

Original Article

PREVALENT RISK FACTORS OF HCV TRANSMISSION IN HEALTH CARE WORKERS (HCWS) IN PAKISTAN

ASAD ZIA¹, IKRAM ULLAH¹, SHAHID ALI², MUHAMMAD ZIA³, SHILU MATHEW⁴, KANEEZ FATIMA⁵,
ABIDA RAZA^{6*}, ISHTIAQ QADRI^{7*}

¹Department of Biotechnology, Quaid-I-Azam University Islamabad, Pakistan, ²The Biotech Medical Labs and Research Center Islamabad, Pakistan, ³Department of Biotechnology, Faculty of Biological Sciences, Quaid i Azam University Islamabad Pakistan, ⁴Center of Excellence in Genomic Medicine Research, King Abdul Aziz University, Jeddah, Saudi Arabia, ⁵Institute of Infection and Immunity, Lahore, Punjab, Pakistan, ⁶Nuclear Institute of Radiotherapy and Oncology, Islamabad, Pakistan, ⁷King Fahd Medical Research Center, King Abdul Aziz University, Jeddah, Saudi Arabia
Email: ishtiaq80262@yahoo.com

Received: 02 Jun 2015 Revised and Accepted: 08 Aug 2015

ABSTRACT

Objective: To study and analyze the prevalent risk factors of Hepatitis C Virus (HCV) transmission in Health Care Workers (HCWs) in Pakistan

Methods: A literature survey (2005-2012) was conducted from the available literatures to identify the most prominent risk factors and prevalence rate of HCV affected workers in Pakistan. Health care workers include doctors, nurses, paramedical staffs, dispensers, laboratory technicians and pharmacists. The most common risk factors associated with the high incidence rate of HCV in HCWs are lack of well-trained paramedical staff and their non-scientific behavior, improper disposal of hospital waste, lack of sterilization facilities, poor infrastructure, direct exposure to blood and its products and finally needle stick injury.

Results: The mean prevalence of HCV in HCWs is 4.46%±2, with the highest prevalence (6%) in Islamabad and Rawalpindi area.

Conclusion: We recommend for the HCWs to become aware of the possible risks of HCV spread and minimize the complications of hospital care. The government should have to initiate awareness program on HCV infection among health care professionals.

Keywords: HCV, Health care workers, Risk factors.

INTRODUCTION

Hepatitis is a major public health concern around the globe and mainly affects least developed countries including Pakistan. In Pakistan, almost 40% of the total burden of diseases is caused by infectious or transmittable diseases including tuberculosis, diarrhea, immunisable childhood diseases, malaria, HBV, HCV as well as acute respiratory infections [1-3]. According to the medium term development framework (2010) of Pakistan, the increasing threat of injecting drug users pose a major problem when one considers the hidden cases of HIV/AIDS and HCV among the addicted people. HCWs are also among the risk of acquiring transmissible diseases especially HCV. Hepatitis C is a blood borne infection which causes a high human morbidity and mortality both in the general population and health care workers [4, 5].

Occupational exposure to healthcare workers is considered any contact with a material that carries the risk of acquiring an infection, which occurs during the working activities, either in direct contact with patients or with body fluids or tissues [6]. The greatest risk for transmission of HCV, HBV or HIV occurs after a percutaneous injury, such as needle stick injury and cuts with sharp objects [7, 8].

According to Leachy (2011) and WHO (2013), approximately 9% of the global population are infected with HCV, HBV and or HDV worldwide. HBV and HCV globally account for 60% of cirrhosis and 80% of hepatocellular carcinoma (HCC) as well as cause one million deaths each year. Least developed countries share a substantial set of hurdles to continue the epidemic, including insufficient screening, poor medical infrastructures, shortage of healthcare workers, inadequate access to care and treatment [9].

According to Hussain *et al.* (2010), approximately 10 million Pakistani people, from among the 6% of the overall population, are suffering from HCV. About 16,000 HCV infections have occurred worldwide in the year 2000 due to occupational exposure among HCWs [10, 11] of the 35 million people of the worldwide working population, 12% represents the health care workforce. An individual

that provides health care services in a systematic way to individuals, families or communities is called HCW [12]. Health care providers not only work in hospitals but also in academic and research institutions. The size, skills and commitment of the health care workforce greatly affect health services.

