IJBPAS, January, 2019, 8(1): 147-162

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

PREVALENCE OF HEPATITIS C VIRUS INFECTION AMONG HEALTH CARE WORKERS IN RADA'A CITY, YEMEN

AHMED Y. AL-QUDARI[1], MOHAMED T. AL-MAKTARI[3], ANWAR A. AL-KUBATI[1, 2]

[1]Department of Veterinary Medicine, Faculty of Agriculture and Veterinary Medicine, Thamar University, Dhamar, Yemen

[2]Department of Medical Laboratory Sciences, Faculty of Medical Sciences, Al-Saeeda University, Dhamar, Yemen

[3]Departmentof Public Health –Parasitology, Faculty of Medicine and Health Sciences, Sana'a University, Sana'a, Yemen

***Corresponding author: Ahmed Yahya Saleh Al-Qudari, E-mail: qudariays@yahoo.com**

Received 3rd Aug. 2018; Revised 2nd Sept. 2018; Accepted 4th Oct. 2018; Available online 1st Jan. 2019

https://doi.org/10.31032/IJBPAS/2019/8.1.4622

ABSTRACT

Background. Hepatitis C virus (HCV) infection is considered one of the most important universal public health problems. HCV usually transmitted parenterally and create a work-related risk to the health care workers (HCWs). Although the fact that a number of studies that conducted in Yemen have provided an estimate of HCV prevalence, there only few studies that reveal the condition in the HCWs. ***Aim.*** Across-sectional study conducted between March and July 2014 to determine the prevalence of HCV and recognize key risk factors for HCV infection among HCWs. ***Methods.*** The study population involved 345 HCWs (173 females and 172 males) who subjected for screening of HCV antibodies (Abs) using ELISA quantitative technique. A structured questionnaire used to collect the socio-professional data that statistically analyzed using SPSS program, and $P \leq 0.05$ considered a significant. ***Results.*** The overall crude

prevalence of HCV Abs was 14/345 (4.05%). There was no significantly difference (p=0.99) between males (4.06%) and females (4.04%). The prevalence of HCV Abs was a highly significant (p=0.001) among the cleaning staff (6.52%) and having almost ten times higher risk of HCV seropositivity (***p*****:** 0.001, RR: 10.2, χ^2: 20.3, 95% CI: 3.4–30) as compared with those in other occupational categories. ***Conclusion***. The respect of universal health safety measures by the medical set particularly those who are working in the cleaning process and their screened for Hepatitis C infection are immediately required to reduce the risk of infection with HCV and protect the medical staff in Yemen.

Keywords: Prevalence; HCV; Anti-HCV; Health Care Workers; Yemen

INTRODUCTION:

HCV infection is considered one of the most important health problems globally (1, 2). Untreated HCV infection might develop within the time to the liver cirrhosis, liver failure and hepatocellular carcinoma (HCC) throughout the world (3-5). Mostly, HCV infection is transmitted parenterally and this is forms an occupational risk to the HCWs (6).It's reported that approximately one million out of three million HCWs per year infected with HCV infection due to the accidental injuries by their occupational instruments that can be polluted with infected blood or other fluids (7, 8). These accidents increase the hazard of HCV transmission (9). Needle sticks injuries stay a risk to HCWs and their patients (8, 10). It's reported that incidence of HCV seroconversion among those who exposed to the needle sticks injuries ranging from 0 to 10% (11, 12).

HCV distributed throughout the world and the prevalence of anti-HCV positivity among HCWs differs from region to region (7). According to several studies conducted in different parts of the world, the prevalence of Anti-HCV ranging from 0 to 9.7%(7). In Saudi Arabia, the prevalence of HCV among HCWs was 0% (13). In contrast, the higher prevalence of HCV among HCWs was reported in Egypt and Philippines (8% and 9.7% respectively) (14, 15). In Arabian Peninsula, Yemen is the poorest and the second largest heavily populated country. Several studies showed that HCV prevalence among Yemenis healthy volunteers, blood donors and hemodialysis patients was 1.7%, 2.7% and up to 60% respectively (16).

However, the minority determined HCV prevalence among HCWs. Out of 546 HCWs tested in the capital of Yemen (Sana'a) in 2004, 3.5% were positive for Anti-HCV(17). In Yemen, there are a few number of studies regarding prevalence of HCV infection as work-related threat in the high-risk groups of health care staff working in hospitals in Rada'a City, Yemen. The current study therefore designed to estimate the prevalence of anti-HCV amongst HCWs and identify possible risk factors of HCV infection.

