prevent further spread of such infections.
Objectives: The current study aimed to determine the prevalence of hepatitis B virus (HBV) and hepatitis C virus (HCV) among blood donors in Duhok, Northern Iraq.
Methods: A cross-sectional survey was conducted on blood donors attending Duhok blood bank. A total of 7900 subjects were included in the study from January to December 2014. Subjects were tested for evidence of hepatitis B surface antigen (HBsAg) and HCV antibody (HCV-Ab). A questionnaire was used to collect demographic and personal data of each positive subject. All HCV-positive samples were assessed by real-time quantitative polymerase chain reaction (RT-PCR) to confirm the results.
Results: Among the studied sample, the prevalence of HBsAg and HCV-Ab were 62/7900 (0.78%) and 16/7900 (0.2%), respectively. The results of RT-PCR for quantitation of HCV showed that only 1/7900 (0.013%) patients was HCV-positive. No significant difference was observed in the positivity of HBV and HCV between donors living in the city and rural areas ($P > 0.05$). In addition, history of dental procedure was given in 77% and 75% of HBV- and HCV-positive donors, respectively.
Conclusions: The prevalence of HBV infection among donors in Duhok was comparable with those of reports from other parts of Iraq. Education and immunization should be initiated to target the high-risk groups. Furthermore, a community-based study is recommended to study the prevalence of HBV and HCV infection in the population.

Keywords: Hepatitis B Virus, Hepatitis C Virus, Duhok, Iraq, Reverse Transcription Polymerase Chain Reaction

1. Background

Infection with hepatitis B virus (HBV) and hepatitis C virus (HCV) are major global health problems (1). It is estimated that about 350 million people are chronically infected with HBV and about 200 million people are infected with HCV worldwide (2). Moreover, infection with these viruses might associate with increased mortality rate as the infection may predispose to the development of serious liver diseases such as liver cirrhosis, liver failure and hepatocellular carcinoma (HCC) (3).

Both HBV and HCV are transmitted through direct contact with blood, transfusion of blood and blood products, intravenous injections and unprotected sex (4). Although the transfusion of blood and its product is a recognized risk factor of acquiring HBV and HCV (1, 2, 4-10), it represents a non-alternative life-saving therapy used to reduce morbidity and save thousands of lives every year (11). In the developing countries, transmission of infection from donors to recipients is increasingly recorded with HBV and HCV due to the lack of the routine serological tests for donors (2). To address that, routine serological tests for transfusion-transmissible infections (TTIs), including HBV and HCV, were recommended by world health organization (WHO) to reduce the transmission of these infections (1, 7). The donors' tests results could be used as an indicator of a safe blood supply (7). In addition, it was also used to determine the HBV and HCV prevalence rate among blood donors which helps health providers to understand the epidemiology of such an infection in the community (1).

The implementation of the blood donor predonation screening system led to a significant decrease in HBV and HCV prevalence rates (12, 13). Moreover, educating the donors about the mode of transmission of HBV and HCV made them more alerted to avoid the risk factors (1, 7).

Additionally, the prevalence of HBV in the general population declined globally since the initiation of HBV vacci-

nation, especially in the young age group (14-17). This decline is more notable among children under 14 years old due to the implementation of HBV vaccination in national vaccination program (18). In China, HBV prevalence decreased to 2.3% in the age range of 5-14 years old, and to less than 1% among children younger than five years old (17). Furthermore, a Taiwanese study determined a significant impact of HBV vaccination on the prevalence of HCC in children (19). Chang et al. reported a significant decrease in HCC prevalence in children aged 6 - 14 years old from 0.7 per 100,000 children in 1981 to 0.36 per 100,000 children in 1994 (19). However, the effect of HBV vaccination on the infection prevalence among blood donors is not remarkable, since most of the donors did not get HBV vaccine in their childhood (7).

2. Objectives

The current study aimed to determine the prevalence of HBV and HCV among blood donors in Duhok, Iraq.