Fewer safety precautions and a higher prevalence of infections increase the risk of HCV in the HCWs communities. In Pakistan various health programs are initiated to control the risk of morbidity and mortality. These programs includes; Family Planning and Primary Health Care, HIV/AIDS Control Program, National Programme for Prevention and Control of Blindness, National TB Control Program, Cancer Treatment, Dengue Epidemic and Control Programme, National Maternal and Child Health Program, Malaria Control Program and Drug Abuse [13]. However, there are no such programs have been initiated for the prevention of HCV in Pakistan. Some research studies show that the prevalence of HCV varies between four provinces of Pakistan, and it is reported at 6.7% in Punjab 5% in Sindh, 1.5% in Baluchistan and 1.1% in Khyber Pakhtunkhwa [14]. Hepatitis patients are not registered formally, however hospital based data suggest that every fourth patient in the medical ward has liver related diseases. From the literature, we found that various risk factors are involved in the transmission of HCV in the general population. This literature based on novel study was conducted specifically to identify the rationale the most prevalent risk factors of HCV in the HCW, working in the health care system.

MATERIALS AND METHODS

A literature survey was conducted to identify the most prominent risk factors and prevalence rate from the available literature in Pakistan HCW. Literature was searched in PubMed, Google Scholar and Pak Medina by using the keywords; prevalence of HCV in Pakistan, HCV and HCW in Pakistan, HCV in Pakistan HCW, HCV for Nurses of Pakistan, risk factors of HCV in HCWs. The primary data on the prevalence of HCV in health care worker were identified and reviewed.

Categories of health care workers in Pakistan

In Pakistan, two types of health care systems are functioning, the private sector and the public/government sector. In both the types of system, various categories of health care professionals are involved as showed in fig. 1. All of these health care professional directly or indirectly involved in the transmission of HCV. Various suggestions were found for the prevention of HCV transmission both to and from HCWs. Some of these suggestions were about awareness

of the importance of screening for hepatitis, self-care, and application of appropriate preventive measure during their provision of services, and reduction in the gaps in their knowledge and practice. We also found that doctors and administrative staffs are very less affected by hepatitis virus due to the fact that administrative staffs are not in direct contact with the patients and doctors do preventative measures and preoperative screening of patients for HCV. All the others staffs were found to be at high risk of HCV transmission.

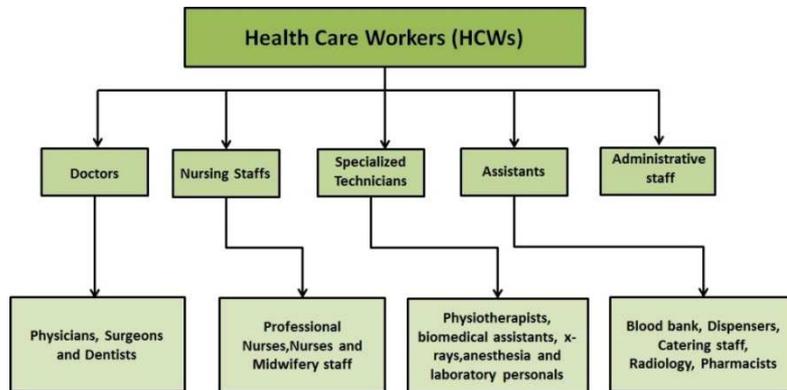


Fig. 1: Flow diagram showing different categories of HCWs, working in Pakistan

RESULTS AND DISCUSSION

Prevalence rate of HCV

The prevalence rate of HCV is shown in the table 1. The prevalence rate of HCV increases day by day due to insufficient control program and unawareness among HCWs and lack of regular blood analysis. A little have been reported about HCV prevalence in HCWs in Pakistan. There are no separate data available on the prevalence of HCV in individual categories of HCWs. However, we have tried to cite the prevalence rate of HCWs reported in literature in different regions of Pakistan as shown in table 1.

Prevalent risk factors in HCWs

HCV is a blood-borne virus that poses a substantial risk to HCWs from occupational exposure to blood and anybody fluid containing HCV in the workplace. The prevalence of HCV infections in HCW is greatly varied from region to region because of different genetics, socioeconomic factors, race, and environmental factors. The increase in seropically of HCV in HCWs is associated with increasing age, number of years in health care occupation; blood transfusion and needle stick injuries [28]. Increasingly frequent use of invasive techniques, application of new therapeutic methods, increase in the number of persons infected with blood-borne diseases (HBV, HCV and HIV), as well as longer survival of infected individuals, all combined keep the occupational exposure of health care providers topical. Needle stick injuries and other percutaneous injuries with sharp objects are the major means of occupational injuries to HCWs [29, 30]. The introduction of multiple procedures minimizes the risk of the hospital based on HCV infection. However, outbreaks are still being observed due to parenteral route, blood transfusions, fluid infusions, injections, and invasive medical and surgical interventions using contaminated specimens and equipment [31]. HCV transmission has also been documented to result from contact with infected health care workers e. g. during surgery [32]. Worldwide there are about 35 million HCWs are available and according to WHO (2003) about 3 million of them experience percutaneous exposures to blood-borne pathogens every year. Among those about 2 million are exposed to HBV, 0.9 million to HCV and 170,000 to HIV. These injuries may result in 15,000 HCV, 70,000 HBV and 1000 HIV infections. Most of these cases (90%) occur in developing countries. HCV poses a serious health problem affecting people from all walks of life in every country but HCWs are at higher risk than the general population. Occupational health and safe medical practice is an arising issue in developing countries like Pakistan, India and