MATERIALS AND METHODS

Study design and population:

The present study conducted between March and July 2014 as a cross-sectional study in population of HCWs in a several public and private hospitals in Rada'a City, Yemen. The study involved a total of 345 subjects including of HCWs (doctors, nurses, hematological laboratories, dentists and cleaners) working in a number of public and private hospitals in Rada'a city and informed consent was obtained from all participants. A questionnaire was used to collect the socio-professional data which including the sex, age, occupational category, marital status and the exposure to some risk factors associated within the infection transmission.

Samples collection:

The blood samples (5 ml) were collected by trained laboratory technicians from each participant in the current study using sterilized EDTA vacutainer blood collection tubes.

Laboratory testing:

All collected samples were subjected for screening of HCV Abs by one step cassette style anti-HCV device (Rapid Anti-HCV Test, Intec, China) according on the manufacturer's instructions. Subsequently, the positive samples reconfirmed using Enzyme Linked Immunosorbent Assay (DRG, HCV antibodies, USA) following manufacturer's instructions.

Statistical analysis:

Statistical analysis was conducted with SPSS statistical program, version 15.0. The Binary Logistic Regression was used for the analytical assessment and a *p-value* of ≤0.05 was considered statistically significant.

RESULTS

Sociodemographic Characteristics:

Out of 736 HCWs employment in different public and private hospitals in Rada'a City, only 345 (46.87%) agreed to

participate to this study. They were 173 (50.14%) women and 172 (49.85%) men; the mean age was 29.8 years (range 20 to 60). According to the sex, the distribution of participants was approximately equal (Male=49.9%, and Female=50.1%). The majority of the subjects were married (N=187, 54.2%) and in the age category of 20 to 29 years old (N=204, 59.1%). Regarding occupational category, more than third of subjects (N=132, 38.3%) were nurses.

Prevalence of HCV infection:

Out of 345 participants, 14were positive for HCV Abs (4.05%) as presented in Table 1. There was no association between the prevalence of HCV Abs and gender (P=0.99) and age (P=0.75) as shown in Table 1 and Figure 1 respectively.

Among HCWs and according to their occupational category, the prevalence of HCV Abs was statistically significant in those who are working in the cleaning practices and having almost ten times higher risk of HCV seropositivity (*p*: 0.001,RR: 10.2, $\chi^{2:}$20.3, 95% CI: 3.4–30) as compared to the other occupational categories (Figure 2).

Most of the participants in the present study were married (54.2%), and the rest were single (42.6%), divorced (2.3%) and widow (0.9%). The divorced and single participants were at risk of HCV seropositivity (RR: 3.24 and 1.8 respectively). However, the association between the prevalence of HCV Abs and marital status was not statistically significant as presented in Figure 3.

Potential risk factors for HCV infection:

Exposure to needle stick injuries, was reported by 143 (41.44%) of HCWs, and only seven of them (4.89%) were positive for HCV antibody with not statistical significance (p=0.5). The frequency of HCV infection among HCWs was not statistically associated with injected drug abuse (p=0.65), contact with patient samples (p=0.5) and contact with surgical waste (p=0.41).On the other hand, only 20 HCWs (5.79%) had received a blood transfusion in their lifetime and no HCV Abs detected among them. Some of the HCWs (200, 57.97%) had dental procedure and seven (3.5%) of them were positive for anti-HCV with not statistical significance (p=0.52). Among those who subjected for cupping (6.66%), only two of them were positive for Anti-HCV with no significant association (p=0.66). In HCWs who

exposed to surgical operation (27.53%), only four (4.21%) of them were positive for HCV Abs. However, there was no significantly association (p=0.92) between the prevalence of HCV Abs and surgical exposure as presented in Table 2.