3. Methods

3.1. Blood Samples

The study samples included all individuals who donated blood from 01 January to 31 December, 2014. A 5 mL blood sample was obtained from each donor. Then the samples were centrifuged at 1500 rpm for 3 minutes for serum preparation. In addition, a questionnaire was prepared and used for each study subject to collect personal information (name (optional), age and gender), socioeconomic situation (such as marital status and occupation), history of exposure to risky procedures or behaviours, family history of HBV infection, and history of immunization against HBV in three doses. The ethical clearance was obtained from School of medicine, faculty of medical sciences, University of Duhok and Kurdistan board for medical specialties.

3.2. Enzyme Linked Immunosorbent Assay

The level of HCV-Ab (fourth generation) and the hepatitis B surface antigen (HBsAg) were assessed by commercial DIA.PRO Diagnostic Bioprobes ELISA kit (Italy) following manufacturer's instruction.

3.3. RNA Extraction

RNA extraction was conducted using QIAamp RNA Extraction Kit (Qiagen) according to the manufacturer's instructions using QIAcube extractor (Qiagen). The extracted RNA concentration was confirmed through measurement by NanoDrop®.

3.4. Quantification of HCV RNA

Quantification of HCV RNA was performed by real-time quantitative PCR (RT-PCR). It was conducted using the Artus HCV RG RT-PCR kit (Qiagen, Hamburg, Germany). An aliquot of 20 μL of purified sample was utilised in a total reaction volume of 50 μL. Amplification reaction for each sample and standard was performed in duplicates. Amplification cycling was performed using the Rotor-Gene Q device (Qiagen). Data analysis was performed with the Rotor-Gene software according to the manufacturer's instructions.

3.5. Statistical Assessment

Data analysis was conducted by Minitab 15 software. The Chi-square test was used for the analytical assessment and a P value of ≤ 0.05 was considered statistically significant.

4. Results

4.1. Characteristics of Donors

Over the period of the study, 7900 donors were screened for HBsAg and HCV-Ab. Among the donors, 7864/7900 (99.5%) were male. The mean age of the donors was 33.4 $\pm$ 8.3 years. The donors came from Duhok and its vicinity. While 3842/7900 (48.6%) came from Duhok, 4058/7900 (51.4%) subjects came from the surrounding vicinities; 50/62 (80.6%) and 13/16 (81%) of the HBsAg and HCV-positive subjects were married. None of the recruited subjects had a history of HBV vaccination.

4.2. HBsAg and HCV-Ab Positivity

It was found that 62/7900 (0.78%) donors showed positive HBsAg results. All the HBsAg and HCV-positive donors were male. It is noteworthy that 32/3843 (0.83%) donors from Duhok were HBsAg positive, while 30/4057 (0.73%) donors from the surrounding vicinities had positive results ($P > 0.74$) (Table 1). On the other hand, 16/7900 (0.2%) donors were positive for HCV-Ab. None of the females recruited in this study were positive for HCV-Ab. No significant difference was observed between the donors in rural and city centre ($P = 0.17$) (Table 1).

4.3. Real-Time Quantitative Polymerase Chain Reaction of HCV

All the HCV-positive donors were assessed by RT-PCR to confirm HCV positive samples; accordingly, amongst the 16 HCV-positive subjects, only one patient was positive. All RT-PCR negative patients repeated the test after one month and results showed that they were all negative.