Bangladesh [33]. A study conducted by Releet *al.*, (2002) in Mumbai, observed the incidence of occupational exposure due to infected blood and body fluids was highest among resident doctors (76%), followed by nurses (11%), and interns (5%) [34]. HCWs in Pakistan are summarized in table 2 and are discussed. Various interventions are also suggested for reducing the transmission of blood borne infections among the HCWs in Pakistan. fig. 2 depicts the risk factors to be taken into account for reducing blood-borne infections with the support of education, counseling, and media campaign to educate public, insistence of oral medications, creating positive opportunities for youth and introducing safety precautions.

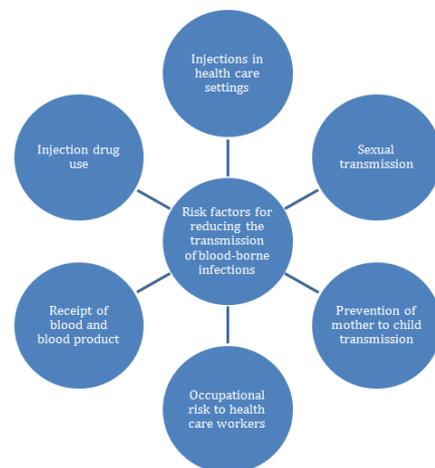


Fig. 2: Suggested interventions for blood-borne infections among HCWs

a) Lack of well-trained paramedical staff and their non-scientific behavior

The prevalence of anti-HCV antibodies in medical staff in developing countries like Pakistan is much higher than those in developed countries due to the lack of knowledge, proper training and standard practices in medical procedure [17]. Physicians, laboratory technicians, nurses and dialysis unit personnel are the main at risk. Nurses are the most risk group because of close contact with the patients [15, 38, 43, 45, 46]. Doctors and other health care professionals are at high risk of acquiring the HCV infection while

handling the patients, during treatment and investigation procedures in ward, medical ICUs, angiography labs, during surgery, renal dialysis, accidental cuts and pricks during surgery with contaminated instruments [47]. Occupational and non-occupational exposure to infected blood is the main mode of infection and risk

factor[20]. In the third world countries, the medical crew lacks knowledge about the transmission hospital acquired infections. These are caused by improper training of staff on healthcare worker management, poor handling of health care waste and poor attitude of staff towards hospital discipline[39, 41].

Table 1: Comparative data taken from literature showing the prevalence rate of HCV in HCWs of neighboring countries

Population	Method of detection	Region	Population size	Frequency	References
Healthcare worker in Pakistan	EIA	Karachi	114	4.4%	[15]
	PCR	AKU Karachi	53	4%	[16]
	ELISA	Civil Hospital Karachi	250	5-6%	[17]
	ELISA	Islamabad Rawalpindi	217	6%	[18]
	ELISA	Abbott bad	125	5.6%	[19]
	Questioner	PIMS Islamabad	383	1.6%	[11]
	ELISA	Rawalpindi	100	6%	[20]
	ELISA	Khyber Pakhtunkhwa	824	4.13%	[20]
Healthcare worker in India (data retrieved from DMRI (Database of Medical Research in India), Google scholar, PubMed,	ELISA	Karachi	1051	2.9%	[21]
	ELISA	Himachal Pradesh	200	0%	[22]
	ELISA	New Delhi	100	4%	[23]
	ELISA	Odisha	30	0%	[24]
	ELISA	New Delhi	376	0.26%	[25]
Bangladesh	ELISA	Karnataka	405	0%	[12]
	ELISA	Dhaka	355	1.4%	[26]
	ICT	Dhaka	1000	0.4%	[27]

ICT; Rapid Immuno chromatography test

Table 2: The most common risk factors associated with the HCV transmission in HCWs in Pakistan