Table 1: Prevalence of HCV Abs among HCWs in relation to sex

Gender	No.	Anti-HCV +		χ^2	*P*
		No.	%		
Male	172	7	4.06	0.00	0.99
Female	173	7	4.04		
Total	**345**	**14**	**4.05**		

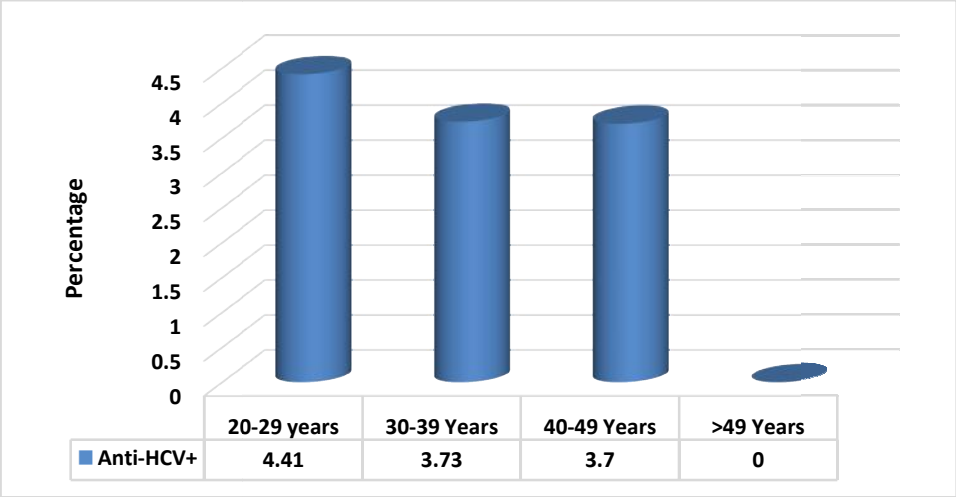

Figure 1: Prevalence of HCV Abs among HCWs in relation to age (χ^2 = 0.13, p=0.75)

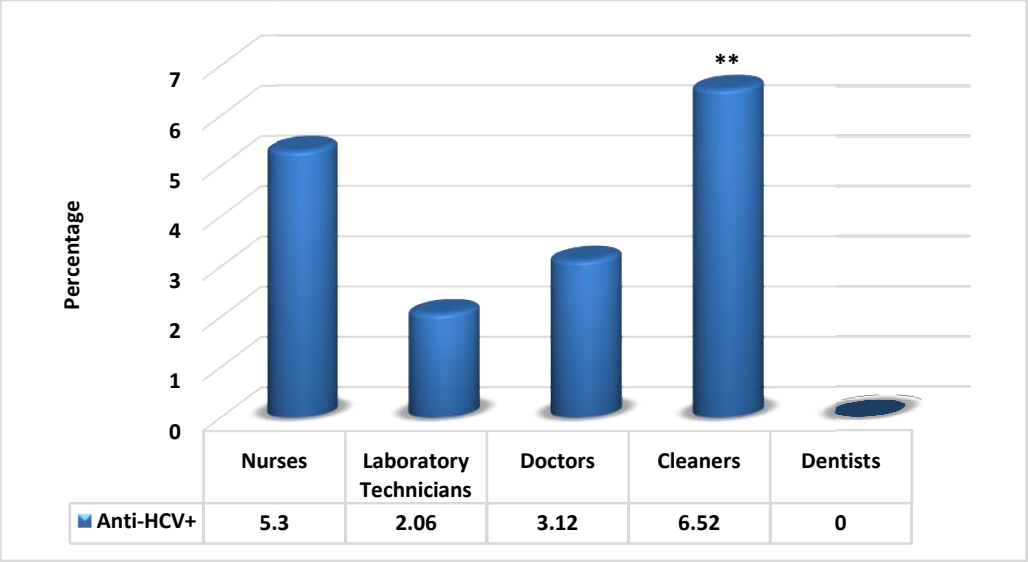

Figure 2: Prevalence of HCV Abs among HCWs in relation to occupation (= highly significant, χ^2 = 20.3, p=0.001)**