Table 1. The Distribution of Hepatitis B Virus Surface Antigen and Hepatitis C Virus Antibody Positivity According to the Place of Residence

Distribution of Hepatitis	City	Rural	P Value
HBV Status			
HBsAg			0.74
Positive	32	30	
Negative	3811	4027	
Total	3843	4057	
HCV Status			
HCV Ab			0.17
Positive	11	5	
Negative	3831	4053	
Total	3842	4058	

4.4. Risk Factors Associated With HBV and HCV Infection

Amongst the HBsAg positive donors, 48/62 (77%) had a history of previous dental procedures. While 21/62 (33.8%) had a history of surgical procedures, only 1/62 (1.6%) reported a history of blood transfusion. All of the HBsAg positive donors denied any history of illegitimate sex and drug abuse. On the other hand, amongst the 16 HCV-Ab positive donors, 75% had a history of dental procedures and 62% reported a history of surgical procedures. In addition, 1/16 (6%) had a history of blood transfusion. Again, all of the HCV-Ab positive donors denied any history of illegitimate sex and drug abuse. It is noteworthy mentioning that some donors had positive history for more than one risk factor.

5. Discussion

The spread of blood borne viruses, especially HBV and HCV, increases at an alarming rate worldwide and this created a dramatic impact upon some countries such as Iraq. Worldwide, recent data showed that approximately 350 million subjects are chronically infected with HBV (18) and about 200 million subjects are infected with HCV (2).

The prevalence of HBV infection was studied in Iraq previously (20, 21). In two reports studying the prevalence of HBV-positive subjects in Babylon and Najaf, the prevalence was around 0.7%, while the prevalence was as high as 3.5% in Kerbala (22, 23). In the current study, 0.78% of the recruited samples were positive for HBV. In a study conducted in Egypt recruiting healthy volunteer blood donors, HBV positivity was reported for 5% of the subjects (24). Similarly, in a study conducted in Kuwait, the prevalence of HBsAg positive subjects among Kuwaiti nationals and non-Kuwaiti Arabs was 1.1% and 3.5%, respectively (25). In another study conducted in Saudi Arabia, it was found that the prevalence of HBV-positive was 3.8% among blood donors (26). On the other hand, a study conducted in Iran showed that the prevalence of HBV amongst blood donors decreased from 1.79% in 1998 to 0.41%. Such a decline might be due to improvement in vaccination program, using blood transfusion database and possibly decreasing the prevalence of HBV infection in general population (27).

The current study indicated that 0.2% of the samples were positive for HCV-Ab. This is less than what was found previously in Iraq, where 0.5% of blood donors were positive for HCV-Ab in Babylon (22). The prevalence of HCV-Ab positive subjects varies from one country to another ranging from 0.4% to 19.2% (28-30). In a study conducted in Iran, the prevalence of HCV-positive cases was 0.5%; while the prevalence was 0.4% in Saudi Arabia (26, 31). The current study aimed to confirm the diagnosis of HCV by RT-PCR. It was found that only one patient (0.013%) was currently infected with HCV. The current paper is the first to study the prevalence of HCV in Iraq by RTPCR. Further studies with larger sample recruitment should be conducted to confirm the results.

The first licensed hepatitis B vaccines were plasma-derived and composed of purified HBsAg; most currently available hepatitis B vaccines are produced by recombinant DNA technology. Hepatitis B vaccines are typically given in a three-dose series (18). In the current study, none of the donors obtained vaccination which might be due to different reasons. First of all, the vaccination against HBV was only included in the routine expanded program of immunization in 2003. It means that only the people younger than 12 years old were included in this program. Secondly, the unavailability of vaccine or its high cost might deprive people from the vaccination. The poor vaccination status among this population warrants the authority to plan a

Table 2. The Distribution of Risk Factors Associated With HBV and HCV Infection

Infection (No.)	Blood Transfusion	Surgical Procedure	Dental Procedure	Tattoo	Drug User	Illegitimate Sex	Family History of Hepatitis
HBV (62)	1 (1.6)	21 (33.8)	48 (77)	8 (6)	0	0	7 (11)
HCV (16)	1 (6)	10 (62)	12 (75)	4 (25)	0	0	0

Abbreviations: HBV, hepatitis B virus; HCV, hepatitis C virus.

vaccination program for the people who are at increased risk of blood born viral infections. Also, there is a demand for awareness sessions in the general population about the importance of vaccination.

