

## Original Article

# Hepatitis C Infection among Health Care Workers in Aswan: Seroprevalence and Risk Factors

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## Abstract

**Background:** Health care workers (HCWs) wherever they work are at high risk of trapping infectious blood-borne pathogens, including hepatitis C virus (HCV). Epidemiological studies are needed to focus on HCWs' work profiles which represent the major threat to their health.

**Objective(s):** To determine the prevalence and associated risk factors of HCV seropositivity among HCWs in Aswan University Hospital, Aswan city, Egypt.

**Methods:** A cross-sectional study was carried out during the year 2018 on 206 HCWs selected randomly by proportionate allocation. Data were collected through direct interviews and blood samples were obtained for the detection of HCV antibodies by an enzyme-linked immunosorbent assay (ELISA) test.

**Results:** Out of 206 screened HCWs, 14 of them were positive HCV-Ab giving a prevalence of 6.8%. Cleaning workers had the highest proportion of HCV seropositivity. The significant predictors of HCV-Ab seropositive test were infrequent hand washing after blood or body fluid exposure (OR= 5.12), inconsistent use of personal protective equipment (OR= 4.94), prolonged work duration (OR= 3.93), and having a family history of HCV infection (OR= 3.50).

**Conclusion:** The seroprevalence of HCV among HCWs is alarmingly high. In view of our results, adherence to hand-hygiene, proper use of personal protective equipment and regular screening for HCWs should be strongly emphasized.

**Keywords:** Hepatitis C virus; seroprevalence, health care workers; occupational exposure.

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## INTRODUCTION

Hepatitis C virus (HCV) infection is a widespread epidemic crisis and causes several liver disorders, including liver cancer.<sup>(1)</sup> Globally, more than one hundred million individuals have hepatitis C infection.<sup>(2)</sup> Many people with hepatitis C are living in Middle Eastern countries.<sup>(3)</sup> Egypt has the highest rate, where the HCV antibody prevalence rate in 2016 was almost fifteen percent (14.8%)<sup>(4)</sup>; two-thirds of them suffered from persistent hepatitis.<sup>(5)</sup> Of the difficult issues about HCV situation in Egypt is that the epidemic map of HCV including its history, genotype, risk factors, and pattern of care is unique.<sup>(6)</sup>

Health care workers (HCWs) wherever they work are at high risk of infectious blood-borne pathogens including HCV.<sup>(7)</sup> The triggers related to their infection are being in contact with contaminated sharp instruments, injection malpractices, incorrect handling of biological materials,

and insufficient education.<sup>(8)</sup> The number of infected HCWs is often affected by the overall number of HCV infected population. This rate is often high in HCWs living in less developed countries.<sup>(4,7)</sup> Hepatitis C virus infection has a terrible impact on the practice of HCWs.<sup>(8)</sup> Some authors have made efforts to create risk assessment tools that help in the improvement of HCWs routine practices and reduce the reluctance of some HCWs to implement procedures of infection control. Risk assessment of HCV infections for HCWs requires regular monitoring of their workplaces focusing on their work nature, duration, and the time of exposure to the sick persons' blood and other infected materials.<sup>(9)</sup>

Understanding the current situation of HCV problem in Egypt is crucial to achieving the World Hepatitis Alliance target which aimed at the elimination of viral hepatitis by 2030.<sup>(6)</sup> HCV prevention and control should be a national priority issue. Political, health care system and community collaboration must be met.<sup>(6)</sup> The Egyptian

National Committee for the Control of Viral Hepatitis adopted a strategy that could help in the unique battle against HCV prevalence rate. It directs the present and future strategies for HCV screening as well as facing the challenges of HCV prevention to prove that the HCV elimination has come to be a real possibility.<sup>(1)</sup>

A meta-analysis study revealed a significant increase in the prevalence of HCV infection in health care personnel compared to non-health care personnel.<sup>(7)</sup> To investigate HCWs' occupational risk of infection, several epidemiological studies are needed to focus on HCWs' work profiles which represent the major threat to their health. Targeted prevention actions must be based on the detection of work-related problems and this needs to be investigated further.<sup>(7,8)</sup>

The extent of the occupational spread of blood-borne microbes is deficient in Upper Egypt communities. The present study aimed to determine the prevalence and associated risk factors of HCV seropositivity among HCWs in Aswan University Hospital, Aswan city, Egypt.