S. No.	Risk factors	Reasons	References
1.	Lack of well-trained paramedical staff and their non-scientific behavior	<ul style="list-style-type: none"> Lack of knowledge and negative attitudes toward blood borne diseases Contact with patients Lacks of knowledge about the transmission of hospital acquired infections Lack of vaccination Poor attitude of staff towards hospital discipline Improper training of staff on healthcare worker management Lack of standard practices in medical procedure Poor hygiene habits of health care workers such as washing hands and instruments in the same washbasin or pouring bodily takedown the toilet 	[11, 35-37]
2.	Improper disposal of Hospital Waste	<ul style="list-style-type: none"> Poor handling of health care waste Lack of system for the disposal of sharp waste Unsafe injection practices 	[15]
3.	Lack of sterilization facilities	<ul style="list-style-type: none"> Inadequate cleaning of equipment Hospitals are not adequately equipped for screening of blood and blood products The use of old, damaged, or prohibited sterilization packaging systems without adequate control An ineffective infection control systems Procedures to prepare equipment for sterilization did not comply with recognized standards 	[38]
4.	Poor Infrastructure	<ul style="list-style-type: none"> Overcrowded govt. hospitals Short staffed and have meager funds to provide medicines and health supplies Ghost workers Poor hospital management Doctors' irresponsible attitude Poor Anti HCV screening facility Transport of contaminated and decontaminated tools 	[39-41]
5.	Direct exposure to blood and its products	<ul style="list-style-type: none"> Skin contact Exposure to contaminated body fluids and trauma by contaminated equipment 	[11]
6.	Needle stick injury	<ul style="list-style-type: none"> During disposal of used syringe, recapping, specimen collection, manipulating a syringe needle bending and Withdrawing blood or during intravenous cannulation. 	[42-44]

b) Improper disposal of hospital waste

In Pakistan, unsafe injection practices are increasing day by day due to increased cost and lack of proper disposal system for sharp waste. Estimated markets of disposable syringes are around 300 million in Pakistan, but there is no proper system for the disposal of waste syringes. Most of the used syringes are discarded in the community sites without decontamination and destruction [15, 43] observe a serious increase of HCV infection in HCWs especially in nurses due to improper disposal of use syringes in a hospital at Lahore. In military hospital at Rawalpindi [20] observed the higher frequency of anti-HCV antibodies in sanitary workers as compare to other healthcare workers. Inadequate cleaning of equipment increases the possibility of hospital acquired HCV transmission [48, 49].

c) Lack of sterilization facilities

Exposure to HCV contaminated blood provides great chances to contaminate surfaces, instrument and environment. The public sector hospitals in Pakistan are not sufficiently equipped for screening, sterilization and standard procedures are not practiced due to over crowdedness of patients [38].

d) Lack of poor infra-structure

In Pakistan health care system is divided in to two types, private and public. Approximately 70% of the population is covered by private sector hospitals and clinics [50]. Different types of health care provisions are provided that range from faith healers to train allopathic physicians.

The public sector comprises different health facilities ranging from Basic Health Units (BHUs) to a tertiary care center. In Pakistan, Primary Health Care (PHC) units comprise both BHUs and rural health centers (RHCs). To achieve the stipulated goals within the health sector, the efficiency of the health system should be increased [51]. Many of day care centers like BHUs and PHCs are just fragile structures without any strict policy, resources and even trained staff [52].

In Pakistan, most of the communities live in urban areas and most of them rely on government hospitals for their medical care, which is overcrowded, short staffed and have meager funds to provide medicines and health supplies. Repeated use of syringes and surgical equipment's without proper sterilization further spread of this deadly viral infection among unsuspected patients. Many times the medical miracles in Pakistan lie in the idea that some patients actually survive their hospital stay. Most of the medical staff is absent for months at a time and have been referred as ghost workers [40]. Saeed and Ibrahim (2005) observed that poor hospital management, doctor's irresponsible attitude and patient's illiteracy and poverty are the main reasons for poor infrastructure.

e) Direct exposure to blood and its products

Transfusion of blood products have been another main route of HCV transmission in Pakistan. Anti-HCV screening facility started in 1994 in few centers of the Pakistan, however, the facility of screening blood through HCV RNA was available at one center in Pakistan from 1991-1997. The main possible reasons for these are lack of resources, poorly trained staff, ill-equipped resources and ineffective screening of blood donors for anti-HCV antibody [53]. The main sources of transmission of hepatitis B and C are the non-implementation of international standards regarding blood transfusion, piercing of nose and ear with unsterilized needles, reuse of needles for injections, injecting drug users, shaving from barbers, tattooing, and use of unsterilized dental and surgical instruments [54].

f) Needle stick injury

Worldwide estimated population of HCW is 35 million people and it represents 12% of the working population. HCW including physicians, nurses, paramedics and laboratory technicians, are especially exposed to injury by sharp instruments in the course of their duty [55, 56]. The most often performed procedures with the risk of injury are: intramuscular or subcutaneous injection, taking blood samples, or during the intravenous cannulation, repeated replacing the cap on an already used needle and collision with someone [44, 57].