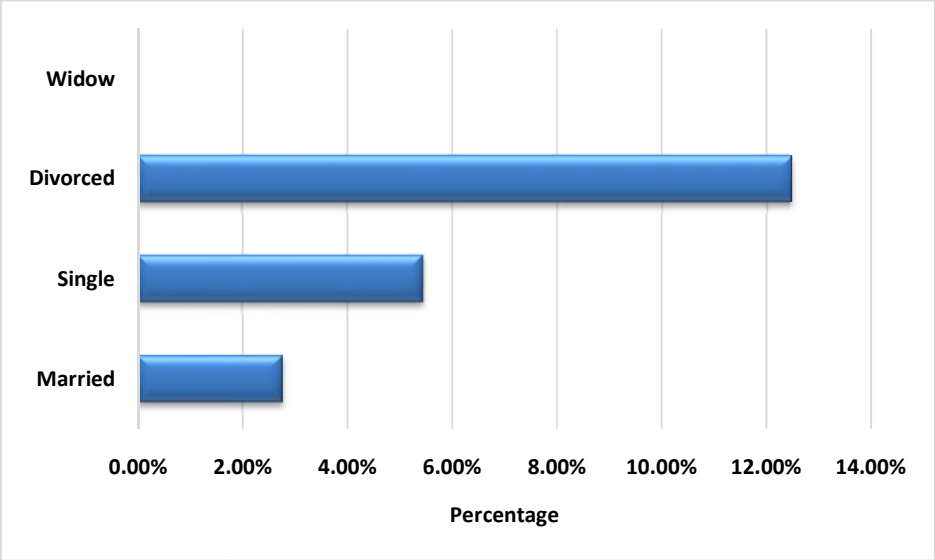

Figure 3: Prevalence of HCV Abs among HCWs in relation to marital status (χ^2 = 1.23, p=0.33)

Table 2: Prevalence of HCV Abs among HCWs in relation to potential risk factors

Potential risk factors	No.	Anti-HCV +		RR	95% CI	χ^2	*P*
		No.	%				
Needle stick injury	143	7	4.89	1.4	0.5–3.9	0.44	0.5
Injected drug abuse	37	1	2.70	0.6	0.03–4.7	0.2	0.65
Contact with patient samples	249	9	3.61	0.7	0.3-2.0	0.45	0.5
Contact with surgical waste	69	4	5.79	1.6	0.5–4.9	0.67	0.41
Cupping	23	2	8.69	1.4	0.3–5.9	0.19	0.66
Dental procedure	200	7	3.5	0.7	0.3–2.0	0.38	0.52
Surgical operation	95	4	4.21	1.1	0.34–3.3	0.01	0.92
Blood transfusion	20	0	0.00	--	--	0.4	0.3

χ^2: Chi-square, *P:* Probability value ≤ 0.05: significant, RR: Relative risk, CI: confidence interval.

DISCUSSION

HCV is a blood-borne virus that transmitted parenterally and affects millions of people all over the world. Patient may remain unaware of their HCV status for long period, while pose a threat to infect others. As a part of their occupation, Health Care Workers(HCWs) frequently deal with patients, including HCV infected patients, and perform procedures likely to expose them to viremic blood or other body fluids (7). HCV transmission from patients to HCWs appears to be more frequent than previously thought. In developed countries, such transmissions were documented at several occasions (18), but similar data from developing countries are lacking. Consequently, it has been reported that HCV is more prevalent in

HCWs than in other occupational groups or even general population (19-21).The present study estimate crude HCV prevalence among HCWs in Rada'a city to be 4.1%.This is in agreement with a previous study showing HCV prevalence among HCWs in Sana'a to be 3.5%(17). Internationally, reports regarding HCV prevalence in HCWs showed considerable inconsistencies. Absence(0% prevalence) was reported in Saudi Arabia and Iraq, less than 0.5% were reported in Denmark, Scotland, and Turkey; and below 1% were reported in Albania, Spain, United States and Poland (7, 22, 23). On the other hand, higher HCV prevalence were reported in HCWs of Philippines (9.7%) and Egypt (8%) (7, 14), while comparable values of 3.2%, 4% and 5.6% were reported in Pakistan as well as 4% in Nigeria (7, 24, 25).

Inconsistency in HCV prevalence may reflect variation of HCV prevalence in the background populations (7, 25, 26). In Yemen, overall HCV prevalence in background population was estimated to be 1.7 or 1.8%; while it was 0.8%, 1.3%, 2.3% and 5.1% in Aden city, Ibb city, Sana'a city and Socotra island, respectively (27-29). Similarly, in Morocco, HCV prevalence in HCWs was 2.5%, higher than prevalence in background population which was 1.58% (30). HCV prevalence in HCWs of Egypt (8%) was not significantly different from that of Cairo population (10.4%) (14). Similarly, HCV prevalence in Italian HCWs (1.2%) was not significantly different from control group (0.8%)(31). Apart from patient to HCWs transmission, the risk of HCV transmission from HCWs to attendee's of Health Care Centers (HCCs) or from patient to patient was also previously reported (18, 23, 32, 33). In this respect, the possibility of HCV transmission from surgeon to patient during a single operation was estimated to be 0.014%±0.002% and 0.00018% ±0.00002% for HCV-RNA positive and HCV- unknown status surgeons, respectively (34). This emphasizes the need for periodic screening of the HCWs for HCV infection as a part of disease control program.

