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Hepatitis C Virus transmission among healthcare workers in Ain Shams University Hospitals, Cairo, Egypt

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Contents

ACRONYMS

ALT : Alanine transaminase
Anti-HCV Ab: Anti Hepatitis C Virus Antibody
ASUHs: Ain Shams University Hospitals
CS : Caesarean section
EDHS: Egypt Demographic and Health Survey
EIA: Enzyme-Linked Immunosorbent Assay
HBsAg: Hepatitis B surface antigen
HBV: Hepatitis B Virus
HCV RNA : Hepatitis C virus Ribonucleic Acid
HCV: Hepatitis C Virus
HCWs: Healthcare workers
ICU: Intensive Care Unit
IM: Intramuscular
IUD: Intra-uterine device
IV: Intravenous
NHTMRI: National Hepatology & Tropical Medicine Research Institute
OBE: Occupational Blood Exposure
OR: Odds ratio
PAT: Parenteral antischistosomal therapy
PCR: Polymerase Chain Reaction
SC: Subcutaneous
VHRL: Viral Hepatitis Research Laboratory

1. INTRODUCTION

Over 170 million people are infected with HCV worldwide[1], and an estimated 2 billion people have been infected by HBV worldwide of which 360 million suffer from chronic infection[2]. The prevalence of HCV in Egypt varies in the literature, ranging from 8.7% to 40% of the population[3,4,5,6] and the prevalence was estimated at 14.7% among 15-59 years old in Egypt Demographic and Health Survey (EDHS) 2008[7]. Healthcare workers (HCWs) are at particular risk of HCV infection and other blood borne pathogens[8] with an estimated 66% of HCV infections among HCWs being attributed to occupational exposures[9].

There are no comprehensive studies on the current prevalence among healthcare workers and associated risk factors for transmission in Egypt. In 2002, a comprehensive national guidelines for control of nosocomial infections was developed and adopted by ministry of health and population in Egypt[10], and in 2008 the Egyptian National Control Strategy for Viral Hepatitis was formulated in which HCWs comprised an important target for future control strategies. Consequently, a surveillance program was initiated in Ain Shams University Hospitals (ASUHs) in 2008 in collaboration between the department of infection control and department of community medicine.

The program included education and prevention against occupational blood exposure (OBE) among healthcare workers (HCWs) of ASUHs. Ain Shams University Hospitals consist of four hospitals of totally 3,200 beds with more than 4,500 staff working in all departments. The hospitals are the internal medicine hospital, obstetrics and gynecology hospital, Pediatrics hospital and Surgery hospital. In addition, there are three specialized centers, mental health center, oncology center and clinical toxicology center. Each year, around 1,300 new interns, both physicians and nurses, are assigned to different departments in ASUHs.

Data from the surveillance programme in ASUHs that were collected in 2008-2010 were used to provide the opportunity to examine the following objectives: To estimate the background seroprevalence of HCV and HBV infection among HCWs of ASUHs, to identify risk factors associated with HCV and HBV infection among HCWs and to estimate HCV incidence among HCWs during an 18-month follow-up period.

2. PARTICIPANTS AND METHODS

2.1 Organization and sampling

The study took place in ASUHs, one of the major tertiary care hospitals in Cairo, with over 3,200 beds and 4,500 employees working in 72 different departments. The study consisted of two parts: Cross-sectional prevalence survey that was conducted between August-October 2008. And a cohort study of a subsample of HCV-negative HCWs that was conducted in two stages each lasting three months between July-September 2009 and February-April 2010, respectively.

At the time of the prevalence survey, 2,300 HCWs were estimated to be available between August and October 2008 for sampling and interview, of which the sample size was calculated. With this number, the precision (calculated as half the 95% confidence interval) around an estimated HCV prevalence of 10% would be ±1.23. For the risk factor study, considering that 10% of HCWs would be infected (i.e., cases), the study would have 80% power to detect ORs of at least (1.53) for the association between exposures and HCV infection, for exposures present among 10% of HCV-negatives under the usual assumptions (alpha = 0.05, two-sided tests). Would for instance only 1500 HCWs be available for analysis, and under the same assumptions, the precision would become ± 1.52 %, and ORs would become statistically different from one only if higher than (1.7).

Recruitment for the first round of follow-up in the cohort study began in July 2009. After exclusion of anti-HCV positive HCWs, a list of participants in the survey was refined to include 1,400 HCWs who were only working in direct contact with patients. Recruitment then stopped at 417 participants in September 2009, of which 15 were erroneously included and thus were excluded in the final analysis.

The second round of follow-up started in February 2010, participants in the first round were contacted for a second sample and a three-month period was allowed for sampling to be aligned with the date of recruitment at follow-up; maintaining six months in-between the two rounds of follow-up. This adds to the twelve months prior to the first sample and thus summing to eighteen months of follow-up since the prevalence survey. By the end of April 2010, 300 HCWs were sampled and the second round of follow-up was completed, with 25% loss-to-follow up (see Annex.1). HCWs who were lost to follow-up either refused to be sampled, or were not reached by the study team due to diverse range of causes, mostly change of work location or incomplete contact details.

2.2 Data collection

After informed consent written in Arabic was obtained by participants at both the survey and follow-up stages, participants were administered a close-ended questionnaire on sociodemographic characteristics and past exposure profiles to community, iatrogenic and occupational risk factors of viral hepatitis transmission. Community risk factors included: injection practices (type of syringe used, route and provider of injection), sharing of tooth brushes and razors, tattooing and shaving at the barber's shop. Iatrogenic factors included detailed past medical history (previous hospital admissions, surgeries, invasive and non-invasive procedures), dental procedures (type, site and provider of procedures), blood transfusion, bilharziasis treatment and obstetric history for current or previously married females (previous delivery or abortion, site and provider of procedures). Occupational factors included pricks or sharp injuries, adherence to infection control practices, exposure to body fluids and/or blood splash and HBV vaccination. Questionnaires of different stages of the study were identical, with slight adjustment of past exposures time scale. Exposure queries were confined to life-time, past year and past six months duration for the survey, first round and second round of follow-up, respectively. In the cross-sectional survey, an infection control nurse was in charge of interviewing participants in different departments with explanation of the study objectives and assisting in questionnaire filling as well as drawing blood samples (10ml). The same procedure was carried out in the follow-up stages with supervision of a medical doctor; all were interns who volunteered to take part in the study (See Annex.2). Prior to commencement of each stage, all involved nurses and doctors were thoroughly trained at the department of community medicine in ASU. Testing for biological markers took place in two labs, the central lab at ASUHs (for samples of the cross-sectional survey) and the Viral Hepatitis Research Laboratory (VHRL) in National Hepatology and Tropical Medicine Research Institute in Cairo (NHTMRI), for samples of the follow-up study. The sampling consisted of drawing (10 ml) of venous blood and transported on the same day for centrifugation and freezing of serum (-70 ℃) at both labs. Serological status was determined according to an algorithm validated locally on Egyptian sera (M. Abdel-Hamid et al). Sera of the survey study were tested in ASUHs central lab for HCV antibodies using Abbott HCV EIA 3.0 (Abbott Laboratories, IL, USA) testing, HBsAg using AUSZYME Monoclonal third generation EIA (Abbot Laboratories, IL, USA) and Alanine transaminase (ALT). Samples positive for HCV antibodies were tested again and those testing positive by the two serological tests were considered positive for HCV antibodies. Samples with discordant results were considered negative. Sera of the follow-up study were tested in

NHTMRI for HCV antibodies using the same technique in ASUHs lab and samples with positive HCV antibodies were tested in for HCV-RNA using a one step in-house reverse transcriptase-PCR assay and ALT. Participants who had positive HCV antibodies were referred by study coordinator to NHTMRI hepatology clinic for further investigations and evaluation. The study protocol was approved by the ethical committees at NHTMRI (Accreditation number: IORG0003280) in 21/01/2008, and received funding from ASU annual research fund.

2.3 Statistical analysis

All data were entered on specially designed data entry module in Microsoft Access 2007 in the department of community medicine at Ain Shams University. Data analysis was performed using STATA statistical package version 11 (Stata corporation, College Station, TX). Estimates of HCV (anti-HCV antibodies) and HBV (HBsAg) prevalence were computed with their 95% confidence interval. Data of population of Greater Cairo was extracted from the DHS survey database, to be used to calculate age standardized prevalence of anti-HCV among HCWs in the survey study with the 95% confidence interval. Estimate of HCV incidence was obtained by dividing the number of new HCV infections by the total number of person-years of follow-up for the entire cohort (for new cases, only half of the person-time of follow-up will be counted). A 95% confidence interval around incidence rate was obtained by assuming a Poisson distribution of cases.

Characteristics of participants with and without HCV antibodies were compared using Student t test for continuous variables and Chi-square test for categorical variables. All exposures were tested for association with anti-HCV positivity in univariate analysis with calculation of odds ratio and 95% confidence interval while adjusting for age. Age adjustment was performed by including age as continuous variable whenever age-adjustment was needed as it had almost perfect linear relation with anti-HCV seropositivity on a logit scale (except for those under 20 years old). Variables with significance level less than 0.25 in the univariate models were entered simultaneously in a multivariate logistic regression model to test associations between significant exposures as well as other factors of interest while controlling for other exposure. Variables were removed one by one from the multivariate model in a stepwise fashion, using a likelihood ratio test at each step and starting by those with highest p values until all variables left in the model have p values less than 0.05.