The majority of donors in the study were male. This gender imbalance might be due to the fact that in Iraqi society men are more proactive and independently make decisions. In addition, males are called to take responsibilities and represent their tribes and families.

Certain types of behaviours increase the risk of contracting HBV and HCV infections; for example, use of contaminated needle during acupuncture, intravenous drug abuse (32), ear piercing and tattooing (33), heterosexuals or homosexuals sexual activities (especially for HBV) (34), infants born to infected mothers (35), healthcare providers (36, 37), subjects undergoing haemodialysis (38) and patients with haemoglobinopathy (39). It was previously shown that HBV can be transmitted sexually and vertically from mother to new born baby. This is due to the exposure to infectious blood and body fluid. It was also previously shown that HBsAg can be found in all body secretions and excretions. However, only blood, vaginal and menstrual fluids, and semen are infectious (35, 39, 40). HBV can stay active in the environment for up to seven days. Hence, blood contaminated household objects can pose a risk for transmission (41). Sharing these objects such as toothbrushes or razors can transmit the virus within the family. The current study found that 11% of HBV-positive subjects had a positive family history of HBV infection. Lack of education about the method of transmission may help the spread of infection. None of the HCV-antibody-positive subjects had a positive family history. This might be due to the low infectivity rate of this virus as it was reported that the chance of getting the infection after an exposure is only 3%; while it is 30%-60% in HBV, depending on the HBe antigen positivity (35, 39, 40).

Drug users are at high risk of blood borne viral infection due to sharing contaminated needles (40). A study in Egypt found that 28% of HBV-positive cases had a history of drug abuse (24). None of the HBV- and HCV-positive subjects admitted the use of drugs. This might be due to the rarity of these drugs in the region or the embarrassment of admitting using such drugs due to the social stigma associated with such a habit.

It was previously shown that unsterilized surgical instruments resulted in an outbreak of blood borne viral infection in private clinics and hospitals (40, 42, 43). The current study showed that the majority of HBV- and HCV-positive subjects had a history of visiting dentists and undergoing previous surgeries. This warrants an urgent investigation about the infection control measures especially sterilisation in all hospitals and private clinics particularly those of dentists.

Studying the risk factors associated with HBV and HCV in Iraq would give significant information to the infection control department and health planers to control the spread of such infections. This was a preliminary study and case control studies should be planned for future. It is noteworthy that, HCV-Ab positivity does not reflect the prevalence of HCV as it does not differentiate between old resolved and recent cases. Therefore, in future all positive cases should be referred to viral load study (RT-PCR) to confirm the results.

Footnote

Authors' Contribution: All authors contributed in planning, data collection, data analysis and drafting of the paper.

References

1. Flichman DM, Blejer JL, Livellara BI, Re VE, Bartoli S, Bustos JA, et al. Prevalence and trends of markers of hepatitis B virus, hepatitis C virus and human Immunodeficiency virus in Argentine blood donors. *BMC Infect Dis.* 2014;**14**:218. doi: 10.1186/1471-2334-14-218. [PubMed: 24755089].
2. Zaheer H, Saeed U, Waheed Y, Karimi S, Waheed U. Prevalence and trends of hepatitis B, hepatitis C and human immunodeficiency viruses among blood donors in Islamabad, Pakistan 2005-2013. *J Blood Disorders Transf.* 2014;**5**(217):2.
3. Walter SR, Thein HH, Amin J, Gidding HF, Ward K, Law MG, et al. Trends in mortality after diagnosis of hepatitis B or C infection: 1992-2006. *J Hepatol.* 2011;**54**(5):879–86. doi: 10.1016/j.jhep.2010.08.035. [PubMed: 21145812].