The present study demonstrates that HCV seropositivity was not associated with gender (p=0.99). Our finding is in agreement with those reported in Egypt (14); Nigeria (25); Morocco (30); and Bangladesh(35). In contrast, a retrospective study for more

than a decade that covered five European countries (France, Italy, Spain, United Kingdom and Switzerland) showed that HCV seropositivity was significantly associated with male-HCWs rather than female-HCWs (p=0.04) (26).However, such difference could be attributed to underlying variations in route of transmission and associated risk factors. In the developed countries, HCV infection associated mainly with injection drug use while in developing countries unsafe parenteral practices and transfusion where the main routes of transmission (27, 36, 37).The results of this study indicated that the HCV seropositivity among investigated HCWs was not associated with age. Several studies showed HCV seropositivity to be associated with age of HCWs. However, these studies were not in agreement on affected age stratum. Hence, this variation may arise from variations in the investigated population. For example, some studies showed that HCV prevalence display tendency to increase with age and reach the peak in the >50 years' group(14, 30). Other studies reported that the highest HCV prevalence was associated with the 30-39 years' group (p=0.012) (23) or 41-45 years' group (p<0.05) (25).

Our study covered wide range of HCWs, including doctors (physicians and consular), nurses, laboratory workers, dentist and cleaners. The highest rate of HCV seropositivity was found among cleaner (6.5%), with relative risk equal to 10.2, CI= 3.4 – 30, X^2 = 20.3, P.V <0.001. Similarly, HCV was highly prevalent (16%) in a hospital's manual workers in Egypt (14). People working in these job usually belongs to low socioeconomic groups, have low incomes and low educational background, if compared with other investigated occupational groups. Such characters were reported to be a risk factors for HCV infection in Yemen (27, 38).In the present study, HCV prevalence in nurses was 5.3%, but association was not significant with this occupation. Likewise, Thorburn and colleagues (2001) found no association between HCV seropositivity and occupational categories. Similar study showed that nursing was the highest occupational group prone to HCV infection with a prevalence of 4.44% (30). In general, it has been reported that HCV seropositivity associated with working in

hospital's departments with frequent exposure to blood (31) and working in hemodialysis units (6). Though not investigated in the present work, some studies showed association between HCV seropositivity and duration of work in HCCs(30, 31); however, such association was not constant (6, 25).

In this study, direct contact with surgical waste and patients' samples as well as exposure to needle stick injuries was repeatedly reported by investigated HCWs though association with HCV seropositivity was not significant. Studies on HCV prevalence reported frequent exposure among HCWs to needle stick injuries (24, 30, 39)and significant association with HCV seropositivity was also documented (31). HCV infection in HCWs was linked to percutaneous exposure to HCV rather than to mucocutaneous exposure, despite the few cases of transmission reported after mucocutaneous exposure. In this regard, it has been reported that HCV infection occurs in one out of ten percutaneous exposures to blood containing HCV-RNA(7, 26). Notably, disposal of biohazards, infectious agents, and sharp objectives is not regulated by law in Yemen; and this may contribute to the high HCV prevalence in cleaning workers in the present study. In the current investigation, transfusion was reported by 5.8% of the involved HCWs. None of the HCV seropositives had previously received blood transfusion. Similarly, 6.8% of the involved HCWs in Bangladesh reported previous transfusion and 1 out of five HCV seropositives had received transfusion (40). In contrast, numbers of transfusions were reported to be significantly associated with HCV seropositivity in HCWs in Egypt, and to be prevalent in HCV seropositive HCWs in Chile (5 out of 11) (14, 41). In Yemen, HCV prevalence in blood donor was reported to be 1% in Sana'a city (42, 43) and 1.3% in Aden city. Blood transfusion was significantly associated with HCV seropositivity in blood donor in Aden city (44)while association was not significant in pregnant women in Sana'a City (38).