3. RESULTS

3.1 The Prevalence Survey

3.1.1 Population description

Sociodemographic characteristics of participants in the prevalence survey are shown in Table 1. 2,253 HCWs (50.1% of hospital employees) were screened, of which a total of 1,770 were included in the final analysis after excluding 483 (21.4%) observations due to missing data. The mean (range) age of participants was 34 (16-65) and 74% of participants were females. Over sixty percent of participants were married at the time of survey. Almost half of participants were nurses, 22% were manual workers, while doctors comprised 14% of participants and the remaining were lab technicians and pharmacists. Most hospital departments were screened at the time of survey, with 22% of HCWs in surgical departments and 21% in internal medicine departments, 14% in each of Pediatrics and Emergency-Intensive Care Unit (ICU), 9% in Obstetrics hospital and 7.6% in hospital laboratories, while the remaining 10% worked in other medical or non-medical departments. 21% of participants reported having periodic check-up (Table 2) and 48% (not shown in Table 2) had at least one dose of HBV vaccination.

Table 1 Population description of HCWs in prevalence survey study in ASUHs, 2008

	N (%)
Age (yrs)	
<25	419 (23.7)
25-29	335 (18.9)
30-34	267 (15.1)
35-39	231 (13.1)
40-44	183 (10.3)
45-49	149 (8.4)
50-54	107 (6.1)
≥ 55	79 (4.5)
Gender	
Female	1,303 (73.6)
Male	467 (26.4)
Marrietal Status	
Single	577 (32.6)
Married	1,103 (62.3)
Widow	54 (3.0)
Divorced	34 (1.9)
Missing	2 (0.1)
Occupation	
Doctor	161 (9.1)
House Officer	77 (4.4)
Nurse	835 (47.2)
Manual worker	383 (21.7)
Lab technician	84 (4.8)
Pharmacist	150 (8.5)
Missing	80 (4.5)
Ward name	
Pediatrics	249 (14.1)
Surgery	382 (21.6)
Obstetrics	160 (9.0)
Internal Medicine	363 (20.5)
Other Medical	82 (4.6)
ICU & Emergency	238 (13.5)
Lab	135 (7.6)
Non-medical	88 (4.9)
Missing	73 (4.1)

3.1.2 Hepatitis viruses markers and ALT results

3.1.2.1 Anti-HCV prevalence

The overall crude anti-HCV prevalence was 141/1770=7.9% (95% confidence interval, 6.7%-9.2%). Age standardized seroprevalence of anti-HCV antibodies was 8.06% (95% confidence interval, 6.8%-9.3%) and the prevalence (by age and gender) of the survey study population and that of Greater Cairo (DHS, 2008) are shown in figure 1.

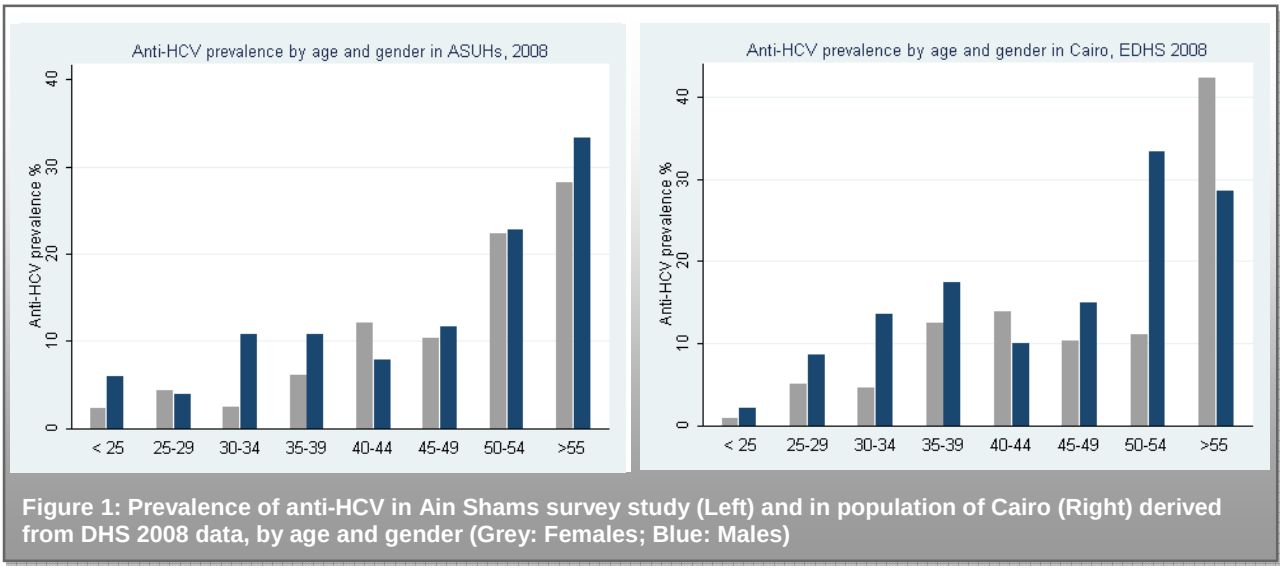


Figure 1: Prevalence of anti-HCV in Ain Shams survey study (Left) and in population of Cairo (Right) derived from DHS 2008 data, by age and gender (Grey: Females; Blue: Males)

The prevalence among the population of greater Cairo was 10.3% (95% confidence interval 7.9-12.7) and males had higher risk compared to females (Figure 1), with significant rise of anti-HCV seroprevalence for those older than 50 years. The same pattern was seen in our study, with male predominance of higher anti-HCV seroprevalence and near doubling of prevalence for those older than 50 years.

3.1.2.2 Hepatitis B surface antigen (HBsAg) prevalence and ALT results

Among HCWs who participated in the prevalence survey, 26/1770=1.5% (95% confidence interval, 0.9%-2.0%) had positive HBsAg testing. The mean ALT level was 18.6 U/L and 92/1770 (5.2%) had levels of ALT above the upper reference limit (41 U/L) which had significant association with anti-HCV seropositivity (P<0.001) with OR: 4.9 (95% confidence interval 2.9-8.1).

3.1.3 Associations between risk factors and Anti-HCV: Univariate analysis

3.1.3.1 Sociodemographic factors

Age had significant association with HCV seropositivity (P<0.001) and had almost perfect linear relation with seropositivity on a logit scale (except for those under 20 years old), thus it was used as a continuous variable whenever age adjustment was needed. Females had 38% lower odds for seropositivity compared to males (Table 2), though the difference was not statistically significant in the univariate analysis. Also, the association between marital status and seropositivity was no longer significant after adjusting for age.

In the age-adjusted univariate analysis, only occupation of participants was found to be significantly associated with seropositivity (P<0.001) with manual workers having the highest (OR:4.9, 95% confidence interval 1.7-13.9).

Table 2 : Anti-HCV prevalence by Sociodemographic Characteristics of HCWs in the survey (n: 1770) with non-adjusted and age adjusted univariate analysis results

	N (%)		Non-adjusted			Age Adjusted		
		HCV positive N(%)	OR	95% CI	*p*	OR	95% CI	*p*
Age (yrs)								
<25	419 (23.7)	12 (2.9)	1	-				
25-29	335 (18.9)	14 (4.2)	1.48	0.67 - 3.24				
30-34	267 (15.1)	15 (5.6)	2.02	0.93 - 4.38				
35-39	231 (13.1)	17 (7.4)	2.69	1.26 - 5.75				
40-44	183 (10.3)	20 (10.9)	4.16	1.99 - 8.71				
45-49	149 (8.4)	16 (10.7)	4.08	1.88 - 8.84				
50-54	107 (6.1)	24 (22.4)	9.81	4.72-20.39	<0.001			
≥ 55	79 (4.5)	23 (29.1)	13.93	6.57-29.54				
Gender								
Female	1,303 (73.6)	96 (7.4)	1	-		1	-	
Male	467 (26.4)	45 (9.6)	1.34	0.92-1.9	0.121	1.38	0.94-2.02	0.098
Marital Status								
Single	577 (32.6)	15 (2.6)	1	-		1	-	
Married	1,103 (62.3)	112 (10.2)	4.23	2.45 - 7.33		1.67	0.89 - 3.14	
Widow	54 (3.0)	11 (20.4)	9.58	4.15 – 22.15	<0.001	1.92	0.72 - 5.13	0.423
Divorced	34 (1.9)	3 (8.8)	3.63	0.99 -13.19		1.37	0.36 - 5.22	
Missing	2 (0.1)							
Marriage duration(yrs)								
Singles	577 (32.6)	15 (2.6)	1	-		1	-	
≤12 years	581 (32.8)	39 (6.7)	2.69	1.47 - 4.95		1.65	0.87 - 3.14	
>12 years	555 (31.4)	84 (15.1)	6.68	3.81 - 11.73	<0.001	1.88	0.87 - 4.06	0.331
Unspecified	57 (3.2)	3 (5.3)	2.08	0.58-7.42		1.11	0.29-4.15	