Table 3: The precautionary measures and recommendations to be applied

S. No.	Recommendations
1.	Health care workers should be vaccinated at the time of entry in service
2.	For appropriate detection of infection and prevention, health care workers should be screened annually
3.	The availability of auto disable syringe and safety box in the public health care (PHC) facilities
4.	Education on proper method of sterilization and continuous professional development of HCWs is needed
5.	Careful supervision of staff and good management
6.	Health care professionals should use some preventive measures such as double scrubbing time, protective mask, eye protection spectacles and use of double gloves
7.	Effective infection control programme is to be implemented in a health care setting
8.	To minimize the risk of HCV transmission in Health care setting, accurate and detailed advice should be given to HCV positive Health care workers
9.	Further work should be done regarding post-exposure prophylaxis (PEP) to make more and more HCW aware of it who deals with the sharps
10.	Infection control education should be an integral part of the curriculum of all disciplines including medical, dental, nursing and paramedics in both government and private hospitals
11.	Government agencies should have to initiate awareness program on HCV infection among these health care professionals
12.	Additionally, in all health settings, effective infection control measures should be implemented and mandatory reporting of sharp injuries should be organized. It is hoped that with the passage of time knowledge, attitude and practices of HCWs will improve
13.	For safe injection practices surveillance system and awareness program should be initiated in health care workers
14.	The most important preventive action in respect to HBV, HCV and HIV infections is nonspecific pre-exposure prophylaxis
15.	Implementation of a system for detecting, reporting, investigation and control of infections
16.	New procedures, including protection for employees against their own failings, have to be implemented to limit the risk of nosocomial infections
17.	Safety spectacle, mask and goggles should be used to protect eyes and mouth where splashing is possible
18.	control contamination of surfaces by containment and using appropriate decontamination procedures
19.	The premises condition should be upgraded according to quality standards and the outdated equipment required to be replaced
20.	There is an essential need for auditing medical centers and health care workers for compliance
21.	New procedures, including protection for employees against their own failings, have to be implemented to limit the risk of HCV infections
22.	Knowledge on viral hepatitis and its management should be improved
23.	The importance of training of health care personnel which should always be performed for new employees, and periodically for employed nurses, physicians and laboratory technicians, and other clinical personnel, as well as for supporting staff

Most of the HCW in developing a health care system are unaware of the fact that hepatitis C can be transmitted by needle stick injury [33, 58, 59]. Most of the HCW had been exposed to needle stick injury at least 1-5 times in their whole professional life [11, 20]. A study shows that if a HCW has constant skin contact and needle stick accidents, anti-HCV prevalence is higher than that in the healthy population [60, 61]. Workers who sustained percutaneous exposures to blood from patients who are anti-HCV positive have found variable rates of HCV transmission [7, 62]. HCW are more exposed to contaminated body fluids and trauma by contaminated equipment, and they are at higher risk of acquiring and transmitting hepatitis C [16]. There are about 1.5 million units of blood products transfused each year in Pakistan [63]. Data on the safety of this transfusion process are scanty perhaps due to the lack of a system of reporting infectious or non-infectious adverse events [64]. The Center for Disease control and prevention, 2008 (CDC) estimates that two out of every 100 HCW are infected with HCV after a needle stick or a similar type of exposure to HCV positive blood in the workplace [65].

The treatment of HCV with antiviral and interferon is far more expensive than the cost of education and prevention measures. HCWs should take precautionary measures in order to provide better services. Moreover, HCWs should be aware of their own health status and root causes of HCV infection. By taking the precautionary measures given in table 3, the spread of HCV among health care professionals can be affectively control. The recommendation mention in this review is taken from various reviews and research articles that include: Goniewicz *et al.*, 2012; Deuffic-Burban *et al.*, 2011 and Henderson *et al.*, 2010 [28, 44, 66].

ACKNOWLEDGEMENT

The funding of this work was provided by KACST large R & D grant 162-34 to IQ. KF was supported by a research grant from IQ Foundation. Ethical approval was not required for our study as the study does not involve human samples as well as animal models.

