Hepatol Int (2007) 1:387–393
DOI 10.1007/s12072-007-9008-3

ORIGINAL PAPER

Prevalence and risk factors for hepatitis C infection in rural north Vietnam

Van Thi Thuy Nguyen · Mary-Louise McLaws · Gregory J. Dore

Received: 2 April 2007 / Accepted: 21 May 2007 / Published online: 19 July 2007

Abstract
Background In Vietnam, the prevalence of hepatitis C virus (HCV) infection among injecting drug users and patients with liver disease is known to be high, yet the magnitude of HCV in the general population, particularly in rural areas, has not been clearly estimated. A community-based study was used to determine the prevalence of HCV infection in a rural population of north Vietnam and explore risk factors associated with HCV acquisition.
Method A community-based viral hepatitis seroprevalence study using a multistage sampling method to recruit participants was undertaken. The study population size (n = 837) had been determined on the basis of estimated hepatitis B virus (HBV) prevalence. Information on demography and potential risk factors were obtained using face-to-face interviews, and all selected participants were tested for anti-HCV antibody.
Results HCV prevalence in the study population was 1.0% (95% CI: 0.4%–1.9%). Hospital admission (adjusted odds ratio [AOR]: 7.19; 95% CI: 1.59–32.53; P = .01) and having tattoos (AOR: 13.37: 95% CI: 1.86–96.15; P = .01) were independent predictors of HCV infection, and farmers were less likely to have HCV infection than those in other occupations (AOR: 0.19; 95% CI: 0.04–0.84; P = .02).
Conclusion The prevalence of HCV infection is low in the general rural population in northern Vietnam. An association between HCV infection and hospital admission and tattoos indicate a need to improve the standards of infection control in healthcare and other settings in this region.

Keywords Prevalence · Risk factors · Hepatitis C infection · Rural population · Vietnam

This project was funded by the Ministry of Health of Vietnam.

V. T. T. Nguyen · M.-L. McLaws
School of Public Health and Community Medicine, University of New South Wales, Sydney, Australia

V. T. T. Nguyen
e-mail: v.nguyen@unsw.edu.au

M.-L. McLaws
e-mail: m.mclaws@unsw.edu.au

G. J. Dore (✉)
National Centre in HIV Epidemiology and Clinical Research, University of New South Wales, Level 2, 376 Victoria St, Darlinghurst 2010 New South Wales, Australia
e-mail: gdore@nchecr.unsw.edu.au

Background

There are approximately 170 million persons infected worldwide with hepatitis C virus (HCV), which is a major cause of liver disease [1]. Estimates of HCV prevalence in Southeast Asian countries are 2.0% to 3.8% [2,3] for the general population, 12.5% for patients with chronic liver disease [4], and more than 90% for injecting drug users [5]. Approximately 10% to 20% of chronic HCV infection cases, regardless of country of origin or risk factor, will develop cirrhosis, of whom 1% to 5% will progress to hepatocellular carcinoma within 30 years from their initial infection [1].

The absence of an HCV vaccine and the prohibitive cost of HCV treatment for the vast majority of the world's HCV-infected population means that continued high HCV incidence will produce an ever-increasing liver disease burden for decades to come. Thus, identification and elimination of risk factors for HCV remains the only option for reduction of HCV-related disease burden for most

developing economies. Currently, there is limited information on HCV prevalence and risk factors in the general population of Vietnam, with most studies focused on patients with liver disease or high-risk groups such as injecting drug users and blood donors [6–15]. Our study aimed to estimate HCV prevalence and identify risk factors for infection in a rural population in northern Vietnam.

Method

A community-based HCV and hepatitis B virus (HBV) seroprevalence study was undertaken in two rural districts of Thai Binh Province in northern Vietnam with the study population selected using a multistage sampling method. Two districts, Kien Xuong and Vu Thu, were randomly selected from seven districts in the Thai Binh Province. Three communes were then randomly selected from these three districts. In each commune, a registration book was used to identify those who were 16 years of age and older from three selected villages who were then listed for the next round of selection. This study population was then randomly selected using a systematic method. A more detailed description of the methodology and results of HBV testing has been published [16].