	N (%)		Non-adjusted			Age Adjusted		
		HCV positive N(%)	OR	95% CI	*p*	OR	95% CI	*p*
Occupation								
Doctor	161 (9.1)	4 (2.5)	1	-		1	-	
House Officer	77 (4.4)	2 (2.6)	1.05	0.19-5.84		2.18	0.38-12.54	
Nurse	835 (47.2)	44 (5.3)	2.18	0.77-6.16		2.36	0.82-6.75	
Manual worker	383 (21.7)	63 (16.5)	7.73	2.76-21.61		4.87	1.71-13.86	
Lab technician	84 (4.8)	10 (11.9)	5.61	1.61-17.47	<0.001	3.86	1.14-13.00	<0.001
Pharmacist	150 (8.5)	10 (6.7)	2.80	0.86-9.14		1.91	0.58-6.32	
Missing	80 (4.5)							
Ward name								
Paediatrics	249 (14.1)	16 (6.4)	1	-		1	-	
Surgery	382 (21.6)	25 (6.6)	1.02	0.53-1.95		1.06	0.54-2.07	
Obstetrics	160 (9.0)	9 (5.6)	0.87	0.37-2.01		0.86	0.36-2.04	
Internal Medicine	363 (20.5)	35 (9.6)	1.56	0.84-2.87		1.84	0.97-3.49	
Other Medical	82 (4.6)	10 (12.2)	2.02	0.88-4.65		1.40	0.59-3.33	
ICU & Emergency	238 (13.5)	20 (8.4)	1.34	0.67-2.64		2.11	1.04-4.31	
Lab	135 (7.6)	10 (7.4)	1.17	0.51-2.64	0.484	1.13	0.49-2.64	0.133
Non-medical	88 (4.9)	6 (6.8)	1.07	0.40-2.81		0.92	0.34-2.47	
Missing	73 (4.1)							
Duration of work								
≤ 1 year	45 (2.5)	1 (2.2)	1	-		1	-	
2-3 years	389 (21.9)	13 (3.3)	1.52	0.19-11.9		2.91	0.36-23.39	
4-10 years	486 (27.5)	26 (5.4)	2.49	0.33-18.76		2.98	0.39-22.82	
More than 10 years	679 (38.4)	85 (12.5)	6.29	0.85-46.29	<0.001	2.91	0.39-21.89	0.669
Missing	171 (9.7)							
Periodic check-up								
No	863 (48.8)	59 (6.8)	1	-		1	-	
Yes	371 (20.9)	38 (10.2)	1.56	1.01-2.38	0.046	1.44	0.93-2.24	0.107
Missing	536 (30.3)							
Site of periodic check-up[◊]								
At work	200 (57.64)	22 (11.0)	1	-		1	-	
External work	147 (42.36)	12 (8.16)	0.72	0.34-1.50	0.381	0.61	0.29-1.30	0.204
Missing	24(6.5)							

[◊]Among those who answered yes to periodic check-up (*n*: 347) [Key: House officer: Medical doctors in training; ICU: Intensive Care Unit]

3.1.3.2 Community risk factors

Almost half of participants reported having more than 10 injections in their lifetime (Table 3); the majority (81%) of them had those injections given by a medical doctor and the main route of administration reported by HCWs was the intramuscular route (84%). Eleven percent (50/467) of males reported sharing of razors, and 80% of them shaved their beards at the barber's shop. Tattooing and cautery were the least reported by HCWs of which percentages were 2.3% and 2.9%, respectively. In the age-adjusted univariate analysis, only using used razors when shaving at the barber's shop was found to be significantly associated with 92% increase of

seropositivity odds (P: 0.03) but this is negligible as only 5 HCWs reported this exposure of which 3 of them had positive anti-HCV (Table 3).

Table 3 : Anti-HCV prevalence by community risk factors of HCWs in the survey (n: 1770) with non-adjusted and age adjusted univariate analysis results

	N (%)		Non-adjusted			Age Adjusted		
		HCV positive N(%)	OR	95% CI	*p*	OR	95% CI	*p*
Lifetime injections								
Never	100 (5.7)	6 (6)	1	-		1	-	
Less than 10 times	547 (30.9)	38 (6.9)	1.17	0.48-2.84		1.13	0.48-2.81	
More than 10 times	820 (46.3)	67 (8.2)	1.39	0.59-3.3		1.06	0.44-2.55	
Regularly	50 (2.8)	7 (14.0)	2.55	0.8-8.04	0.419	1.73	0.53-5.65	0.713
Unknown number	253 (14.3)	23 (9.1)	1.57	0.62-3.97		1.40	0.54- 3.64	
Injections given by‡								
Doctor/Nurse								
No	289 (17.3)	22 (7.6)	1	-		1	-	
Yes	1,345 (80.5)	110 (8.2)	1.08	0.67- 1.74	0.747	0.90	0.58-1.47	0.686
Missing	36 (2.2)							
Pharmacist								
No	1,272 (76.2)	102 (8)	1	-		1	-	
Yes	336 (20.1)	27 (8)	1	0.64-1.56	0.992	1.09	0.69-1.72	0.692
Missing	62 (3.7)							
Midwife/Barber								
No	1 ,550 (92.8)	125 (8.1)	1	-		1	-	
Yes	47 (2.8)	2 (4.3)	0.51	0.12- 2.11	0.301	0.57	0.14-2.41	0.447
Missing	73 (4.4)							
Other Provider								
No	1 ,532 (91.7)	122 (7.9)	1	-		1	-	
Yes	69 (4.1)	5 (7.3)	0.9	0.36-2.29	0.827	0.83	0.32-2.15	0.694
Missing	69 (4.1)							
Route of injection								
Subcutaneous								
No	1,347 (80.7)	106 (7.9)	1	-		1	-	
Yes	239 (14.3)	21 (8.8)	1.13	0.69-1.84		1.01	0.60-1.67	
Don’t know	20 (1.2)	2 (10)	1.3	0.29-5.68	0.849	1.23	0.26-5.79	0.967
Missing	64 (3.8)							
Intramuscular								
No	195 (11.7)	12 (6.2)	1	-		1	-	
Yes	1,413 (84.6)	116 (8.2)	1.36	0.74-2.52		1.29	0.69-2.42	
Don’t know	39 (2.3)	4 (10.3)	1.74	0.53-5.72	0.520	1.38	0.41-4.73	0.699
Missing	23 (1.4)							
Intravenous								
No	459 (27.5)	40 (8.7)	1	-		1	-	
Yes	1,145 (68.6)	92 (8)	0.92	0.62-1.35		0.82	0.55-1.22	
Don’t know	42 (2.5)	3 (7.1)	0.8	0.24-2.72	0.876	0.69	0.19-2.45	0.601
Missing	24 (1.4)							
Sharing practices								
Tooth brush								
No	1,612 (91.1)	126 (7.8)	1	-		1	-	
Yes	158 (8.9)	15 (9.5)	1.24	0.7-2.17	0.468	1.28	0.72-2.29	0.410
Towels								
No	1,004 (56.7)	85 (8.5)	1	-		1	-	
Yes	766 (43.3)	56 (7.3)	0.85	0.6-1.20	0.372	0.98	0.68-1.40	0.893
Razors								
No	1,688 (95.4)	131 (7.8)	1	-		1	-	
Yes	82 (4.6)	10 (12.2)	1.65	0.83-3.27	0.175	1.75	0.86-3.56	0.145

	N (%)		Non-adjusted			Age Adjusted		
		HCV positive N(%)	OR	95% CI	*p*	OR	95% CI	*p*
Nail clippers								
No	1,003 (56.7)	82 (8.2)	1	-		1	-	
Yes	767 (43.3)	59 (7.6)	0.93	0.66-1.32	0.709	1.12	0.78-1.61	0.524
Shaving of beard ○								
No	58 (12.4)	3 (5.2)	1	-		1	-	
Yes	409 (87.6)	42 (10.3)	2.09	0.63-7.00	0.185	1.99	0.59-6.76	0.229
Shaving at barber's shop ♦								
No	81 (19.8)	5 (6.2)	1	-		1	-	
Yes	328 (80.2)	37 (11.3)	1.93	0.73-5.08	0.182	2.28	0.84-6.16	0.103
Barber uses new razors □								
No	5 (1.5)	3 (60.0)	1	-	-	1	-	-
Yes	317 (96.7)	33 (10.4)	0.08	0.01-0.48		0.08	0.01-0.52	
Don't know	6 (1.8)	1 (16.7)	0.13	0.01-2.18	0.027	0.17	0.01-2.9	0.030
Ever had Tattoo								
No	1,730 (97.7)	136 (7.9)	1	-		1	-	
Yes	40 (2.3)	5 (12.5)	1.67	0.65-4.34	0.289	1.76	0.66-4.72	0.262
Ever had Cautery								
No	1,718 (97.1)	136 (7.9)	1	-		1	-	
Yes	52 (2.9)	5 (9.6)	1.24	0.48-3.16	0.664	1.22	0.46-3.21	0.690
Ever had Ear piercing								
No	912 (51.5)	77 (8.4)	1	-		1	-	
Yes	858 (48.5)	64 (7.5)	0.87	0.62-1.23	0.445	0.87	0.61-1.24	0.428

‡ Among HCWs who ever had injections (*n*: 1670) ○ Among males only (*n*: 467) ♦ Among males who shave their beards (*n*: 409) □ Among males who shave their beards at the barber's shop (*n*: 328)

3.1.3.3 Healthcare related (Iatrogenic) risk factors

Fifty-three percent of HCWs had been admitted to a hospital of which 47.8% (450/944) were admitted more than once (Table 4). Most of admissions were for giving birth or surgery. Only 119 (6.7%) HCWs had received blood in their lifetime, though 18 of them could not specify the number of times they received blood. Among different procedures done, sutures and intra-venous catheterization were more reported than other procedures (31%, 27% respectively).

Regarding dental procedures, 341/1770 (19.3%) of HCWs had one or more gingival treatments, 782/1770 (44.2%) had one or more teeth fillings and 1024/1770 (57.9%) had dental local anaesthesia once or more in their lifetime.

One hundred and four (6%) of HCWs had bilharziasis and 27/104 (26%) of them reported having Parenteral antischistosomal therapy (PAT).

As to Obstetric history, 78% of married or previously married females had previous delivery which was normal or caesarean section in 56%, 30% respectively. Instrumentation in delivery was uncommon, with 7.6% of females who reported previous ventouse application. As for

contraceptive methods, 62% of females had intra-uterine device (IUD), 16% had injections and 7% had sub-cutaneous capsules. Dilatation and curettage was reported by 19.3% of females.

In the age-adjusted univariate analysis, only history of Bilharziases and PAT were strongly associated with anti-HCV seropositivity. Specifically, receiving PAT had 6-fold increased odds of HCV infection (95% confidence interval, 2.6-13.9). Previous blood transfusion was associated with seropositivity (P: 0.068). Previous tissue biopsy was inversely associated with seropositivity (OR: 0.32) and this finding was marginally significant after adjusting for age (P: 0.06).