4. Andrade AF, Oliveira-Silva M, Silva SG, Motta IJ, Bonvicino CR. Seroprevalence of hepatitis B and C virus markers among blood donors in Rio de Janeiro, Brazil, 1998-2005. *Mem Inst Oswaldo Cruz.* 2006;**101**(6):673–6. [PubMed: 17072482].
5. Al Abaddi B, Al Amr M, Abasi L, Saleem A, Hazeem NA, Marafi A. Seroprevalence of HBV, HCV, HIV and syphilis infections among blood donors at Blood Bank of King Hussein Medical Center: a 3 year study. *World Fam Med J Incorpor Middle East J Fam Med.* 2014;**12**(6):10–3.
6. Uneke CJ, Ogbu O, Inyama PU, Anyanwu GI, Njoku MO, Idoko JH. Prevalence of hepatitis-B surface antigen among blood donors and human immunodeficiency virus-infected patients in Jos, Nigeria. *Mem Inst Oswaldo Cruz.* 2005;**100**(1):13–6. [PubMed: 15867956].
7. Song Y, Bian Y, Petzold M, Ung CO. Prevalence and trend of major transfusion-transmissible infections among blood donors in Western China, 2005 through 2010. *PLoS One.* 2014;**9**(4):ee94528. doi: 10.1371/journal.pone.0094528. [PubMed: 24714490].
8. Glynn SA, Kleinman SH, Schreiber GB, Busch MP, Wright DJ, Smith JW, et al. Trends in incidence and prevalence of major transfusion-transmissible viral infections in US blood donors, 1991 to 1996. Retrovirus Epidemiology Donor Study (REDS). *JAMA.* 2000;**284**(2):229–35. [PubMed: 10889598].
9. Kafi-abad SA, Rezvan H, Abolghasemi H, Talebian A. Prevalence and trends of human immunodeficiency virus, hepatitis B virus, and hepatitis C virus among blood donors in Iran, 2004 through 2007. *Transfusion.* 2009;**49**(10):2214–20. doi: 10.1111/j.1537-2995.2009.02245.x. [PubMed: 19527477].
10. Dodd RY, Notari E, Stramer SL. Current prevalence and incidence of infectious disease markers and estimated window-period risk in the American Red Cross blood donor population. *Transfusion.* 2002;**42**(8):975–9. [PubMed: 12385406].
11. Lavanya V, Viswanathan T, Malar SAS, Malarvizhi A, Moorthy K. Prevalence of hepatitis B virus infection among blood donors with antibodies to hepatitis B core antigen. *Int J Med Med Sci.* 2012;**4**(6):128–37.
12. Gurol E, Saban C, Oral O, Cigdem A, Armagan A. Trends in hepatitis B and hepatitis C virus among blood donors over 16 years in Turkey. *Eur J Epidemiol.* 2006;**21**(4):299–305. doi: 10.1007/s10654-006-0001-2. [PubMed: 16685581].
13. Vogt M, Lang T, Frosner G, Klingler C, Sendl AF, Zeller A, et al. Prevalence and clinical outcome of hepatitis C infection in children who underwent cardiac surgery before the implementation of blood-donor screening. *N Engl J Med.* 1999;**341**(12):866–70. doi: 10.1056/NEJM199909163411202. [PubMed: 10498458].
14. Mast EE, Margolis HS, Fiore AE, Brink EW, Goldstein ST, Wang SA, et al. A comprehensive immunization strategy to eliminate transmission of hepatitis B virus infection in the United States: recommendations of the Advisory Committee on Immunization Practices (ACIP) part 1: immunization of infants, children, and adolescents. *MMWR Recomm Rep.* 2005;**54**(RR-16):1–31. [PubMed: 16371945].
15. Liang X, Bi S, Yang W, Wang L, Cui G, Cui F, et al. Epidemiological serosurvey of hepatitis B in China–declining HBV prevalence due to hepatitis B vaccination. *Vaccine.* 2009;**27**(47):6550–7. doi: 10.1016/j.vaccine.2009.08.048. [PubMed: 19729084].
16. Liang X, Bi S, Yang W, Wang L, Cui G, Cui F, et al. Evaluation of the impact of hepatitis B vaccination among children born during 1992-2005 in China. *J Infect Dis.* 2009;**200**(1):39–47. doi: 10.1086/599332. [PubMed: 19469708].
17. Luo Z, Li L, Ruan B. Impact of the implementation of a vaccination strategy on hepatitis B virus infections in China over a 20-year period. *Int J Infect Dis.* 2012;**16**(2):e82–8. doi: 10.1016/j.ijid.2011.10.009. [PubMed: 22178658].
18. Shepard CW, Simard EP, Finelli L, Fiore AE, Bell BP. Hepatitis B virus infection: epidemiology and vaccination. *Epidemiol Rev.* 2006;**28**:112–25. doi: 10.1093/epirev/mxj009. [PubMed: 16754644].