## METHODS

This cross-sectional study was carried out in Aswan University Hospital, Aswan city, Upper Egypt. The study was carried out from January 2018 through April 2018. It was conducted on HCWs that had worked in the studied hospital for at least one year before the conduction of the study. HCWs are defined as staff members who are potentially exposed to a patient's body fluids and medical sharp instruments during the routine course of work.<sup>(7)</sup> According to 2018 hospital workforce records, HCWs who had been working in the studied hospital at that time included 451 physicians, 758 nurses, 102 technicians, and 140 workers. Senior faculty members were excluded from this study as it was difficult to recruit them.

The sample size was calculated using EPI info statistical package program Version 7.2.01 (CDC, Atlanta, GA, USA). For this cross-sectional study, the expected prevalence of HCV infection among Egyptian HCWs was 16.6%<sup>(10)</sup> and using a margin of error of 1% with a 95% confidence level, the required sample size was 186, which was increased 206 to compensate for non-responses. Health care workers were selected randomly from a prepared list based on the 2018 hospital workforce records considering proportionate allocation to size of each HCWs category.

Participating HCWs were subjected to data collection and blood sampling. Data were collected by a structured interviewing questionnaire which was filled anonymously. The questionnaire covered details about personal, medical and surgical history. We inquired if there was any risky exposure such as direct blood contact, blood transfusions, injury from hepatitis patient, accidental needle prick in the last six months, IV drug use or if the spouse or any other family member were infected by HCV. We took information about hand washing after blood or body fluid exposure and the nature of the use of personal protective

equipment (PPE). We also asked if HCWs had attended any training workshops for educating about their occupational exposure to blood-borne infections.

By adopting an aseptic technique, three ml venous blood sample was collected from each participating HCW in a plain tube having a clot activator. The tubes were identified showing the date of a blood sample collection and a sequential number conforming to questionnaire code. Blood samples were transported to the University Hospital laboratory, where they were centrifuged, and the sera were separated and kept at  $-20^{\circ}\text{C}$  until analyses were done.

Samples were screened for HCV-Ab by third-generation enzyme-linked immunosorbent assay (ELISA) technique (EIAgen HCV-Ab [v.4], Adaltis, Italy). Positive and negative controls were included into each run to confirm the assay. The positive and negative results were based upon the cut-off value described in manufacturer's guidelines. We tested positive samples in duplicate and those reactive in both events were considered positive for HCV-Ab.

*Pilot study:* We carried out a pilot study on a convenient sample of 20 HCWs. Slight modifications occurred and rephrasing was made regarding some work-related risk factors. The pilot sample was not included in this study.

### Statistical analysis

Data were managed using SPSS (Statistical Package for Social Science) program for statistical analysis (version 23). Quantitative data were stated as mean  $\pm$  SD whereas qualitative data were presented as number and percentage. The chi-square test and Fisher's exact test were used to test the association between qualitative variables. Mann-Whitney U test was used to compare the differences between the two groups when the outcome variable is quantitative. A binary logistic regression model was applied to find factors associated with HCV positive test results. *p*-value was considered statistically significant when it is  $\leq 0.05$ .

### Ethical considerations

The study protocol was approved by the Medical Ethics Review Committee in the Faculty of Medicine, Aswan University. The study is in accordance with the Second Declaration of Helsinki and the International Guidelines for Research Ethics. Participation in the study was voluntary and informed written consent was obtained from all participants after revealing the aim and considerations of the study. Anonymity and confidentiality of data were assured and maintained. The study was done under the supervision of the Infection Control Unit.