Table 4 Anti-HCV prevalence by iatrogenic risk factors of HCWs in the survey (n: 1770) with non-adjusted and age adjusted univariate analysis results

	N (%)		Non-adjusted			Age Adjusted		
		HCV positive N(%)	OR	95% CI	*p*	OR	95% CI	*p*
Ever admitted to hospital								
No	826 (46.7)	53 (6.4)	1	-		1	-	
Yes	944 (53.3)	88 (9.3)	1.49	1.05 - 2.14	0.023	1.08	0.75-1.57	0.673
Number of admissions								
Never	820 (46.3)	53 (6.5)	1	-		1	-	
Once	353 (19.9)	30 (8.5)	1.34	0.84 - 2.14		1.12	0.69-1.81	
More than Once	450 (25.4)	45 (10.0)	1.61	1.06 - 2.44	0.140	1.07	0.69-1.66	0.948
Don't know	141 (7.9)	13 (9.2)	1.47	0.78 - 2.77		0.94	0.48-1.82	
Missing	6 (0.3)							
Reasons of admission†								
Treatment/Investigations								
No	1,467 (82 .9)	115 (7.8)	1	-		1	-	
Yes	303 (17.1)	26 (8.6)	1.1	0.71 - 1.72	0.667	0.88	0.55-1.39	0.588
Surgery								
No	1,207 (68.2)	89 (7.4)	1	-		1	-	
Yes	563 (31.8)	52 (9.24	1.28	0.89 - 1.83	0.183	0.98	0.68-1.43	0.931
Giving birth•								
No	532 (61.9)	59 (11.1)	1	-		1	-	
Yes	322 (37.4)	28 (8.7)	0.77	0.48 - 1.23	0.265	0.87	0.54-1.42	0.590
Missing	6 (0.7)							
Ever received blood								
No	1,651 (93.3)	123 (7.5)	1	-		1	-	
Yes	119 (6.7)	18 (15.1)	2.21	1.29-3.78	0.004	1.45	0.83-2.53	0.196
Number of times								
Never	1,651 (93.3)	123 (7.5)	1	-	-	1	-	-
Once	71 (4.0)	8 (11.3)	1.58	0.74-3.37		1.03	0.47-2.26	
More than once	30 (1.6)	4 (13.3)	1.91	0.66-5.56		1.12	0.37-3.38	
Unknown number	18 (1.0)	6 (33.3)	6.21	2.29-16.83	0.007	4.77	1.06-13.59	0.068
Lifetime number of surgeries								
Never	283 (15.9)	23 (8.1)	1	-		1	-	
Once	489 (27.6)	34 (6.9)	0.84	0.49 - 1.47	0.420	0.75	0.42-1.32	0.499
More than once	541 (30.6)	50 (9.2)	1.15	0.69 - 1.93		0.69	0.39-1.19	
Don't know	20 (1.13)	3 (15.0)	1.99	0.54 - 7.31		1.32	0.33-5.33	
Missing	437 (24.7)							
Tissue biopsy								
No	1 ,692 (95.6)	138 (8.2)	1	-		1	-	
Yes	78 (4.4)	3 (3.9)	0.45	0.14 - 1.45	0.131	0.32	0.09-1.05	0.060
Urinary Catheter								
No	1 ,571 (88.8)	91 (7.0)	1	-		1	-	
Yes	199 (11.2)	18 (9.0)	1.17	0.69 - 1.97	0.558	0.84	0.49-1.43	0.509

	N (%)		Non-adjusted			Age Adjusted		
		HCV positive N(%)	OR	95% CI	*p*	OR	95% CI	*p*
Intravenous catheter								
No	1 ,296 (73.2)	91 (7.0)	1	-		1	-	
Yes	474 (26.8)	50 (10.6)	1.56	1.09 - 2.24	0.016	1.39	0.95-2.01	0.087
Suture								
No	1,215 (68.6)	98 (8.0)	1	-		1	-	
Yes	555 (31.4)	43 (7.8)	0.96	0.66-1.39	0.819	0.34	0.56-1.22	0.343
Abscess drainage								
No	1 ,595 (90.1)	127 (7.9)	1	-		1	-	
Yes	175 (9.9)	14 (8.0)	1.01	0.57-1.79	0.986	0.91	0.5-1.64	0.758
Laparoscopy								
No	1 ,726 (97.5)	137 (7.9)	1	-		1	-	
Yes	44 (2.5)	4 (9.1)	1.16	0.4-3.29	0.780	0.88	0.3- 2.55	0.807
Gastrointestinal endoscopy								
No	1 ,717 (97.0)	138 (8.0)	1	-		1	-	
Yes	53 (2.9)	3 (5.7)	0.69	0.2-2.23	0.509	0.57	0.17-1.89	0.322
Other endoscopy								
No	1 ,741 (98.4)	137 (7.9)	1	-		1	-	
Yes	29 (1.64)	4 (13.79)	1.87	0.64-5.46	0.285	1.46	0.49-4.38	0.519
Varicies injection								
No	1 ,766 (99.8)	140 (7 .9)	1	-		1	-	
Yes	4 (0.2)	1 (0.3)	3.87	0.4-37.46	0.303	2.52	0.23-27.22	0.478
Cardiac cathetarization								
No	1,759 (99.4)	139 (7.9)	1	-		1	-	
Yes	11 (0.6)	2(18.2)	2.59	0.55-12.1	0.274	1.28	0.26-6.27	0.767
Haemodialysis								
No	1,758 (99.3)	139 (7.9)	1	-		1	-	
Yes	12 (0.7)	2 (16.7)	2.33	0.51-10.74	0.278	1.11	0.23-5.42	0.894
Contrast Radiography								
No	1 ,684 (95.1)	133 (7.9)	1	-		1	-	
Yes	86 (4.9)	8 (9.3)	1.19	0.57- 2.53	0.647	0.84	0.39-1.81	0.655
Accupuncture								
No	1 ,711 (96.7)	140 (8.2)	1	-		1	-	
Yes	59 (3.3)	1 (1.7)	0.19	0.03-1.41	0.105	0.19	0.03-1.38	0.101
Cupping therapy								
No	1 ,745 (98.6)	139 (7.9)	1	-		1	-	
Yes	25 (1.4)	2 (8.0)	1.004	0.23-4.31	0.995	0.91	0.21-4	0.901
Dental procedures								
Gengiva treatment								
Never	1,429 (80.7)	108 (7.6)	1	-		1	-	
Once	208 (11.8)	20 (9.6)	1.3	0.79-2.15		1.29	0.77-2.18	
More than once	133 (7.5)	13 (9.8)	1.33	0.72-2.43	0.446	0.97	0.52-1.82	0.613
Teeth Fillings								
Never	988 (55.8)	81 (8.2)	1	-		1	-	
Once	387 (21.9)	33 (8.5)	1.04	0.68-1.59		1.11	0.72-1.71	
More than once	395 (22.3)	27 (6.8)	0.82	0.52-1.29	0.62	0.68	0.43-1.09	0.161
Teeth extraction								
Never	685 (38.7)	42 (6.1)	1	-		1	-	
Once	491 (27.7)	44 (8.9)	1.51	0.97-2.34		1.23	0.78-1.93	
More than once	594 (33.6)	55 (9.3)	1.56	1.03-2.37	0.069	0.95	0.61-1.49	0.487
Dental local anaesthesia								
Never	746 (42.2)	55 (7.4)	1	-	-	1	-	-
Once	455 (25.7)	40 (8.8)	1.21	0.79-1.85		1.18	0.76-1.82	
More than once	569 (32.2)	46 (8.1)	1.11	0.74-1.66	0.675	0.77	0.5-1.18	0.183
Site of dental procedure								
Hospital								
Never	411 (23.2)	26 (6.3)	1	-	-	1	-	-
Once	475 (26.8)	51 (10.7)	1.78	1.09-2.91		1.37	0.82-2.27	
More than once	353 (19.9)	38 (10.8)	1.79	1.06-3	0.034	1.03	0.59-1.79	0.352
Missing	531 (30.0)							

	N (%)		Non-adjusted			Age Adjusted		
		HCV positive N(%)	OR	95% CI	*p*	OR	95% CI	*p*
Clinic								
Never	407 (22.9)	27 (6.6)	1	-		1	-	
Once	365 (20.6)	26 (7.1)	1.08	0.62-1.89	0.933	0.94	0.53-1.67	0.509
More than once	341 (19.3)	22 (6.5)	0.97	0.54-1.73		0.71	0.39-1.31	
Missing	657 (37.1)							
Ever had Bilharziasis								
No	1,615 (91.2)	109 (6.8)	1	-		1	-	
Yes	104 (5.9)	26 (25.0)	4.61	2.84-7.48	<0.001	3.59	2.16-5.98	<0.001
Don't know	51(2.9)	6 (11.8)	1.84	0.77-4.41		2.89	1.17-7.14	
Bilharziasis Treatment								
No	1,629 (92)	113 (6.9)	1	-		1	-	
Tablets	63 (3.6)	11 (17.5)	2.84	1.44-5.59		3.02	1.5-6.06	
Injections±Tablets	27 (1.5)	13 (48.2)	12.45	5.72-27.14	<0.001	6.03	2.62-13.87	<0.001
Don't know	51 (2.9)	4 (7.8)	1.14	0.4-3.23		1.51	0.52-4.39	
Obstetric history•								
Ever delivery								
No	61 (7.1)	4 (6.6)	1	-		1	-	
Yes	674 (78.4)	75 (11.1)	1.78	0.63-5.06	0.241	1.33	0.46-3.88	0.585
Missing	125 (14.5)							
Ever abortion								
No	215 (25)	14 (6.5)	1	-		1	-	
Yes	214 (24.9)	29 (13.6)	2.25	1.15-4.39	0.014	1.62	0.81-3.26	0.176
Missing	431 (50.1)							
Ever ventouse								
No	213 (24.8)	19 (8.9)	1	-		1	-	
Yes	65 (7.6)	7 (10.8)	1.23	0.49-3.08	0.659	1.39	0.52-3.68	0.516
Missing	582 (67.7)							
Ever Caesarean section								
No	163 (18.9)	14 (8.6)	1	-		1	-	
Yes	252 (29.3)	23 (9.1)	1.07	0.53-2.14	0.851	1.44	0.69-3.04	0.328
Missing	445 (51.8)							
Sutures after delivery								
No	140 (16.3)	13 (9.3)	1	-		1	-	
Yes	302 (35.1)	29 (9.6)	1.04	0.52-2.06	0.916	1.29	0.63-2.68	0.481
Missing	418 (48.6)							
Normal labour								
No	69 (8.0)	6 (8.7)	1	-		1	-	
Yes	481 (55.9)	56 (11.6)	1.38	0.57-3.34	0.455	1.05	0.42-2.62	0.913
Missing	310 (36)							
Contraception								
Intra-uterine device								
No	125 (14.6)	8 (6.4)	1	-		1	-	
Yes	531 (61.7)	63 (11.9)	1.97	0.92-4.22	0.082	1.88	0.86-4.12	0.115
Missing	204 (23.7)							
Injections								
No	248 (28.8)	21 (8.5)	1	-		1	-	
Yes	135 (15.7)	14 (10.4)	1.25	0.61-2.55	0.540	1.53	0.71-3.28	0.279
Missing	477 (55.5)							
Sub-cutaneous capsule								
No	270 (31.4)	22 (8.2)	1	-		1	-	
Yes	60 (7.0)	7 (11.67)	1.49	0.6-3.67	0.386	1.9	0.71-5.07	0.199
Missing	530 (61.6)							
Gynaecological procedures								
Cautery								
No	296 (34.4)	26 (8.8)	1	-		1	-	
Yes	51 (5.9)	4 (7.84)	0.88	0.29-2.65	0.823	0.83	0.26-2.68	0.758
Missing	513 (59.7)							