19. Chang MH, Chen CJ, Lai MS, Hsu HM, Wu TC, Kong MS, et al. Universal hepatitis B vaccination in Taiwan and the incidence of hepatocellular carcinoma in children. Taiwan Childhood Hepatoma Study Group. *N Engl J Med.* 1997;**336**(26):1855–9. doi: 10.1056/NEJM199706263362602. [PubMed: 9197213].
20. Hussein NR. Prevalence of HBV, HCV and HIV and Anti-HBs antibodies positivity in healthcare workers in departments of surgery in Duhok City, Kurdistan Region, Iraq. *Int J Pure Appl Sci Technol.* 2015;**26**(2):70.
21. Hussein NR, Rasheed ZA, Taha AA, Shaikhow SK. The Prevalence of Hepatitis D Virus Infection amongst Patients with Chronic Active Hepatitis B Virus Infection in Duhok Governorate. *Int J Pure Appl Sci Technol.* 2015;**28**(1):1.
22. Al-Rubaye A, Tariq Z, Alrubaiy L. Prevalence of hepatitis B seromarkers and hepatitis C antibodies in blood donors in Basra, Iraq. *BMJ Open Gastroenterol.* 2016;**3**(1):e000067. doi: 10.1136/bmjgast-2015-000067. [PubMed: 26966550].
23. Mahmood AK, Addose SA, Salih HA, Khadi AA. Seroprevalence of HBs ag and Anti HCV positive blood donors in Najaf governorate. *Iraqi J Community Med.* 2001;**14**:29–33.
24. Awadalla HI, Ragab MH, Osman MA, Nassar NA. Risk factors of viral hepatitis B among Egyptian blood donors. *Br J Med Med Res.* 2011;**1**(1):7.
25. Ameen R, Sanad N, Al-Shemmari S, Siddique I, Chowdhury RI, Al-Hamdan S, et al. Prevalence of viral markers among first-time Arab blood donors in Kuwait. *Transfusion.* 2005;**45**(12):1973–80. doi: 10.1111/j.1537-2995.2005.00635.x. [PubMed: 16371052].
26. Mohammed Abdullah S. Prevalence of hepatitis B and C in donated blood from the jazan region of saudi arabia. *Malays J Med Sci.* 2013;**20**(2):41–6. [PubMed: 23983576].
27. Kafi-abad SA, Rezvan H, Abolghasemi H. Trends in prevalence of hepatitis B virus infection among Iranian blood donors, 1998-2007. *Transfus Med.* 2009;**19**(4):189–94. doi: 10.1111/j.1365-3148.2009.00935.x. [PubMed: 19708860].
28. 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.* 2011;**51**(1):198–202. doi: 10.1111/j.1537-2995.2010.02801.x. [PubMed: 20663107].
29. Klevens RM, Hu DJ, Jiles R, Holmberg SD. Evolving epidemiology of hepatitis C virus in the United States. *Clin Infect Dis.* 2012;**55 Suppl 1**:S3–9. doi: 10.1093/cid/cis393. [PubMed: 22715211].
30. Vriend HJ, Van Veen MG, Prins M, Urbanus AT, Boot HJ, Op De Coul EL. Hepatitis C virus prevalence in The Netherlands: migrants account for most infections. *Epidemiol Infect.* 2013;**141**(6):1310–7. doi: 10.1017/S0950268812001884. [PubMed: 22963908].
31. Khodabandehloo M, Roshani D, Sayehmiri K. Prevalence and trend of hepatitis C virus infection among blood donors in Iran: A systematic review and meta-analysis. *J Res Med Sci.* 2013;**18**(8):674–82. [PubMed: 24379843].
32. Akselrod H, Grau LE, Barbour R, Heimer R. Seroprevalence of HIV, hepatitis B virus, and HCV among injection drug users in Connecticut: understanding infection and coinfection risks in a nonurban population. *Am J Public Health.* 2014;**104**(9):1713–21. doi: 10.2105/AJPH.2013.301357. [PubMed: 24134382].
33. Jafari S, Copes R, Baharlou S, Etminan M, Buxton J. Tattooing and the risk of transmission of hepatitis C: a systematic review and meta-analysis. *Int J Infect Dis.* 2010;**14**(11):e928–40. doi: 10.1016/j.ijid.2010.03.019. [PubMed: 20678951].
34. Corona R, Prignano G, Mele A, Gentili G, Caprilli F, Franco E, et al. Heterosexual and homosexual transmission of hepatitis C virus: relation with hepatitis B virus and human immunodeficiency virus type 1. *Epidemiol Infect.* 1991;**107**(3):667–72. [PubMed: 1661241].
35. Toussi SS, Abadi J, Rosenberg M, Levanon D. Prevalence of hepatitis B and C virus infections in children infected with HIV. *Clin Infect Dis.* 2007;**45**(6):795–8. doi: 10.1086/521169. [PubMed: 17712766].
36. Averhoff FM, Glass N, Holtzman D. Global burden of hepatitis C: considerations for healthcare providers in the United States. *Clin Infect Dis.* 2012;**55 Suppl 1**:S10–5. doi: 10.1093/cid/cis361. [PubMed: 22715208].
37. Singhal V, Bora D, Singh S. Hepatitis B in health care workers: Indian scenario. *J Lab Physicians.* 2009;**1**(2):41–8. doi: 10.4103/0974-2727.59697.