## RESULTS

The study involved 206 HCWs with an age range of 19 to 55 years and a mean age of  $28.72 \pm 8.34$  years. About 55% were male and 45% were female. Two-thirds of the participated HCWs (65.0%) were never married, and three-quarters of them resided in urban areas (75.7%). Both physicians ( $n= 80$ ) and nurses ( $n= 91$ )

represented 83.0% of the enrolled HCWs. Of the 206 examined HCWs, we detected 14 HCWs as having positive HCV-Ab in serum by ELISA test, giving an overall prevalence of 6.8% (Figure 1). HCV-Ab was higher among cleaning workers (21.7%) than among lab technicians (16.5%), and lowest among physicians (2.5%) (Figure 2). A statistically significant increase in HCV-Ab seropositivity was identified in older age group ( $36.93 \pm 11.7$  vs.  $28.13 \pm 7.74$  years,  $p=0.002$ ). Notably, males and

ever married subjects had a significantly higher prevalence of HCV-Ab than females and those who never married (8.9% vs. 4.3% and 13.9% vs. 3.0%,  $p=0.041$  and  $p<0.001$  respectively).

Prolonged employment duration was significantly associated with HCV-Ab seropositivity. A high prevalence of HCV-Ab was noted in HCWs who had spent over 5 years in their work (Mean  $\pm$  SD=  $13.79 \pm 5.74$  vs  $7.92 \pm 3.48$ ,  $p<0.001$ ) (Table 1).

**Table 1: Distribution of HCV serology results for the HCWs by baseline characteristics**

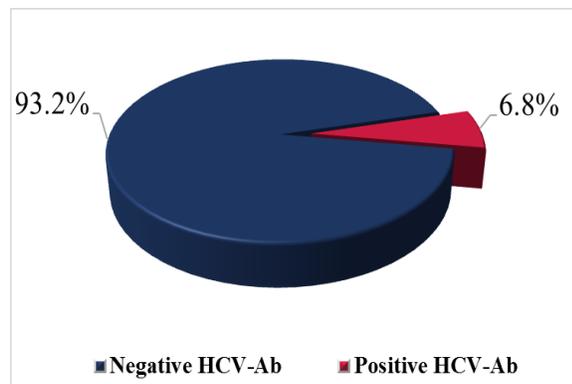
Variable	Negative HCV-Ab (n= 192)		Positive HCV-Ab (n= 14)		p-value
	No.	%	No.	%	
<b>Age (years)</b>					
< 25 years	88	96.7	3	3.3	<b>0.008</b>
25 < 35 year	72	94.7	4	5.3	
$\geq 35$ years	32	82.1	7	17.9	
Mean $\pm$ SD	28.13 $\pm$ 7.74		36.93 $\pm$ 11.75		<b>0.002*</b>
<b>Sex</b>					
Male	102	91.1	10	8.9	<b>0.041*</b>
Female	90	95.7	4	4.3	
<b>Residence</b>					
Urban	145	92.9	11	7.1	0.546*
Rural	47	94	3	6	
<b>Marital status</b>					
Never married	130	97	4	3	<b>0.001*</b>
Ever married	62	86.1	10	13.9	
<b>Place of work</b>					
Surgical departments/ Obstetrics and Gynaecology	73	96	3	4	0.054
ICU & Emergency	36	92.3	3	7.7	
Laboratory	15	78.9	4	21.1	
Internal medicine	31	91.2	3	8.8	
Others $\blacklozenge$	37	97.4	1	2.6	
<b>Working duration (years)</b>					
$\leq 5$ Y	12	100	0	0	<b>0.007</b>
5–10Y	148	95.5	7	4.5	
> 10Y	32	82.1	7	18	
Mean $\pm$ SD	7.92 $\pm$ 3.48		13.79 $\pm$ 5.74		<b>&lt;0.001*</b>