	N (%)		Non-adjusted			Age Adjusted		
		HCV positive N(%)	OR	95% CI	*p*	OR	95% CI	*p*
Dilatation and curettage								
No	251 (29.2)	18 (7.2)	1	-		1	-	
Yes	166 (19.3)	19 (11.5)	1.67	0.85-3.29	0.137	1.33	0.65-2.73	0.432
Missing	443 (51.5)							

† Each HCW might have more than one reason for previous hospital admissions

• Among married or previously married females (*n:* 860).

3.1.3.4 Occupational exposures

Exposure to prick injuries by syringes was not uncommon, reported by 67% of HCWs screened and more than half of all HCWs reported having at least one prick injury per month. Fifty-five percent of HCWs were not sure about the frequency of having been pricked without gloves and a similar proportion did not know how many times they had tears in their gloves (Table 5). Most HCWs reported exposure to body fluids in form of blood (89%), and to lesser extent they reported exposure to Urine, Sputum, Pus, ascitis and cerebrospinal fluid.

Prior to age-adjustment, wearing gloves at work reduced the risk of infection by 40% (95% confidence interval, 0.38-1.01), and exposure to prick injuries during taking blood samples was found to be inversely associated with seropositivity (P <0.001). However, in the age-adjusted univariate analysis, none of the occupational exposures were significantly associated with seropositivity.

Two variables in the occupational exposures (Prick injury during taking blood sample and exposure to body fluids in the form of blood) had levels of significance less than 0.25 in the age adjusted univariate analysis, yet they were not fitted in the multivariate model due to high proportion of missing values (more than 20%).

Table 5 Anti-HCV prevalence by occupational risk factors of HCWs in the survey (n: 1770) with non-adjusted and age adjusted univariate analysis results

	N (%)		Non-adjusted			Age Adjusted		
		HCV positive N(%)	OR	95% CI	*p*	OR	95% CI	*p*
Occupational Exposures								
Exposure to prick injury								
By Syringe								
No	564 (31.9)	51 (9.0)	1	-		1	-	
Yes	1,188 (67.1)	86 (7.2)	0.78	0.55-1.13	0.194	1.02	0.69-1.48	0.929
Missing	18 (1.0)							
By Sharps								
No	733 (41.4)	62 (8.5)	1	-		1	-	
Yes	358 (20.2)	24 (6.7)	0.78	0.48-1.27	0.314	0.99	0.6-1.66	0.995
Missing	679 (38.4)							

	N (%)		Non-adjusted			Age Adjusted		
		HCV positive N(%)	OR	95% CI	*p*	OR	95% CI	*p*
Number of pricks per month								
No pricks	487 (27.5)	46 (9.5)	1	-		1	-	
Once or less	675 (38.1)	47 (6.9)	0.72	0.47-1.09		1.03	0.66-1.60	
More than once	365 (20.6)	24 (6.6)	0.67	0.40-1.13	0.317	0.93	0.55-1.59	0.955
Don't know	119 (6.7)	11 (9.2)	0.98	0.49-1.95		0.86	0.42-1.76	
Missing	124 (7.0)							
Number of pricks since starting work								
No pricks	512 (28.9)	46 (8.9)	1	-		1	-	
1-3 times	587 (33.2)	39 (6.6)	0.72	0.46-1.12		1.09	0.68-1.74	
≥4 times	266 (15)	21 (7.9)	0.87	0.51-1.49		1.09	0.62-1.91	
Don't know	218 (12.3)	15 (6.9)	0.75	0.41-1.37	0.505	0.81	0.43-1.51	0.813
Missing	187 (10.6)							
Exposure during								
Taking blood sample								
No	721 (40.8)	69 (9.6)	1	-		1	-	
Yes	584 (32.9)	24 (4.1)	0.4	0.25-0.65	<0.001	0.68	0.41-1.13	0.135
Missing	465 (26.3)							
Surgery								
No	829 (46.8)	74 (8.9)	1	-		1	-	
Yes	225 (12.7)	11 (4.9)	0.52	0.27-1.01	0.052	0.71	0.36-1.4	0.329
Missing	716 (40.5)							
Blood transfusion								
No	885 (50.1)	76 (8.6)	1	-		1	-	
Yes	71 (4.0)	4 (5.6)	0.64	0.23-1.79	0.391	0.95	0.33-2.78	0.927
Missing	814 (45.9)							
Giving injection								
No	723 (41)	65 (8.9)	1	-		1	-	
Yes	518 (29.2)	25 (4.8)	0.5	0.32-0.83	0.006	0.86	0.52-1.42	0.552
Missing	529 (29.8)							
In lab								
No	856 (48.4)	73 (8.5)	1	-		1	-	
Yes	152 (8.6)	9 (5.9)	0.68	0.33-1.38	0.281	0.75	0.36-1.57	0.444
Missing	762 (43.0)							
Wearing gloves at work								
No	206 (11.6)	22 (10.7)	1	-		1	-	
Yes	1,348 (76.2)	93 (6.9)	0.62	0.38-1.01	0.056	0.95	0.57-1.58	0.845
Missing	216 (12.2)							
Tear of gloves at work▶								
No	139 (10.3)	9 (6.5)	1	-		1	-	
Yes	1,120 (83.1)	81 (7.2)	1.13	0.55-2.29	0.744	1.23	0.59-2.55	0.580
Missing	89 (6.60)							
Number of times▲								
Never	88 (7.9)	4 (4.6)	1	-		1	-	
1-3 times	290 (25.9)	20 (6.9)	1.56	0.52-4.68		1.87	0.61-5.77	
More than 3 times	108 (9.7)	6 (5.6)	1.24	0.34-4.52	0.528	1.46	0.39-5.47	0.663
Don't know	634 (56.6)	51 (8.1)	1.84	0.65-5.21		1.77	0.61-5.13	
Ever had pricks without gloves								
No	664 (37.5)	62 (9.3)	1	-		1	-	
Yes	879 (49.7)	58 (6.6)	0.69	0.47-0.99	0.048	0.86	0.58-1.27	0.454
Missing	227 (12.8)							
How many times◀								
Once	140 (15.9)	11 (7.9)	1	-		1	-	
Twice	92 (10.5)	5 (5.4)	0.67	0.23-2.01		0.55	0.18-1.72	
>2	160 (18.2)	8 (5.0)	0.62	0.24-1.58		0.52	0.19-1.37	
Don't know	487 (55.4)	34 (6.9)	0.88	0.44-1.79	0.708	0.61	0.29-1.28	0.536

	N (%)		Non-adjusted			Age Adjusted		
		HCV positive N(%)	OR	95% CI	*p*	OR	95% CI	*p*
Exposure to fluids								
No	320 (18)	25 (7.8)	1	-		1	-	
Yes	1,166 (65.9)	80 (6.9)	0.87	0.54-1.39	0.557	1.05	0.65-1.69	0.854
Missing	284 (16.1)							

‣ Among those who wear gloves at work (*n*: 1348), ▲ Among those who wear gloves at work and had tears in their gloves (*n*: 1,120), ◂ Among those who were exposed to prick injuries without gloves (*n*: 879)

3.1.4 Multivariate logistic Regression Results

Variables that had level of significance below 0.25 in the age-adjusted univariate analysis were fitted in a multivariate logistic regression model (Table 6).

Periodic check-up had acceptable significance after age-adjustment (P: 0.107) to be fitted in the multivariate model, yet it was excluded due to the apparent increase in odds of seropositivity in those who had periodic check-up (OR: 1.4, 95% confidence interval 0.9-2.2). This could be misleading since HCWs who contracted HCV infection will consequently have periodic check-up as part of their management and thus this variable is not causally linked to seropositivity. Reporting of shaving with used razors at the barber's shop was also excluded due to lack of power as only 5 HCWs (three of them were anti-HCV positive) reported this observation. Reporting having previous tissue biopsy was not included in the multivariate model due to non plausibility of association (OR: 0.32). The association between seropositivity and exposure to prick injuries during taking blood samples was also excluded due to non plausibility (OR: 0.68) and high proportion of missing values (26%). The latter cause also applies to number of variables excluded from the multivariate model; these are exposure to body fluids in the form of blood. In females, previous abortion or contraceptive use (IUD, SC capsules) were not included due to many missing values. Ever having Bilharziasis was not included in the model though the high level of significance (P<0.001) which was shown in the age-adjusted univariate model, due to high collinearity with treatment of Bilharziasis.