Transfusion mediated-HCV acquisition was dramatically reduced after introduction of routine screening of donated blood for HCV positivity. In England, the post-transfusion HCV infection was fall from almost 2 out of million in 1993-`998 to 1 out of 30 million in 1999-2001 after introduction of HCV-RNA screening of donated blood

(45). However, this is not the case all over the world; many developing countries still linking between transfusion and HCV acquisition. Transfusion was estimated to represent moderate risk for HCV acquisition in the Arabian countries (16). In the current work dental and surgical operations, cupping, injection drug use and marital status were not significantly associated with HCV seropositivity. HCV seropositives represent 3.5% and 4.2% of those reported to had dental and surgical procedures, receptively. On contrast, surgical and dental procedures were reported to be significantly associated with HCV seropositivity in HCWs in Egypt (14). Study in general population of Yemen reported HCV positivity in 2%, 0.0% and 7% of those reported to had dental procedures in Sana'a, Aden and Taiz cities, respectively; while HCV positives represent2% in Sana'a andnonein Aden and Taiz cities among those underwent surgical operations (46). Similarly, in a study targeted pregnant women in Sana'a city, HCV seropositivity was not associated with nether surgery nor dental procedures (38). Relatively low HCV prevalence in general population of Yemen (1.7%) may provide a clue to understand inability of these studies to link HCV seropositivity with these factors (28).

CONCLUSION

The present findings of this study revealed the importance of HCV as an occupational risk to HCWs. The crude prevalence of serological markers of HCV among HCWs in Rada'a City of Yemen exceeds that of general population. The highest rate of HCV occurred among cleaners, also a huge risk of contracting HCV infection was found to be associated with them. Respect of universal health safety measures by the medical set particularly those who are working in the cleaning process is immediately required to reduce the risk of infection with HCV and protect the medical staff in Yemen.

ACKNOWLEDGMENT:

The authors thank with great appreciation the Physicians, Laboratory technologist and technicians, Dentists, Nurses, and Cleaners, who volunteered to participate in this work.

Conflict of Interest:

The authors declare that there is no conflict of interest regarding the publication of this paper.

REFERENCES

[1] Ogundele OA, Olorunsola A, Bakare B, Adegoke IA, Ogundele T, Fehintola FO, et al. Seroprevalence and Knowledge of Hepatitis B and C Among Health Care Workers in a Specialist Hospital in Nigeria. European Journal of Preventive Medicine. 2017;5(1-1):7-12.

[2] Walewska-Zielecka B, Religioni U, Juszczyk G, Wawrzyniak ZM, Czerw A, Soszyński P, et al. Anti-hepatitis C virus seroprevalence in the working age population in Poland, 2004 to 2014. Eurosurveillance. 2017;22(2).

[3] Stanaway JD, Flaxman AD, Naghavi M, Fitzmaurice C, Vos T, Abubakar I, et al. The global burden of viral hepatitis from 1990 to 2013: findings from the Global Burden of Disease Study 2013. The Lancet. 2016;388(10049):1081-8.

[4] Razavi H, Waked I, Sarrazin C, Myers R, Idilman R, Calinas F, et al. The present and future disease burden of hepatitis C virus (HCV) infection with today's treatment paradigm. Journal of viral hepatitis. 2014;21(s1):34-59.

[5] Poynard T, Yuen M-F, Ratzin V, Lai CL. Viral hepatitis C. The Lancet. 2003; 362(9401):2095-100.

[6] Jindal N, Jindal M, Jilani N, Kar P. Seroprevalence of hepatitis C virus (HCV) in health care workers of a tertiary care centre in New Delhi. Indian Journal of Medical Research. 2006;123(2):179.

[7] Coppola N, De Pascalis S, Onorato L, Calò F, Sagnelli C, Sagnelli E. Hepatitis B virus and hepatitis C virus infection in healthcare workers. World journal of hepatology. 2016;8(5):273.

[8] Charles PG, Grayson ML, Angus PW, Sasadeusz JJ. Management of healthcare workers after occupational exposure to hepatitis C virus. The Medical Journal of Australia. 2003;179(3):153-7.

[9] Moghimi M, Marashi SA, Kabir A, Taghipour HR, Faghihi-Kashani AH, Ghoddoosi I, et al.

Knowledge, attitude, and practice of Iranian surgeons about blood-borne diseases. Journal of Surgical Research. 2009;151(1):80-4.