Interviews were undertaken by trained staff from Thai Binh Medical University over a 2-month period, November to December 2002, to collect demographic information, behavioral risk factors, medical history, and consent for blood tests. Immediately following the interview, a 10-mL aliquot of blood was drawn from each participant to test for hepatitis markers, including HCV. Blood samples were sent to the Central Laboratory of Thai Binh Medical University in cold storage at –30°C. Monolisa anti-HCV Plus version 3 (Bio-Rad Laboratories) was used in accordance with the manufacturer's instruction. Only samples that repeatedly tested positive were considered anti-HCV antibody positive.

Data analysis

Data were analyzed using the SPSS version 13.0 statistical program. Prevalence estimates of cases positive for anti-HCV antibody were stratified by demographic characteristics and by two districts. A χ^2 test was used for comparisons between proportions, with α set at the 5% level. Analyses for significant risk factors were conducted using logistic regression for univariate analysis and backward stepwise-logistic regression for multivariate analysis. Variables in univariate analysis with P values lower than .25 were included in the baseline model. Interaction and correlation among variables were assessed before the multivariate analysis.

Ethics

Participation was voluntary and informed consent for interviewing and blood tests was obtained. Participants who tested positive for anti-HCV antibody were offered posttest counseling by specialists. The study protocol was approved by the Ethics Committee of Thai Binh Medical University and the Human Research Ethics Advisory Panel, School of Public Health and Community Medicine, University of New South Wales.

Results

Of the 903 residents approached, 837 (92.6%) agreed to participate. Ages of participants ranged from 16 to 82 years, with mean of 42.3 years. The proportion of male and female participants was very similar (49.2% and 50.8%, respectively). Most participants were farmers (78.6%), ever married (87.8%), and had completed at least secondary school (79.1%). These demographic characteristics did not differ significantly between the enrolment districts of Kien Xuong and Vu Thu (Table 1).

The prevalence of HCV infection was low, 1.0% (8/837, 95% CI: 0.4%–1.9%), with no significant association with age or gender (Table 2). All eight anti-HCV antibody positive participants had at least one parenteral risk factor; two were tattooed, three had ear-piecing, four cases had a history of dental treatment, two had a history of surgery, one had a history of blood transfusion, five had injected with reused syringes, and three had acupuncture. Significant associations with HCV included having a history of hospitalization (odds ratio [OR]: 8.57; 95% confidence interval [CI]: 2.02–36.28; $P < .0001$) and having been tattooed (OR: 9.90; 95% CI: 1.90–51.33; $P = .006$), while farming as the main occupation was protective of HCV (OR: 0.16; 95% CI: 0.03–0.67; $P = .01$) (Table 3). In multivariate analysis, farming remained protective (adjusted odds ratio [AOR]: 0.19; $P = .02$) for HCV and history of hospitalization (AOR: 7.19; $P = .01$) and having been tattooed (AOR: 13.37; $P = .01$) remaining predictive of HCV (Table 4).

Discussion

The prevalence of HCV infection of 1.0% in this rural population is consistent with estimates of between 0.38% and 1.7% from previous studies in north Vietnam [6, 10] but lower than most studies from south Vietnam, where rates have been estimated as between 1.0% and 4.3% [9, 11, 12]. Investigations of HCV prevalence in Vietnam have been few in number [6, 8–10, 12, 14], restricted to small,