Variables that were included in the multivariate analysis are shown in Table 6. While adjusting for all variables in the model, and by forcing gender in the model, variables that were found to be independently associated with ant-HCV positive testing are: Age, with an OR of 2.01 for increase of 10 years of age (P<0.001); HCWs who received unknown number of blood transfusions with an odds of 5.85 (P: 0.001, 95% confidence interval 2.02-16.93), treatment of Bilharziasis with PAT showing the highest OR in the model (6.34) and <0.001 level of significance (95% confidence interval 2.61-15.40) and also those who received tablets for

treatment with 2.9-fold increase in odds (95% confidence interval 1.37-6.16), and finally being a manual worker with OR of 4.28 (95% confidence interval 1.48-12.37).

Table 6 Multivariate analysis of independent associations with anti-HCV seropositivity

Variable	Age adjusted Univariate analysis			Multivariate analysis (Results of final model)			
	OR	95% CI	P	OR	95% CI	P	
Age per year	1.07	1.06- 1.09	<0.001	1.07	1.05- 1.09	<0.001	
Gender*							
Female	1	-		1	-	-	
Male	1.38	0.94-2.02	0.098	1.01	0.62-1.64	0.972	
Occupation							
Doctor	1	-		1	-	-	
House Officer	2.18	0.38-12.54		2.09	0.36-12.20	0.409	
Nurse	2.36	0.82-6.75		2.32	0.79-6.83	0.127	
Manual worker	4.87	1.71-13.86		4.28	1.48-12.37	0.007	0.006
Lab technician	3.86	1.14-13.00		3.05	0.86-10.75	0.083	
Pharmacist	1.91	0.58-6.32	<0.001	1.67	0.49-5.65	0.412	
Ever received blood							
Never	1	-		1	-	-	
Once	1.03	0.47-2.26		1.04	0.45-2.39	0.935	
More than once	1.12	0.37-3.38		1.22	0.39-3.82	0.738	0.033
Unknown number	4.77	1.06-13.59	0.068	5.85	2.02-16.93	0.001	
Treatment of Bilharziasis							
No	1	-		1	-	-	
Tablets	3.02	1.5-6.06		2.90	1.37-6.16	0.006	
Injections±Tablets	6.03	2.62-13.87		6.34	2.61-15.40	<0.001	<0.001
Don't know	1.51	0.52-4.39	<0.001	1.67	0.56-4.93	0.355	
Wards							
Paediatrics	1	-					
Surgery	1.06	0.54-2.07					
Obstetrics	0.86	0.36-2.04					
Internal Medicine	1.84	0.97-3.49					
Other Medical	1.40	0.59-3.33					
ICU & Emergency	2.11	1.04-4.31					
Lab	1.13	0.49-2.64					
Non-medical	0.92	0.34-2.47	0.133				
Sharing of razors							
No	1	-					
Yes	1.75	0.86-3.56	0.145				
Shaving at barber's†							
No	1	-					
Yes	2.28	0.84-6.16	0.103				
Intravenous catheterization							
No	1	-					
Yes	1.39	0.95-2.01	0.087				
Teeth fillings							
Never	1	-					
Once	1.11	0.72-1.71					
More than once	0.68	0.43-1.09	0.161				
Dental local anaesthesia							
Never	1	-					
Once	1.18	0.76-1.82					
More than once	0.77	0.5-1.18	0.183				

*Gender was forced in the multivariate model. † Females are included in the non-exposed reference category in the multivariate analysis.

3.2 The Cohort Study

3.2.1 Population Description

Table 7 Population description of HCWs in cohort study in ASUHs, 2009/2010

	N (%)
Age (yrs)	
<25	66 (16.4)
25-29	55 (13.7)
30-34	72 (17.9)
35-39	73 (18.2)
40-44	59 (14.7)
45-49	40 (9.9)
50-54	18 (4.5)
≥ 55	13 (3.2)
Gender	
Female	319 (79.4)
Male	83 (20.7)
Marrietal Status	
Single	101 (25.1)
Married	282 (70.2)
Widow	14 (3.5)
Divorced	5 (1.2)
Occupation	
Doctor	20 (4.9)
Nurse	256 (63.7)
Manual worker	87 (21.6)
Lab technician	22 (5.5)
Other	8 (1.9)
Ward name	
Pediatrics	43 (10.7)
Surgery	131 (32.6)
Obstetrics	106 (26.4)
Internal Medicine	55 (13.7)
Other Medical	55 (13.7)

A total of 402 workers were included in the final analysis of the cohort study, and their sociodemographic characteristics are shown in table7. The mean age of participants was 35 years and ranged from 16 to 60 years old. Females comprised 79.4 % of participants and almost 75% of participants were married or previously married at the time of first interview. There were 63.7% nurses among participants, 21.6% manual workers, 5.5% laboratory technicians and 4.9% doctors. HCWs in the cohort study worked in surgical departments (32.6%), Obstetrics and gynecology (26.4%), Internal medicine (13.7%), Pediatrics (10.7%) and other medical departments (13.7%).

3.2.2 HCV incidence rate in HCWs

The total period of follow-up was 18 months in which participants were interviewed twice; the first interview (Recruitment) was one year after the prevalence survey and the second interview was 6 months after the recruitment interview. Three hundred HCWs were followed for the entire period and 102 (25.4%) were lost in the second interview. By the end of the study, four HCWs had positive anti-HCV tests (seroconversion) but only one of them had positive HCV RNA test, the later was infected prior to first interview and remained as such till the end. Along the three cases who did not have viremia (HCV RNA positive), one was infected prior to first visit and the other two were infected in the last 6 months of follow-up and thus whether they had seroconversion or not was not verified due to study termination. The characteristics of the four cases are given in table 8, with the positive exposures reported by them.

Table 8 : Description of the four incident cases in the cohort study

	Age	Gender	Marietal Status	Occupation	Reported exposures(18 ms)
Case 1	39	Female	Married	Nurse	No exposures reported
Case 2	40	Female	Married	Nurse	No exposures reported
Case 3	62	Male	Married	Manual Worker	Exposure to body fluids
Case 4	25	Female	Single	Nurse	Exposure to body fluids

Over a total analysis time of 550.8 person years, the estimated incidence rate of HCV infection was 7.3 per 1000 person-years (95% confidence interval 2.7-19.4).

DISCUSSION

The main findings in our study are that we showed a lower anti-HCV prevalence among HCWs in ASUHs compared to population of greater Cairo, with an overall crude anti-HCV prevalence of 141/1770=7.9% (95% confidence interval, 6.7%-9.2%) and age-standardized seroprevalence of anti-HCV antibodies was 8.1% (95% confidence interval, 6.8%-9.3%). Risk factors that were found to be independently associated with anti-HCV positive testing in the multivariate logistic regression model were: Age (OR:1.07,95% CI 1.05-1.09 ,P:<0.001); HCWs who received unknown number of blood transfusions (OR:5.9,95% CI 2.0-16.9,P: 0.001), treatment of Bilharziasis with PAT (OR 6.3:,95% CI 2.6-15.4,P<0.001) and being a manual worker (OR:4.3,95% CI 1.5-12.4,P<0.001).

This study provides insights into the seroprevalence and incidence of anti-HCV antibodies among HCWs working in a tertiary healthcare facility in Egypt. There were no data available on similar settings in Egypt, apart from one study that was conducted by El Gohary et al (1995) in a rural community and reported anti-HCV prevalence of 7.7% (6/78) in HCWs[11]. Estimates of anti-HCV seroprevalence, among HCWs, worldwide vary from 0.28% to 4.1%[12,13,14]. The data of the DHS done in 2008 provided valuable source of comparison in this case[7], specifically the HCV prevalence of the population of greater Cairo, bearing in mind the entire population is living in urban setting. The latter fact is essential when comparison is to be made as most sero-prevalence studies in Egypt are done within rural populations. The overall anti-HCV prevalence

in Egypt, among 15-59 years old, provided in the DHS was 14.1% (95% CI 13.5-14.8), and the prevalence among the population of greater Cairo was 10.3% (95% CI 7.9-12.7). Although there is no data available in this study on detailed demographic characteristics, such as address of participants, level of education and income; yet we assumed a resemblance of the HCWs who participated in this study with the population of Greater Cairo. Under this assumption, and by applying population of Cairo for standardization, the prevalence shown in this study was lower than that of Cairo population (8.1% compared to 10.3%). This is surprising enough since healthcare workers are at higher risk due to different exposures to blood borne infections[8] and the very high background prevalence of reservoir source patients. This result was also described by Moens et al in a large cross-sectional survey of Belgian HCWs, in which the prevalence among HCWs was not higher than general population[15].

The anti-HCV incidence shown in this study (7.3/1000 P.Y) is the first estimate in a healthcare setting in Egypt. However, the incidence rates reported in two recent studies by Aya M. et al (2010) and Doa'a S. et al (2008), both conducted in rural Egyptian communities, were lower (2.4/1000 PY and 5.2/1000 PY, respectively) than the incidence rate we estimated[16],[17]. The gender difference shown in the study, though not statistically significant, is consistent with other studies that have shown a higher risk of HCV infection among males[4]. Our work showed more than four-fold increase in HCV seroprevalence among manual workers (Table 6), and by knowing most of them come from lower socioeconomic background and level of education, they had the highest resemblance with DHS prevalence of Cairo population as manual workers in our study had a standardized anti-HCV seroprevalence of 10.4% (95% confidence interval 8.1-12.7). Although there was no association between different hospital wards and seropositivity in the multivariate logistic regression model, results of the age-adjusted univariate analysis show more than 2-fold increase in risk among HCWs who worked in the Emergency departments or Intensive care units.