ABBREVIATION

Hepatitis C Virus (HCV), Health Care Workers (HCW), Hepatocellular Carcinoma (HCC)

CONFLICT OF INTERESTS

Authors declare no conflict of interest

REFERENCES

1. H AMaKF. Health Care Services and Government Spending in Pakistan. Pakistan Institute of Development Economics; 2007. p. 32.
2. Mathew S, Ali A, Abdel-Hafiz H, Fatima K, Suhail M, Archunan G, *et al.* Biomarkers for virus-induced hepatocellular carcinoma (HCC). *Infect Genet Evol* 2014;26:327-39.
3. Mathew S, Fatima K, Fatmi MQ, Archunan G, Ilyas M, Begum N, *et al.* Computational docking study of p7 Ion channel from HCV genotype 3 and genotype 4 and its interaction with natural compounds. *PLoS One* 2015.10. doi: 10.1371/journal.pone.0126510. [Article in Press]
4. Vinod S WN, Venkatesh V, Tandon R, Singh M, Singh R. Seropositivity rates for Hepatitis B and C viruses in a tertiary care centre of Northern India. *Webmed Central Virology*; 2010. p. 243-7.
5. Fatima K, Mathew S, Suhail M, Ali A, Damanhoury G, Azhar E, *et al.* Docking studies of pakistani HCV NS3 helicase: a possible antiviral drug target. *PLoS One* 2014;9. doi: 10.1371/journal.pone.0106339. [Article in Press]
6. Jagger J DCG, Perry J, Puro V, Ippolito G. Occupational exposure to bloodborne pathogens: epidemiology and prevention. In: *Prevention and control of nosocomial infections*. Edited. RP W. Vol. 65. 4th edn. Philadelphia: Lippincott Williams and Wilkins; 2003.
7. Beltrami EM WIT, Shapiro CN, Chamberland ME. Risk and management of blood-borne infections in health care workers. *Clin Microbiol Rev* 2000;13:385-407.
8. JL G. Management of occupational exposures to blood-borne viruses. *N Engl J Med* 1995;16:444-51.
9. Lemoine M, Nayagam S, Thursz M. Viral hepatitis in resource-limited countries and access to antiviral therapies: current and future challenges. *Future Virol* 2013;8:371-80.
10. Pruss-Ustun A RE, Hutin Y. Estimation of the global burden of disease attributable to contaminated sharps injuries among health-care workers. *Am J Ind Med* 2005;48:482-90.
11. Hussain S PNA, Shams R. Hepatitis B and C prevalence and prevention awareness among health care workers in a tertiary care hospital. *Int J Pathol* 2010;8:6-21.
12. Dodaiah V JK, Javagal S. Seroprevalence of hepatitis B virus and hepatitis C virus in healthcare Workers-AIMS, B G Nagara. *Am J Life Sci* 2013;1:145-9.
13. Pakistan Economic Survey; 2011-12.
14. Umar M BM, Hepatitis C, A Mega Menace. A pakistani perspective. *J Pak Med Stud* 2012;2:68-72.
15. Mujeeb S, A KY, Khanani R. Frequency of parenteral exposure and seroprevalence of HBV, HCV, and HIV among operation room personnel. *J Hosp Infect* 1998;38:133-7.
16. Hamid SS, Farooqui B, Rizvi Q, Sultana T, Siddiqui AA. Risk of transmission and features of hepatitis C after needlestick injuries. *Infect Control Hosp Epidemiol* 1999;20:63-4.
17. Aziz S, Memon A, Tily HI, Rasheed K, Jehangir K, Quraishy MS. Prevalence of HIV, hepatitis B and C amongst health workers of civil hospital karachi. *J Pak Med Assoc* 2002;52:92-4.
18. Khurum M HZ, Butt A UI A, Faheem M. Prevalence of anti-HCV antibodies among health care workers of Rawalpindi and Islamabad. *Rawal Med J* 2003;28:7-11.
19. Sarwar J, Gul N, Idris M, Anis ur R, Farid J, Adeel MY. Seroprevalence of hepatitis B and hepatitis C in health care workers in Abbottabad. *J Ayub Med College Abbottabad* 2008;20:27-9.
20. Khan S, U AS, Ayaz S, Khan SN, Shams S, Ali I, *et al.* Molecular epidemiology of HCV among healthcare workers of khyber pakhtunkhwa. *Virol J* 2011;8:105.
21. Memon A R SK, Memon A, Draz A U, Uzair M, Rauf A, Afsar S. Hepatitis B and C prevalence among the high risks groups of pakistan. A cross sectional study. *Arch Public Health* 2012;70:70-9.
22. Ganju S, Goel A. Prevalence of HBV and HCV infection among health care workers. *Journal of communicable diseases. Lancet* 2000;32:69-71.
23. 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 J Med Res* 2006;123:179-80.
24. Poddar N LPR, Chayani N, Mohanty S, Mallick B, Pattnaik D. Seroprevalence of hepatitis-c virus in blood donors and high risk individuals. *J Evol Med Dent Sci* 2012;1:959-65.
25. Sharma A GR, Bhalla P. Study on prevalence of needle stick injury among health care workers in a tertiary care hospital in New Delhi: a two-year review. *Indian J Public Health* 2012;56:101-3.
26. Alam S AN, Khan M, Mustafa G, Al Mamun A, Mashud G. Seroprevalence of Hepatitis C Virus Infection among health care workers. *J Bangladesh College Physicians Surgeons* 2007;25:126-9.
27. Ghosh DK RSAS, Ghosh CK, Mahmuduzzaman M, Rahman MM, Rahaman A. The prevalence of HCV among Healthcare workers in Dhaka city. *J Shaheed Suhrawardy Med College* 2010;2:12-7.
28. Henderson DK. Managing occupational risks for hepatitis C transmission in the health care setting. *Clin Microbiol Rev* 2003;16:546-68.
29. Sepkowitz KA. Occupationally acquired infections in health care workers. Part I. *Ann Intern Med* 1996;125:826-34.
30. Panlilio AL OJ, Srivastava PU, Jagger J, Cohn RD, Cardo DM. Estimate of the annual number of percutaneous injuries among hospital-based healthcare workers in the United States. *Infection Control Hospital Epidemiol* 2004;25:556-62.
31. Rorat M JT, Szleszkowski L, Gladysz A. Outbreak of hepatitis C among patients admitted to the department of gynecology, obstetrics, and oncology. *Am J Infect Control* 2014;42:7-10.
32. Dawar M, Stuart TL, Sweet LE, Neatby AM, Abbott LP, Andonov AP, *et al.* Canadian hepatitis C look-back investigation to detect transmission from an infected general surgeon. *Can J Infect Dis Med Microbiol* 2010;21:e6-e11.