[PubMed: 21938248].
38. Qadi AA, Tamim H, Ameen G, Bu-Ali A, Al-Arrayed S, Fawaz NA, et al. Hepatitis B and hepatitis C virus prevalence among dialysis patients in Bahrain and Saudi Arabia: a survey by serologic and molecular methods. *Am J Infect Control.* 2004;**32**(8):493–5. doi: 10.1016/S0196655304003669. [PubMed: 15573057].
39. Omar N, Salama K, Adolf S, El-Saeed GS, Abdel Ghaffar N, Ezzat N. Major risk of blood transfusion in hemolytic anemia patients. *Blood Coagul Fibrinolysis.* 2011;**22**(4):280–4. doi: 10.1097/MBC.0b013e3283451255. [PubMed: 21508832].
40. Parry J. At last a global response to viral hepatitis. *Bull World Health Organ.* 2010;**88**(11):801–2. doi: 10.2471/BLT.10.011110. [PubMed: 21076557].
41. Sypsa V, Hadjipaschali E, Hatzakis A. Prevalence, risk factors and evaluation of a screening strategy for chronic hepatitis C and B virus infections in healthy company employees. *Eur J Epidemiol.* 2001;**17**(8):721–8. [PubMed: 12086089].
42. Asthana S, Kneteman N. Operating on a patient with hepatitis C. *Can J Surg.* 2009;**52**(4):337–42. [PubMed: 19680522].
43. Redd JT, Baumbach J, Kohn W, Nainan O, Khristova M, Williams I. Patient-to-patient transmission of hepatitis B virus associated with oral surgery. *J Infect Dis.* 2007;**195**(9):1311–4. doi: 10.1086/513435. [PubMed: 17397000].