#Chi-square test

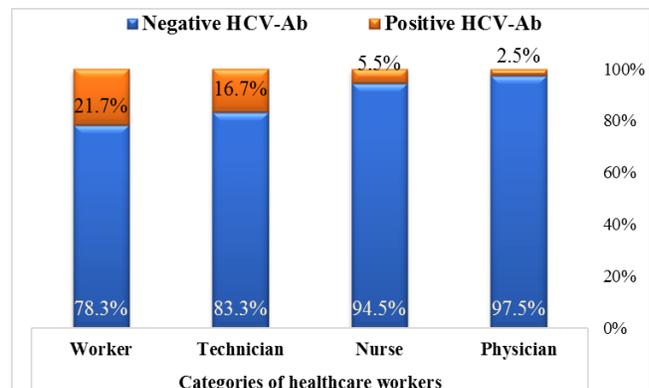
\* p value based on Fisher's Exact Test

•Mann Whitney test

$\blacklozenge$  Others (Pediatrics, Radiology, Ophthalmology and Ear Nose & Throat)



**Figure 1: HCV serology results for the HCWs in Aswan University Hospital, 2018**



**Figure 2: HCV serology results among different categories of the HCWs**

Table (2) showed that most of the seropositive HCWs had positive history of exposure to accidental needle prick injury in the last 6-months, a positive family history of HCV infection, an earlier blood transfusion, or a history of intravenous drug abuse. It also showed a significant association between HCV-Ab seropositive result and infrequent hand washing after blood or body fluid exposure as well as inconsistent using of PPE ( $p= 0.001$  and  $p= 0.009$  respectively). On the other hand, HCV seropositivity was not related to having prior educational training on the prevention of occupational exposure to

blood-borne infections. Table (3) demonstrated the regression analysis of predictors of HCV-Ab seropositivity. Health care workers who did not wash their hands frequently after blood or body fluid exposure neither used PPE consistently had 5 times higher risk of being positive HCV-Ab (OR= 5.12,  $p= 0.022$  and OR= 4.94,  $p= 0.042$  respectively). Further important risk factors for HCV-Ab seropositive result were found among screened HCWs who reported prolonged work durations and a positive family history of HCV infection (OR=3.93,  $p= 0.013$  and OR= 3.50,  $p= 0.011$  respectively).

**Table 2: Distribution of HCV serology results in relation to HCV infection risk factors**

Factors	Negative HCV-Ab (n= 192)		Positive HCV-Ab (n= 14)		p-value#
	No.	%	No.	%	
<b>Direct blood contact in the workplace</b>					
Yes	101	93.6	7	6.4	0.534
No	91	92.9	7	7.1	
<b>History of surgical intervention</b>					
Yes	64	88.9	8	11.1	0.055
No	128	95.5	6	4.5	
<b>History of blood transfusion</b>					
Yes	15	75	5	25	<b>0.006</b>
No	177	95.2	9	4.8	
<b>Injury from hepatitis patient</b>					
Yes	4	2.1	1	7.1	0.299*
No	188	97.9	13	92.9	
<b>Sharing of shaving razors</b>					
Yes	16	8.3	3	21.4	0.126*
No	176	91.7	11	78.6	
<b>Having chronic diseases</b>					
Yes	38	90.5	4	9.5	0.054
No	154	93.9	10	6.1	
<b>History of IV drug use</b>					
Yes	6	66.7	3	33.3	<b>0.017*</b>
No	186	94.4	11	5.6	
<b>Spouse infected with HCV (n=72)</b>					
Yes	3	60	2	40	0.139*
No	59	88.1	8	11.9	
<b>Family history of HCV infection</b>					
Yes	39	88.6	5	11.4	<b>0.002*</b>
No	153	94.4	9	5.6	
<b>Exposure to accidental needle prick in the last 6 months</b>					
Yes	14	77.8	4	28.6	<b>0.006*</b>
No	178	94.7	10	5.3	
<b>Frequent washing hands after blood or body fluid exposure</b>					
Yes	145	96.7	5	3.3	<b>0.001</b>
No	47	83.9	9	16.1	
<b>Consistent use of personal protective equipment</b>					
Yes	134	96.4	5	3.6	<b>0.009</b>
No	58	86.6	9	13.4	
<b>Attending training about infection control measures and occupational safety</b>					
Yes	163	92.1	14	7.9	<b>0.117*</b>
No	29	100	0	0	