[10] Mauss S BT, Rockstroh J, Sarrazin C, Wedemeyer H. Hepatology. 6th edition ed: Flying Publisher; 2015.

[11] Kiyosawa K, Sodeyama T, Tanaka E, Nakano Y, Furuta S, Nishioka K, et al. Hepatitis C in hospital employees with needlestick injuries. Annals of internal medicine. 1991; 115(5): 367-9.

[12] Puro V, Petrosillo N, Ippolito G. Risk of hepatitis C seroconversion after occupational exposures in health care workers. American journal of infection control. 1995; 23(5): 273-7.

[13] Alqahtani JM, Abu-Eshy SA, Mahfouz AA, El-Mekki AA, Asaad AM. Seroprevalence of hepatitis B and C virus infections among health students and health care workers in the Najran region, southwestern Saudi Arabia: The need for national guidelines for health students. BMC Public Health. 2014;14(1):577.

[14] Okasha O, Munier A, Delarocque-Astagneau E, ElHoussinie M, Rafik M, Bassim H, et al. Hepatitis C virus infection and risk factors in health-care workers at Ain Shams University Hospitals, Cairo, Egypt/Infection par le virus de l'hépatite C et facteurs de risque chez les agents de santé de l'hôpital universitaire Ain Shams au Caire (Égypte). Eastern Mediterranean Health Journal. 2015; 21(3): 199.

[15] Arguillas MO, Domingo EO, Tsuda F, Mayumi M, Suzuki H. Seroepidemiology of hepatitis C virus infection in the Philippines: a preliminary study and comparison with hepatitis B virus infection among blood donors, medical personnel, and patient groups in Davao, Philippines. Gastroenterologia Japonica. 1991; 26(3): 170-5.

[16] Daw MA, Dau AA. Hepatitis C virus in Arab world: a state of

concern. The Scientific World Journal. 2012; 2012.

[17] Shidrawi R, Ali Al-Huraibi M, Ahmad Al-Haimi M, Dayton R, Murray-Lyon IM. Seroprevalence of markers of viral hepatitis in Yemeni healthcare workers. Journal of medical virology. 2004; 73(4): 562-5.

[18] Pozzetto B, Memmi M, Garraud O, Roblin X, Berthelot P. Health care-associated hepatitis C virus infection. World Journal of Gastroenterology: WJG. 2014; 20(46): 17265.

[19] Westermann C, Peters C, Lisiak B, Lamberti M, Nienhaus A. The prevalence of hepatitis C among healthcare workers: a systematic review and meta-analysis. Occup Environ Med. 2015:oemed-2015-102879.

[20] Ciorlia LAdS, Zanetta DMT. Hepatitis C in health care professionals: prevalence and association with risk factors. Revista de saude publica. 2007; 41(2): 229-35.

[21] Deuffic-Burban S, Delarocque-Astagneau E, Abiteboul D, Bouvet E, Yazdanpanah Y. Blood-borne viruses in health care workers: prevention and management. Journal of clinical virology. 2011; 52(1): 4-10.

[22] 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. International Journal of Pure and Applied Sciences and Technology. 2015; 26(2): 70.

[23] Thorburn D, Dundas D, McCruden E, Cameron S, Goldberg D, Symington I, et al. A study of hepatitis C prevalence in healthcare workers in the West of Scotland. Gut. 2001; 48(1): 116-20.

[24] Sarwar J, Gul N, Idris M, Farid J, Adeel M. Seroprevalence of hepatitis B and hepatitis C in health care workers in Abbottabad. Journal of Ayub Medical College, Abbottabad: JAMC. 2008; 20(3): 27-9.

[25] Ogar CO, Okafor IMA, Akpan PA. Seroprevalence of Hepatitis C Virus Infection Among Health

Centre Workers in Calabar, Cross River State, Nigeria.

[26] Yazdanpanah Y, De Carli G, Migueres B, Lot F, Campins M, Colombo C, et al. Risk factors for hepatitis C virus transmission to health care workers after occupational exposure: a European case-control study. Clinical Infectious Diseases. 2005;41(10):1423-30.

[27] Gacche RN, Al-Mohani SK. Seroprevalence and risk factors for hepatitis C virus infection among general population in central region of Yemen. Hepatitis research and treatment. 2012;2012.