To further explore the prevalence rate obtained in our study, we estimated the cumulative risk of acquiring infection over 20 years for each HCW. We assumed a prevalence of viremic patients in ASUHs to be 20%, number of prick injuries per month for each HCW to be once (12/ year), total time period of exposure 20 years and the probability of getting infected by a prick injury from a viremic patient at 0.002. By adapting the formula provided in a study done by Yazdanpanah et al[18], the cumulative risk of acquiring infection over 20 years period for each HCW was estimated to be around 10%. In other words, HCWs are still exposed to considerable risk of acquiring HCV. Even though the occupational risks were not associated with

seropositivity in our results and we estimated higher incidence of HCV infection among HCWs, why do HCWs still have lower prevalence of anti HCV seropositivity than general population?
We therefore propose one possible explanation that was elaborated in several studies[19,20,21,22], three were done in Egypt[23,24,25], that hypothesised a higher cell-mediated immune response in high risk groups who are exposed to HCV infection (e.g., sexual contacts of acute HCV infections, family members of chronically infected individuals). This cell-mediated immune response would partially protect against infection, thus explaining how HCWs, through repeated exposures, appear to have lower prevalence of HCV infection.
The prevalence of HBsAg shown in our study=1.5% (95% confidence interval, 0.9%-2.0%) remains comparable to a recent study by Khattab et al on the seroprevalence of hepatitis B among blood donors in Egypt[26].

The results of the mutlivariate analysis showed an increased risk among manual workers in ASUHs for acquiring HCV (OR: 4.3, 95% confidence interval 1.5-12.4), and as occupational exposures were not associated in our results we hypothesise a relation with the lower level of education among manual workers, which has been shown in a study carried out in Cairo by Jimenez et al (2009)[27].
Our results showed the long-known fact of association between PAT and HCV infection[5,28,29,30] with more than six-fold increase of HCV seropositivity in HCWs who reported receiving PAT in their lifetime. But the risk remains among older age groups which therefore will have lower attributable risk of HCV infection in younger generations. We could not explain the odds of 2.9 among those who received tablet for the treatment of Bilharziasis that was shown in the multivariate regression model, though we assumed possible recall bias. We also interpreted the finding of the 5.8-fold higher odds of HCV seropositivity in those who received an unknown number of times of blood transfusion (18/1770) as a possibility of having a medical condition that required frequent transfusion as shown in their exposure profiles, with 14 (78%) of them previously admitted to a hospital for at least one surgical procedure and 10 (55%) of them reported receiving injections more than ten times in their lifetime. This is consistent with studies that have shown an association between blood transfusion and transmission of HCV[6,29,31], yet the attributable fraction of HCV seropositivity would be very small in our study population, knowing that only 18 HCWs reported this exposure. We interpret the reverse association between having had tissue biopsy before and seropositivity as a possible misinterpretation of the questionnaire by interviewers and/or responders, though the association was only shown in the adjusted univariate analysis. And similar association was shown between having periodic

check-up and higher anti-HCV seropositivity, which is not causal in nature as HCV infected individuals tend to have periodic check-up as part of their follow-up. And though two of the community related risk factors (Sharing of razors and shaving at the barber's) did not stand the multivariate regression testing, it is worth mentioning the association shown in the adjusted univariate analysis (with an OR of 1.8, 2.3, respectively) and that is consistent with other studies that have reported a similar association[32]. A similar association was shown with having had previous intravenous catheterization, which is well documented in literature[27,29,33], with 40% higher risk of anti-HCV seropositivity though it was not significant when fitted in the multivariate regression model.

However, the study had several limitations. First is the design limitation, as a cross-sectional study, as it is difficult to establish causal inferences since evidence of temporality (cause preceding effect) is not feasible in cross-sectional designs; also, the sampling frame might not be fully representative due to the use of convenience random sampling and consequently limits external validity. Second, the natural history of HCV is very complex to be interpreted by a cross-sectional study, with events such as seroconversion and spontaneous viral clearance. And even though we followed a subsample from the prevalence survey, yet the sample size (402) lacks power to bring any inferences and also the fact that only 4 HCWs were anti-HCV seropositive by the end of the follow-up which limits the ability to interpret different high risk exposures and consequently extrapolate the results to hospital population. Third, there was clear scarcity of results obtained by risk factors analysis of occupational exposures, apart from the fact of higher risk among manual workers. Thus many documented occupational risk factors associated with HCV transmission, such as prick injuries by sharp objects or needle sticks[9], were not proved to be associated in this study. The high proportion of missing values in some variables, and also a possible misinterpretation of questionnaires alongside with recall bias; all might have contributed much to this limitation. And last, the incidence provided in the cohort study has uncertainty contributed to the high loss-to-follow up rate (25%), much of it was contributed to refusal of resampling.

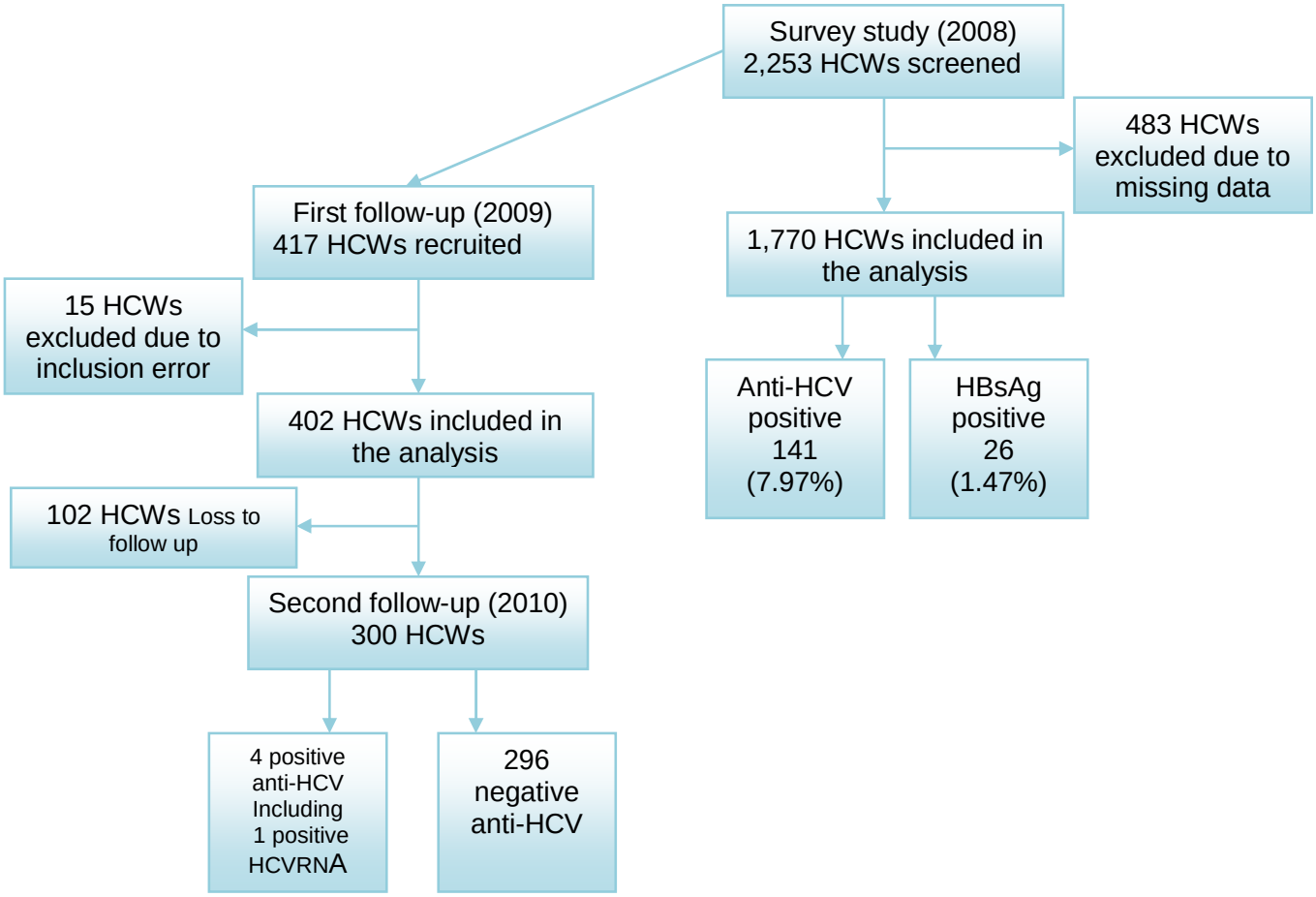
CONCLUSION

Healthcare workers in Ain Shams University Hospitals had a 7.9% seroprevalence of anti-HCV antibodies, which is lower than population of Greater Cairo yet the incidence showed in our study (7.3/ 1000 PY) was higher than general population. There was an increased risk of seropositivity in Manual Workers, which has to be taken into consideration in planning control strategies within the national framework of viral hepatitis control in Egypt. This could be done by focusing on increasing level of awareness and compliance to different standard procedures of infection control measures in healthcare settings. There could be increased risk in some departments than others, such as Emergency and Intensive Care units, which should be considered for future planning. Blood transfusion was also associated with seropositivity, a matter that should be further investigated on local and national levels as to determine the key focal points of interventional campaigns.