#Chi square test

\* $p$  value based on Fisher's Exact Test

^Total number of married =72

**Table 3: Logistic regression analysis of predictors of HCV-Ab seropositivity**

Variable	Adjusted OR	p-value	95.% C.I.	
			LL	UL
Age	1.16	0.821	0.91	1.42
Marital status	3.34	0.294	0.31	31.8
Working duration	3.93	<b>0.013</b>	1.55	11.62
Having chronic disease	1.18	0.844	0.13	9.83
History of blood transfusion	2.08	0.521	0.21	20.4
History of surgical intervention	2.25	0.422	0.31	15.92
History of IV drug addiction	0.84	0.922	0.04	13.34
Exposure to accidental needle prick in last 6 month	2.62	0.411	0.11	4.51
Frequent washing hands after blood or body fluid exposure	5.12	<b>0.022</b>	1.62	24.18
Consistent use of personal protective equipment	4.94	<b>0.042</b>	1.13	26.61
Family history of HCV infection	3.5	<b>0.011</b>	1.7	19.9
<b>*Constant</b>		<b>0.033</b>		

\*R<sup>2</sup>= 0.491

Odds ratio; 1= no risk factor; &lt;1= protective factor; &gt; 1= risk factor

## DISCUSSION

This study reinforces the evidence from other studies that occupational exposure to HCV infection is a dual health problem for medical personals.<sup>(8, 10, 11)</sup> HCWs are more exposed to multiple sources of blood-borne microbes especially with unsafe handling of infected materials. At the same time, HCWs seek medical care during their illness in the same health care facilities which were characterized by poor infection control measures.<sup>(12)</sup>

Occupational exposure to HCV represents forty percent of the total HCV infected cases, and it causes wide-range of physical and psychological burdens to the infected HCWs.<sup>(13)</sup> In this study, among 206 HCWs who were subjected to serological testing, 6.8% had HCV-Ab. Our result complies with the results identified in the other health care settings. Positive HCV-Ab was found in 6.14% of a group of HCWs at a teaching hospital.<sup>(11)</sup> Two studies were conducted in 2013 and 2015 at Ain Shams University Hospital revealed an HCV-Ab prevalence of 7.2%<sup>(14)</sup> and 8.0%<sup>(15)</sup> respectively. A relatively higher prevalence of 16.6% was observed in the Egyptian National Liver Diseases Referral Centre.<sup>(10)</sup> The similarity between the current seroprevalence rate and the preceding seroprevalence rates could be attributed to exposure to similar work environment and educational methods.

Our result lies within the prevalence scope of HCV-Ab among HCWs worldwide which ranged between 0% and 9.7%. It was reported that the prevalence of HCV among HCWs in certain countries is directly proportional to the prevalence of HCV among the overall population of the same country.<sup>(9)</sup> A

systematic review and meta-analysis study was done to estimate the prevalence of HCV infection among HCWs compared to the general population expressed a high prevalence of HCV among health care professionals working in Middle East countries.<sup>(7)</sup> The endemicity of HCV is higher than 3.5% in the Middle East and Northern Africa.<sup>(16)</sup>

The current study revealed that the mean age of positive HCV-Ab studied subjects was significantly more than the mean age of negative HCV-Ab studied subjects. Similar epidemiological studies carried out in Egypt showed that the seroprevalence of HCV increased with increase in age.<sup>(11, 15, 17)</sup>