Table 1 Demographic characteristics of study population

	Kien Xuong District (n = 404)		Vu Thu District (n = 433)		Total (n = 837)		P value
	n	%	n	%	N	%	
Age group							
16–19	40	9.9	33	7.6	73	8.7	0.35
20–29	72	17.8	76	17.6	148	17.7	
30–39	70	17.3	84	19.4	154	18.4	
40–49	82	20.3	84	19.4	166	19.8	
50–59	70	17.3	84	19.4	154	18.4	
60–69	40	9.9	53	12.2	93	11.1	
≥70	30	7.4	19	4.4	49	5.9	
Gender							
Female	199	49.3	226	52.2	425	50.8	0.39
Male	205	50.7	207	47.8	412	49.2	
Educational level							
High school/University	94	23.3	81	18.7	175	20.9	0.25
Secondary school	233	57.7	260	60.0	493	58.9	
Illiteracy/Primary school	77	19.1	92	21.2	169	20.2	
Occupation							
Farmer	312	77.2	346	79.9	658	78.6	0.83
Student	25	6.2	21	4.8	46	5.5	
Teacher	15	3.7	14	3.2	29	3.5	
Government	24	5.9	19	4.4	43	5.1	
Health worker	14	3.5	16	3.7	30	3.6	
Pensioner	14	3.5	17	3.9	31	3.7	
Marital status							
Single	57	14.1	45	10.4	102	12.2	0.10
Married	347	85.9	388	89.6	735	87.8	

Table 2 Prevalence of anti-HCV positive by age and gender

Age groups	Number of participants	Anti-HCV positive (%)		
		Total (N = 837) % [95% CI] (n)	Female % [95%CI] (n)	Male % [95%CI] (n)
16–19	73	1.4 [0.0–7.4] (1)	0.0 [0.0–9.0] (0/39)	2.9 [0.1–15.3] (1/34)
20–39	302	0.7 [0.0–2.4] (2)	0.0 [0.0–2.3] (0/156)	1.4 [0.2–4.9] (2/146)
40–59	320	0.9 [0.2–2.7] (3)	1.8 [0.4–5.3] (3/162)	0.0 [0.0–2.3] (0/158)
≥60	142	1.4 [0.2–5.0] (2)	0.0 [0.0–5.3] (0/68)	2.7 [0.3–9.4] (2/74)
Total	837	1.0 [0.4–1.9] (8)	0.7 [0.1–2.0] (3/425)	1.2 [0.4–2.8] (5/412)
		χ^2 linearity = 0.87		
		P = 0.72		
		DOF = 3		

Abbreviations: HCV, hepatitis C virus; CI, confidence interval; DOF, degree of freedom

convenient study populations, and have not examined risk factors for infection. Previous HCV prevalence rates in Vietnam have been higher for populations with risk factors such as injecting drug use (31.0%–97.2%), blood donation (0.8%–20.6%), liver diseases (9.2%–23.1%), and non–liver disease hospitalized patients (1.0%–9.0%) (Table 5). It is unclear why the prevalence is higher in the south Vietnamese general community than in the north.

Parenteral exposure has been well documented as a major risk factor for HCV transmission [17–22]. In our study, all eight cases had at least one parenteral risk factor. The practice of unsafe injections in the healthcare settings

Table 3 Univariate analysis of risk factors of HCV infection

Variables	Total (N = 837)	n	%	OR	95% CI	Two-sided P value
Demographic characteristics						
Main occupation						
Others	179	5	2.8	1		
Farmer	658	3	0.5	0.16	0.03–0.67	0.01
Age group						
<40	375	3	0.8	1		
≥40	462	5	1.1	1.36	0.32–5.71	0.67
Gender						
Female	425	3	0.7	1		
Male	412	5	1.2	1.73	0.41–7.28	0.45
Educational level						
High school/University	175	2	1.1	1		
Secondary school	493	4	0.8	0.71	0.13–3.90	0.69
Illiteracy/Primary school	169	2	1.2	1.03	0.14–7.44	0.97
History of medical treatment						
History of hospitalization						
No	697	3	0.4	1		
Yes	140	5	3.6	8.57	2.02–36.28	<0.0001
History of blood transfusion						
No	810	7	0.9	1		
Yes	27	1	3.7	4.41	0.52–37.18	0.14
History of dental treatment						
No	593	4	0.7	1		
Yes	244	4	1.6	2.45	0.61–9.89	0.19
History of acupuncture						
No	588	5	0.9	1		
Yes	249	3	1.2	1.42	0.34–5.99	0.63
Having injections with reused syringes						
No/Don't know	375	3	0.8	1		
Yes	462	5	1.1	1.36	0.32–5.71	0.67
History of surgery or medical procedures						
No	630	6	1.0	1		
Yes	207	2	1.0	1.01	0.20–5.06	0.98
Lifestyle						
Tattoo						
No	802	6	0.8	1		
Yes	29	2	6.9	9.90	1.90–51.33	0.006
Sharing razor						
No	712	5	0.7	1		
Yes	125	3	2.4	3.5	0.82–14.74	0.15