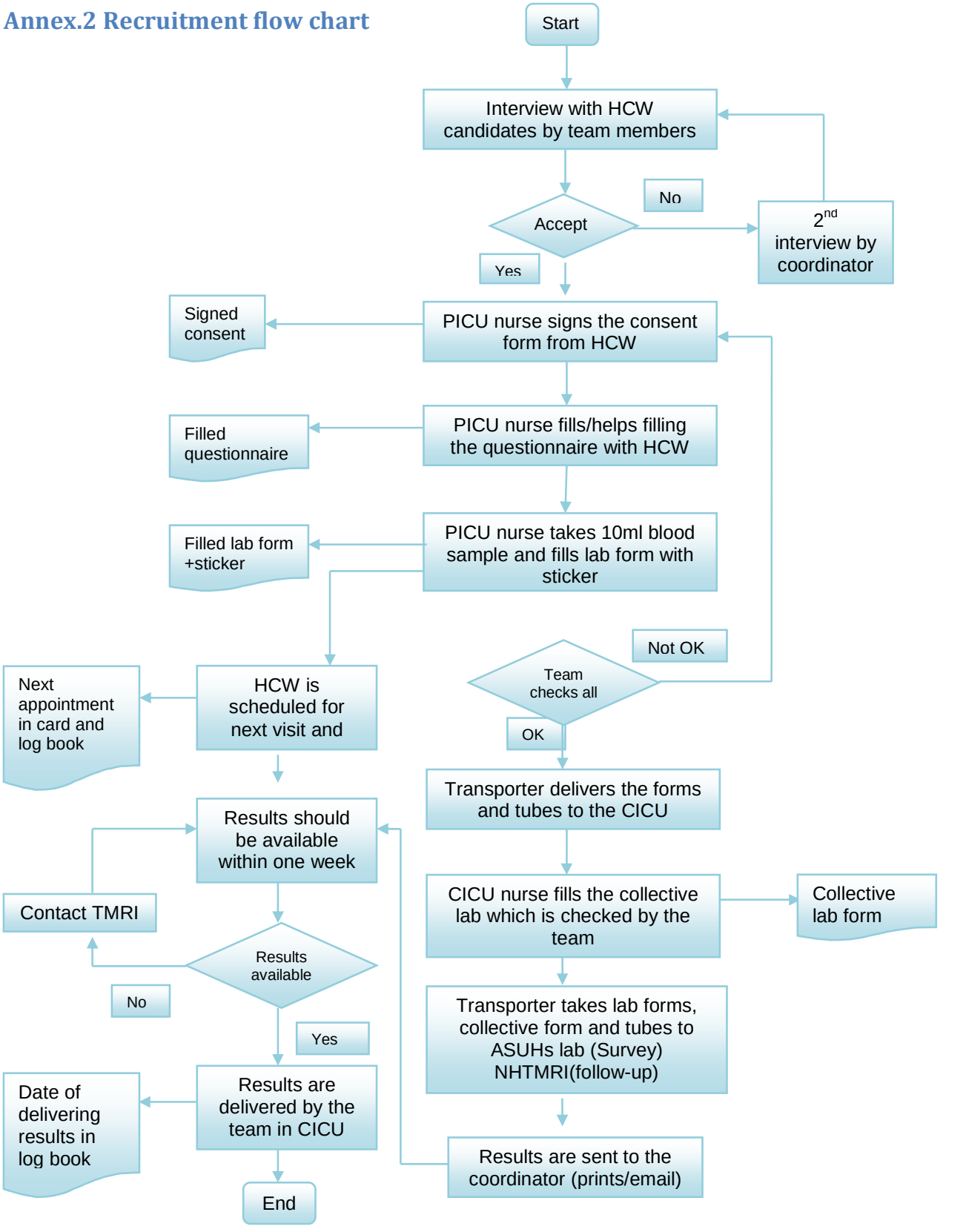
The fact that Egypt has the highest prevalence of HCV worldwide requires focused and efficient strategies in order to break the dissemination cycle of this chronically debilitating disease. Although mass treatment campaigns with Parenteral Antischistosomal therapy in the 1960-1970s contributed much to the epidemic in Egypt as was further proven by our results, yet the current prevalence cannot be attributed to this incident and efforts have to be made to investigate the ongoing rate of transmission and possible risks associated with it.

ANNEX

Annex.1 Ain Shams Study Flow chart



Annex.2 Recruitment flow chart



Key: ***PICU:*** Peripheral Infection Control Unit. ***CICU:*** Central Infection

SUMMARY

Title: **Hepatitis C Virus transmission among healthcare workers in Ain Shams University Hospitals, Cairo, Egypt**

- ***Background***: HCV infection is a major threat to HCWs in Egypt considering the high HCV antibody prevalence in the general population (14.7% in the 15-59 years old age group nationwide), and up to 28% in hospital inpatient population. There are no comprehensive studies on the current prevalence and/or incidence among HCWs and associated risk factors for transmission. The objective of this study was to explore the background prevalence of HCV infection among HCWs working in Ain Shams University Hospitals in Cairo, the association between exposure to patients and HCV infections, and to estimate the HCV incidence over an 18-month period.

- ***Design/Methods***: A cross-sectional survey was conducted between August and October 2008, targeting an estimate of 2,300 HCWs (around 50% of all workers at ASUHs). Out of them, 2,253 were screened for anti-HCV antibodies (EIA-3), HBsAg and ALT levels and 1,770 HCWs were included in the final analysis. HCV antibody prevalence was age-standardized using the age distribution of the Cairo population as the standard. A prospective cohort (402 of HCV-negative HCWs) was followed for a period of 18 months to estimate HCV incidence. As part of the study, participants were asked to complete a questionnaire to explore sociodemographic characteristics as well as risks of occupational blood exposures (OBE) and other possible routes of exposure to HCV.

- ***Results:*** The crude anti-HCV prevalence was 141/1770=7.9% (95% CI, 6.7%-9.2%) and the age-standardized seroprevalence was 8.1% (95% CI, 6.8%-9.3%). Risk factors that were found independently associated with anti-HCV positive testing in the multivariate logistic regression model were: Age (OR for an increase of one year of age:1.07, 95%CI:1.05-1.09); receiving unknown (presumably high) number of blood transfusions (OR:5.9, 95%CI:2.0-16.9), history of parenteral anti-schistosomiasis treatment (PAT) (OR:6.3, 95%CI:2.6-15.4) and being a manual worker (OR:4.3, 95%CI:1.5-12.4). No work exposure was found associated with HCV infection. The estimated incidence rate of HCV infection was 7.3 per 1000 person-years (95% CI 2.7-19.4).

- ***Conclusion:*** Healthcare workers at Ain Shams University Hospitals had lower seroprevalence of anti-HCV antibodies, compared to the population of Greater Cairo. Age, PAT, blood transfusion and being a manual worker were independently associated with HCV seropositivity. Occupational exposures were not associated with HCV transmission in our study, and further studies might be needed to explore the mechanisms underlying this unexpected lower prevalence among this high risk group.

Résumé

Transmission du Virus de l'Hépatite C chez les personnels de santé du centre hospitalier universitaire d'Ain Shams, Le Caire, Égypte

- ***Contexte***: L'infection par le VHC est un risque majeur pour les personnels de santé en Egypte, étant donné la forte prévalence d'anticorps anti-VHC dans la population générale (14,7% parmi les 15-59 ans) et jusqu'à 28% de la population des patients hospitalisés. Il n'existe pas d'études approfondies sur la prévalence actuelle et/ou l'incidence chez les personnels de santé et sur les facteurs de risque associés à la transmission du VHC. L'objectif de cette étude était d'explorer la prévalence de l'infection par le VHC parmi les personnels de santé du centre hospitalier universitaire d'Ain Shams au Caire, les associations entre l'exposition aux patients et l'infection par le VHC, et d'estimer l'incidence du VHC sur une période de 18 mois.
- ***Méthodes***: Une enquête transversale a été menée entre août et octobre 2008, ciblant approximativement 2300 personnels de santé (environ 50% de tous les personnels de santé d'Ain Shams). Parmi eux, 2253 ont été testés pour les anticorps anti-VHC (EIA-3), l'antigène HBs et le taux d'Alanine aminotransferase (ALT), et 1770 personnels de santé ont été inclus dans l'analyse finale. La prévalence d'anticorps anti-VHC a été standardisée sur l'âge, en utilisant comme référence la distribution par âge de la population du Caire. Une cohorte prospective (402 parmi les personnels de santé VHC-négatifs) a été suivie pendant une période de 18 mois pour estimer l'incidence du VHC. Dans le cadre de cette étude, les participants ont été invités à remplir un questionnaire afin explorer les caractéristiques socio-démographiques ainsi que les risques d'accidents d'exposition au sang et les autres voies possibles d'exposition au VHC.
- ***Résultats***: La prévalence des anticorps anti-VHC était de 141/1770 = 7,9% (IC 95%, 6,7% -9,2%) et la séroprévalence standardisée sur l'âge était de 8,1% (IC 95%, 6,8% -9,3%). Les facteurs de risque associés de façon indépendante avec la prévalence des anticorps anti-VHC dans le modèle final de régression logistique multivariée étaient: l'âge (OR: 1,07, IC 95% :1,05-1,09); le fait d'avoir reçu un nombre inconnu (vraisemblablement élevé) de transfusions sanguines (OR: 5,9 , IC 95% :2,0-16,9), une histoire de traitement parentéral de la bilharziose (OR: 6,3, 95% CI :2,6-15,4) et le fait d'être agent de service hospitalier (OR: 4,3, 95% CI: 1,5-12,4). Aucun facteur de risque lié à l'activité professionnelle n'a été associé avec l'infection par le VHC. Le taux d'incidence de l'infection à VHC a été estimé à 7,3 pour 1000 personnes-années (IC 95% : 2,7 -19,4).
- ***Conclusion***: les personnels de santé du centre hospitalier universitaire d'Ain Shams avaient une plus faible prévalence des anticorps anti-VHC par rapport à la population du Caire. L'âge, le traitement parentéral de la bilharziose, la transfusion sanguine et le fait d'être agent de service hospitalier étaient indépendamment associés à la séropositivité du VHC. Les expositions professionnelles n'ont pas été associées à la transmission du VHC dans notre étude, et des recherches ultérieures seraient nécessaires pour explorer les mécanismes sous-jacents de cette prévalence inférieure inattendue au sein de ce groupe à risque.

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