33. Siddique K MS, Syeda Fizza Tauqir SF, Anwar I, Malik A. Z Knowledge attitude and practices regarding needle stick injuries amongst healthcare providers. *Pak J Surgery* 2008;24:243-8.
34. Rele M, Mathur M, Turbadkar D. Risk of needle stick injuries in health care workers-a report. *Indian J Med Microbiol* 2002;20:206-7.
35. Reis C, Heisler M, Amowitz LL, Moreland RS, Mafeni JO, Anyamele C, et al. Discriminatory attitudes and practices by health workers toward patients with HIV/AIDS in Nigeria. *PLoS Med* 2005;2:e246.
36. Joukar F, Mansour-Ghanaei F, Soati F, Meskinkhoda P. Knowledge levels and attitudes of health care professionals toward patients with hepatitis C infection. *World J Gastroenterol* 2012;18:2238-44.
37. D'Souza RF GM, Alstead E, Osonayo C, Foster GR. Knowledge of chronic hepatitis C among east london primary care physicians following the department of health's educational campaign. *Q J Med* 2004;97:331-6.
38. Ali I SL, Rehman L, Khan N, Iqbal A, Munir I, Rashid F, et al. Prevalence of HCV among the high risk groups in Khyber Pakhtunkhwa. *Virology* 2011;8:296.
39. Janjua NZ HYAS. Inappropriate sharp waste disposal at first level health care facilities in Pakistan. In: *ISQua 24th. International Conference*. Vol. 618. Boston: Boston; 2007.
40. A N: Deficiencies of medical system in Pakistan. *Pak J Med Edu* 2003;1:6-9.
41. Kumar N SR, Ara J. Frequency of hepatitis C virus in the spouses of HCV positive patients and risk factors of the two groups. *J Surg Pak* 2010;9:36-9.
42. Bryant J. Organized systems of care. *Am J Infect Control* 1997;25:363-4.
43. Manzoor I DS, Hashmi NR, Sardar H, Babar MS, Rahman A, Malik M. Needle stick injuries in nurses at tertiary health care facility. *J Ayub Med College Abbottabad* 2010;22:174-8.
44. Goniewicz M W-SA, Niemcewicz M, Witt M, Marciniak-Niemcewicz A, Jarosz MJ. Injuries caused by sharp instruments among healthcare workers-international and Polish perspectives. *Ann Agric Environ Med* 2012;19:523-7.
45. https://www.rcn.org.uk/_data/assets/pdf_file/0019/203374/003_304.pdf. [last accessed on 2015 May 02].
46. Talaat M KA, El-Shoubary W. Occupational exposure to needle sticks injuries and hepatitis B vaccination coverage among health care workers in Egypt. *Am J Infect Control* 2003;31:469-74.
47. Alauddin U KAB, Dar MI, Kashmiri Z U A, Batool A, Khan Q, Sanam Mohammad D. Prevalence of hepatitis B and hepatitis C among cardiac surgery patients in relation to post operative recovery. *Pakistan Heart J* 2007;40:31-7.
48. Monsalve-Castillo F, Gomez-Gamboa L. [Hepatitis C virus. Iatrogenic and nosocomial transmission? *Invest Clin* 2004;45:193-5.
49. Froio N, Nicastrì E, Comandini UV, Cherubini C, Felicioni R, Solmone M, et al. Contamination by hepatitis B and C viruses in the dialysis setting. *Am J Kidney Dis* 2003;42:546-50.