[a] Including 73 participants who had no injection

Abbreviations: HCV, hepatitis C virus; CI, confidence interval

as a major contributor to HCV transmission in developing countries is well accepted [18, 20, 23]. The World Health Organization has estimated that 16 billion health care injections are administered annually in its developing and transitional member countries [24] and that overuse and unsafe injecting are at epidemic proportions. An estimated 2.3 to 4.7 million HCV infections per year are due to unsafe injecting practices in the developing world. [25]. Healthcare settings have several potential parenteral contributors to HCV transmission, with blood transfusion, surgery, dental treatment, acupuncture and therapeutic injections (especially with nondisposable syringes), and high frequency of injection documented as independent predictors of HCV infection [18, 20, 23, 26–30]. Those who had *ever* been in a hospital were 2.1 to 3.7 times more likely to have acquired HCV [20, 26, 28–32]. In our study, participants who had more than one hospital admission were found to be 7.2 times more likely to have HCV than

Table 4 Multivariate analysis of predictors of HCV infection[a]

Variables	Total (N = 837)	N	%	Unadjusted OR (95% CI)	P value	Adjusted OR (95% CI)	P value
Main occupation							
Others	179	5	0.5	1	0.01	1	0.02
Farmer	658	3	2.8	0.16 (0.03–0.67)		0.19 (0.04–0.84)	
History of hospitalization							
No	697	3	0.4	1	0.000		0.01
Yes	140	5	3.6	8.57 (2.02–36.28)		7.19 (1.59–32.53)	
Tattoo							
No	802	6	0.8	1	0.006	1	0.01
Yes	29	2	6.9	9.90 (1.90–51.33)		13.37 (1.86–96.15)	

[a] Adjusted for age, gender and HBV infection (HBsAg positive and/or anti-HBc positive) and other listed variables

Abbreviations: HCV, hepatitis C virus; OR, odds ratio; CI, confidence interval

Table 5 Prevalence of HCV infection in Vietnam

Reference	Study population (n)	Prevalence of anti-HCV positive (%)	Prevalence of HCV RNA positive (%)
North Vietnam			
Hoang TL et al. [10]	Rural population (1563)	0.38	
Hoang DM [6]	Urban, rural population and islanders (975)	1.3	
Hoang DM [6]	Blood donors (120)	7.5	
Pham S et al. [7]	Blood donors (499)	0.8	
Nakata S et al. [8]	Patients without liver diseases (511)	4.0	
Corwin AL et al. [13]	Patients without liver diseases (187)	1.0	
Hoang DM et al. [6]	Patients with liver diseases (262)	17.9	
Vu VK et al. [15]	Patients with liver diseases (154)	14.3	
Nguyen TV et al. [14]	Patients with liver diseases (76)	9.2	
Corwin AL et al. [13]	Patients with liver diseases (188)	10.0	
Hoang DM [6]	IDUs (50)	72.0	
Nakata S et al. [8]	IDUs (200)	31.0	
Central and Southern Vietnam			
Kakumu S et al. [12]	Central rural population (890)	1.0	
La TN [9]	Government employees, students, workers, urban population (2573)	4.31	
Tran HTT et al. [11]	Southern urban population (100)		2.0
Pham S et al. [7]	Blood donors (491)	20.6	
Nakata S et al. [8]	Patients without liver diseases (491)	9.0	
Tran HTT et al. [11]	Patients with liver diseases (234)		19.2
Kakumu SK et al. [12]	Patients with liver diseases (289)	23.1	
La TN [9]	IDUs (108)	97.22	
Nakata S et al. [8]	IDUs (67)	87.0	