[28] Bajubair MA, Elrub AA, Bather G. Hepatic viral infections in Yemen between 2000--2005. Saudi Medical Journal. 2008;29(6):871-4.

[29] Chaabna K, Abu Raddad L, editors. The Epidemiology Of Hepatitis C Virus In Yemen: A Systematic Review And Meta-analysis. Qatar Foundation Annual Research Conference; 2014.

[30] Souly K, El Kadi MA, Elkamouni Y, Biougnach H, Kreit S, Zouhdi M. Prevalence of Hepatitis B and C Virus in Health Care Personnel in Ibn Sina Hospital, Rabat, Morocco. Open Journal of Medical Microbiology. 2016;6(01):17.

[31] Campello C, Majori S, Poli A, Pacini P, Nicolardi L, Pini F. Prevalence of HCV antibodies in health-care workers from northern Italy. Infection. 1992;20(4):224-6.

[32] Chant K, Kociuba K, Munro R, Crone S, Kerridge R, Quin J, et al. Investigation of possible patient-to-patient transmission of hepatitis C in a hospital. New South Wales Public Health Bulletin. 1994;5(5):47-51.

[33] Apostolou A, Bartholomew ML, Greeley R, Guilfoyle SM, Gordon M, Genese C, et al. Transmission of hepatitis C virus associated with surgical procedures-New Jersey 2010 and Wisconsin 2011. MMWR Morbidity and mortality weekly report. 2015;64(7):165-70.

[34] Ross RS, Viazov S, Roggendorf M. Risk of hepatitis C transmission from infected medical staff to patients: model-based calculations for surgical settings. Archives of Internal Medicine. 2000;160(15):2313-6.

[35] Uddin M, Islam M, Hossain M, Sarker M, Salimullah A, Begum F, et al. Seroprevalence of Hepatitis C Virus among Health Care Workers. Journal of Dhaka Medical College. 2009;18(1):70-4.

[36] Ha S, Pogany L, Wu J, Gale-Rowe M. Hepatitis C in Canada and the importance of risk-based screening. Canada Communicable Disease Report. 2016;42(3):57.

[37] Insua J, Flaherty M, Silva M. Hepatitis C Virus (HCV) Prevalence and Risk of Unsafe Parenteral Practices in Derqui, Argentine. Gastroenterology & Hepatology. 2017;6(1):00184.

[38] Murad EA, Babiker SM, Gasim GI, Rayis DA, Adam I. Epidemiology of hepatitis B and hepatitis C virus infections in pregnant women in Sana'a, Yemen. BMC pregnancy and childbirth. 2013;13(1):127.

[39] Vazhavandal G, Sasirekha N, Ismail M, Uma A, Subramanian T. Seroprevalence of hepatitis C virus among health care workers of a rural teaching hospital in Tamilnadu. Journal of Evolution of Medical and Dental Sciences. 2014;3(1):32-8.

[40] Alam S, Ahmad N, Khan M, Mustafa G. Seroprevalence of hepatitis C virus infection among health care workers. Journal of Bangladesh College of Physicians and Surgeons. 2007;25(3):126-9.

[41] González R, Soza A, Hernández V, Pérez RM, Álvarez M, Morales A, et al. Incidence and prevalence of hepatitis C virus infection in Chile. Ann Hepatol. 2005;4(2):127-30.

[42] Al-Zubiery T, Alharazi T, Alsumairy H, Al-Zubiery A. Sero-prevalence of Hbs Ag, HCV and HIV Among Blood Donors in Three Blood Bank Centers in Sana'a City: Yemen. Journal of Biotechnology and

Biomedical Science. 2017;1(1):46.

[43] Sultan A, Abdulrahman A, Omar S, Huda S. Short Communication The frequency of hepatitis B and C among blood donors: a hospital-based study in Sana'a, Yemen.

[44] Al Waleedi A, Khader Y. Prevalence of hepatitis B and C infections and associated factors among blood donors in Aden City, Yemen. 2012.

[45] Sy T, Jamal MM. Epidemiology of hepatitis C virus (HCV) infection. International journal of medical sciences. 2006;3(2):41.

[46] Khalil E, Nabehi B, Shamahy H, Saeed W, Musa A, Hassan A. Sero-molecular epidemiology and risk factors of viral hepatitis in Urban Yemen. Int J Virol. 2015;11(3):133-8.