The authors found a significant increase in the HCV seroprevalence rate among males compare to females. A meta-analysis study aimed to portray the magnitude and trend of HCV infection among healthcare staff between 1989 and 2014 showed that males had nearly twice the risk of being HCV-Ab positive.<sup>(7)</sup> However, the risk of HCV transmission according to sex differences is unclear. Males in general may be more exposed to some blood borne risk factors including drug use and traumatic sex practices respectively than females.<sup>(18)</sup>

Likewise, we found a significant difference regarding serum HCV-Ab in relation to marital status. This could reflect that some couples are sharing the same basic personal tools in their daily life.<sup>(19)</sup>

Considering the occupational categories of HCWs, the current study indicated that HCV-Ab seropositivity was more prevalent among cleaning workers. This result was matching with other studies done in Egypt.<sup>(10, 15, 17)</sup> Cleaning workers are more subjected to HCV and other blood-borne infections

because they constantly handle infected material. Moreover, most of them may have a low-level of education and field training.<sup>(20)</sup>

Some authors found that technicians and nurses were more affected.<sup>(21-23)</sup> This variation may be attributed to differences in the nature and duration of exposure in different settings as well as different sample sizes and population demographics. Participants with an employment duration of more than 10 years had a high proportion of positive HCV-Ab compared to others. This implies that more risk of HCV infection can developed with prolonged exposure time. Duration of the work was a significant determinant for HCV infection in studies conducted in upper Egypt<sup>(17)</sup> and Ethiopia<sup>(24)</sup>. Health care workers are providing care for many infected patients and so the risk of occupational transmission increases with the length of time of exposure.<sup>(8)</sup>

Out of 14 seropositive study subjects, three of them used intravenous drugs. This result agreed with Korean and Iranian studies which reported that HCV infection was more prevalent among injection drug users.<sup>(25, 26)</sup> The sharing of equipment for intravenous use of drugs may lead to transmission of HCV virus.<sup>(27)</sup>

The majority of HCV-Ab negative HCWs washed their hands after exposure to blood or body fluid. This was comparable to the results of Munier *et al.*,<sup>(14)</sup> who declared that hand hygiene is a cost-effective intervention to prevent health care settings infections. It disrupts and reduces the chance of transmission of the microbes between the individuals working in the health sector, patients and the entire community.<sup>(28)</sup> Training of HCWs with the provision of the needed resources and supportive working environment are the best approaches to increase the level of compliance with hand hygiene.<sup>(29)</sup> Adherence to PPE use during work was most common among the HCV-Ab negative study sample. This observation is in contrast to other studies conducted in developing countries, which reported high of non-adherence rates.<sup>(24, 30, 31)</sup> It is worth noting that measuring adherence in our study was based on what the participated HCWs answered, not what was actually observed.

Unexpectedly, all 14 HCV positive HCWs attended the training workshops about infection control measures and occupational safety. In Ethiopia, fewer number of infected HCWs participated in similar training events.<sup>(24)</sup> There are considerable gaps in terms of standard infection control practices and application of infection control policies during health care delivery in Egypt.<sup>(31)</sup> HCWs should have an accurate policy for the notification of their occupational risks.

Together, implementation of infection control guidelines and adopting standard universal precautions while HCWs doing their routine work tasks should be

enforced to help in reducing the occupational risk of acquiring HCV and other blood-borne infections.

The present study has several limitations. The collected information was based on what the enrolled HCWs had said, and no attempt was carried out to examine their actual practices during their working shifts to assess their compliance with the infection control measures.

## CONCLUSION AND RECOMMENDATIONS

The study described an alarmingly high seroprevalence of HCV among included HCWs particularly among cleaning workers. The most important significant predictors of being HCV seropositivity were infrequent washing of hands after exposure to blood or body fluid and inconsistent use of PPE. All HCV-Ab reactive samples should be further checked by PCR to identify current HCV status and to avoid later sequelae of HCV infection.

Adherence to hand-hygiene policy and proper use of PPE should be an authoritative priority in all Egyptian health care settings. The study results urge on the importance of the regular screening of blood-borne infectious diseases for HCWs and providing the proper care for those testing positive.

## CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

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