Abbreviation: IDUs, injecting drug users

those who had never been admitted. However, a more detailed analysis of associations with number and duration of hospital admissions was not possible as this information was not collected. After controlling for concurrent HBV infection, we found no significant association between HCV infection and dental procedures, history of surgery, blood transfusion, having injection with reused syringes, and previous acupuncture. These results should be interpreted with caution owing to the relatively small study population in a low HCV prevalence setting.

Tattooing is a known independent risk factor for HCV acquisition, with odds ranging from 4.4 to 6.2 [26, 29]. Tattooing is not a common practice in Vietnam, especially in rural communities, because of the stigma associated with it. Yet, in our study, we found the likelihood of being infected with HCV to be 13 times higher in persons with

tattoos compared with those without tattoos. There was no tattoo shop/service within the communities we studied. However, homemade tattooing is practiced and it is very likely that tattoo equipment is shared.

The link between occupation and HCV acquisition is not clear, with the exception of being a healthcare worker [33]—most possibly due to occupational exposure to HCV from a needlestick injury [34, 35]. An examination of profession in 2,167 blood donors in Thailand found being a laborer or agriculture worker was a risk factor of HCV acquisition [36]. Farmers in our study were less likely to be anti-HCV antibody positive which may indicate lack of unmeasured or unreported lifestyle/behavior risk factors—an association that should be tested in the future in a much larger sample size.

Our study is the first community-based study to estimate the prevalence of HCV in rural Vietnam while exploring risk factors for infection. However, the study had several limitations. Although we found HCV infection to be uncommon and our sample size provided a good degree of reliability for our prevalence rate, 1–2 per 100, a considerably larger population is needed before we can rule out as risk factors for HCV the remaining variables on which we collected data. Our original aim was to investigate the prevalence and risk factors for HBV infection, in a calculated sample size based on the expected HBV prevalence—a far more common occurrence requiring a smaller sample than that for HCV estimates [16]. Recall bias might have influenced our findings, but this would be nondifferential as participants were unaware of their sero-status at the time of their interview. Lastly, the eight anti-HCV-antibody positive participants were not tested for HCV-RNA.

Although prevalence of HCV infection is low in the general population in Vietnam, it is very high among liver disease patients and injecting drug users. Without an available cost-effective vaccine, preventing health care–associated transmission of HCV requires improvements in the standards of infection control in the healthcare setting and education of healthcare professionals.

Acknowledgment We are grateful to Associate Professor Tran Van Que for his support and advice and to the staff of Thai Binh Medical University for collecting data. We also highly appreciate the assistance provided by the health centers of Vu Thu and Kien Xuong districts as well as the health centers of the six communes where the project was conducted. The National Centre in HIV Epidemiology and Clinical Research is funded by the Australian Government Department of Health and Aging and is affiliated with the Faculty of Medicine, The University of New South Wales.