50. Azhar S, Hassali MA, Ibrahim MI, Ahmad M, Masood I, Shafie AA. The role of pharmacists in developing countries: the current scenario in Pakistan. *Hum Resour Health* 2009;7:54.
51. <http://www.heartfile.org/pdf/phpf-GWP.pdf>. [last accessed on 2015 May 02].
52. Jiwani N GR. A silent storm: hepatitis c in pakistan. *J Pak Med Stud* 2011;1:89-91.
53. Akhtar S, Moatter T. Hepatitis C virus infection in polytransfused thalassemic children in Pakistan. *Indian Pediatr* 2004;41:1072-3.
54. Waheed Y SU, Safi SZ, Chaudhry WN, Qadri I. Awareness and risk factors associated with barbers in transmission of hepatitis B and C from Pakistani population: barber's role in viral transmission. *Asian Biomed* 2010;4:435-42.
55. Adams BO, Dal Poz, MR, Shengelia B, Kwankam S, Issakov A, Stilwell B, et al. Health systems performance assessment debates, Methods and Empiricism. In: Edited by Evans CJLMA DB, World Health Organization; 2003.
56. Diallo K, Zurn P, Gupta N, Dal Poz M. Monitoring and evaluation of human resources for health: an international perspective. *Hum Resour Health* 2003;1:3.
57. Habib F KDK, Shan-e-Abbas, Bhatti F, Zafar A. Knowledge and Beliefs among health care workers regarding hepatitis B Infection and needle stick injuries at tertiary Care hospital, Karachi. *J College Physicians Surgeons Pakistan* 2011;21:317-8.
58. Gurubacharya DL MKC, Karki DB. Knowledge, attitude and practices among health care workers on needle-stick injuries. *Kathmandu University Med J* 2003;1:91-4.
59. Mirmomen S, Alavian SM, Hajarizadeh B, Kafaee J, Yektaparast B, Zahedi MJ, et al. Epidemiology of hepatitis B, hepatitis C, and human immunodeficiency virus infections in patients with beta-thalassemia in Iran: a multicenter study. *Arch Iran Med* 2006;9:319-23.
60. Kohler H. The prevalence of hepatitis C in different countries of the ERA/EDTA area. *Nephrol Dial Transplant* 1995;10:468-9.
61. Yazdanpanah Y, Boelle PY, Carrat F, Guiguet M, Abiteboul D, Valleron AJ. Risk of hepatitis C virus transmission to surgeons and nurses from infected patients: model-based estimates in France. *J Hepatol* 1999;30:765-9.
62. Hernandez ME, Bruguera M, Puyuelo T, Barrera JM, Sanchez Tapias JM, Rodes J. Risk of needle-stick injuries in the transmission of hepatitis C virus in hospital personnel. *J Hepatol* 1992;16:56-8.
63. Kassi M, Afghan AK, Khanani MR, Khan IA, Ali SH. Safe blood transfusion practices in blood banks of Karachi, Pakistan. *Transfus Med* 2011;21:57-62.
64. Rahman M JSA. Need for national blood policy to ensure safe blood transfusion. *Pak J Med Sci* 2004;20:81-4.
65. Z HAT. Healthcare Workers and Hepatitis C; 2006.
66. Deuffic-Burban S, Delarocque-Astagneau E, Abiteboul D, Bouvet E, Yazdanpanah Y. Blood-borne viruses in health care workers: prevention and management. *J Clin Virol* 2011;52:4-10.