References

1. World Health Organization. Hepatitis C. Fact sheet No 164 [Online]; October 2000. Available at: http://www.who.int/mediacentre/factsheets/fs164/en/. Accessed November 25, 2006
2. Ratanasuwan W, Sonji A, Tiengrim S, Techasathit W, Suwanagool S. Serological survey of viral hepatitis A, B, and C at Thai Central Region and Bangkok: a population base study. Southeast Asian J Trop Med Public Health 2004;35:416–420
3. Ishida T, Takao S, Settheetham-Ishida W, Tiwawech D. Prevalence of hepatitis B and C virus infection in rural ethnic populations of Northern Thailand. J Clin Virol 2002;24:31–35
4. Pramoolsinsap C, Sumalnop K, Busagorn N, Kurathong S. Prevalence and outcomes of HBV and anti-HCV seropositive patients with chronic liver disease and hepatocellular carcinoma. Southeast Asian J Trop Med Public Health 1992;23:6–11
5. Luksamijarulkul P, Plucktaweesak S. High hepatitis C seroprevalence in Thai intravenous drug abusers and qualitative risk analysis. Southeast Asian J Trop Med Public Health 1996; 27:654–658
6. Hoang DM. Lymphocyte B and C among people with anti-HCV positive in different populations in Hai Phong [dissertation, in Vietnamese]. Hanoi: The Military Institute of Medicine, The Ministry of Education and Training, Vietnam; 2003
7. Pham S, Dao DD, Bui H, et al. Makers of hepatitis C and B virus infections among blood donors in Ho Chi Minh and Hanoi, Vietnam. Clin Diagn Lab Immunol 1994;1:413–418
8. Nakata S, Pham S, Dao D, et al. Hepatitis C and B virus infection in population at low or high risk in Ho Chi Minh and Hanoi, Viet nam. J Gastroenterol Hepatol 1994;9(4):416–419
9. La TN. Hepatitis B and C infection in different population groups in Southern Vietnam and implication for seeking blood donors [PhD dissertation, in Vietnamese]. Hanoi: Hanoi Medical University; 1995
10. Hoang TL, Nguyen TV, Do TD, et al. Hepatitis B and C infection in Thanh Hoa province [in Vietnamese]. J Prev Med 1999;9:5–9
11. Tran HT-T, Ushijima H, Quang VX, et al. Prevalence of hepatitis virus types B through E and genotypic distribution of HBV and HCV in Ho Chi Minh City, Vietnam. Hepatol Res 2003;26: 275–280
12. Kakumu S, Sato K, Morishita T, et al. Prevalence of hepatitis B, hepatitis C, and GB virus C/hepatitis G virus infections in liver disease patients and inhabitants in Ho Chi Minh, Vietnam. J Med Virol 1998;54:243–248
13. Corwin AL, Dai TC, Duc DD, et al. Acute viral hepatitis in Hanoi, Viet Nam. Trans R Soc Trop Med Hyg 1996;90:647
14. Nguyen VT, Hoang NT, Fields H. Hepatitis A, B, C and D infections in different groups and the implications for producing and using hepatitis B vaccine in Vietnam [in Vietnamese]. J Hyg Prev Med 1992;2(1):6–15
15. Vu VK, Ha VM, Nguyen TA, et al. The prevalence of hepatitis C virus infection among patients with chronic liver disease. J Gastroenterol Hepatol 1997;12:A6
16. Nguyen VTT, McLaws M, Dore G. Highly endemic hepatitis B infection in rural Vietnam. J Gastroenterol Hepatol. In press.
17. Dore GJ, Law M, MacDonald M, Kaldor JM. Epidemiology of hepatitis C virus infection in Australia. J Clin Virol 2003;26: 171–184
18. Shin HR, Kim JY, Ohno T, et al. Prevalence and risk factors of hepatitis C virus infection among Koreans in rural area of Korea. Hepatol Res 2000;17:185
19. Memon MI, Memon MA, Hepatitis C. an epidemiological review. J Viral Hepat 2002;9:84–100
20. Sanchez JL, Sjogren MH, Callahan JD, et al. Hepatitis C in Peru: risk factors for infection, potential iatrogenic transmission, and genotype distribution. Am J Trop Med Hyg 2000;63:242–248
21. Di Bisceglie AM. Hepatitis C. Lancet 1998;351:351–355
22. Nishioka SdA, Gyorkos TW. Tattoos as risk factors for transfusion-transmitted diseases. Int J Infect Dis 2001;5:27–34
23. Mele A, Spada E, Sagliocca L, Ragni P, Tosti ME, Gallo G, et al. Risk of parenterally transmitted hepatitis following exposure to

surgery or other invasive procedures: results from the hepatitis surveillance system in Italy. J Hepatol 2001;35:284–289
24. World Health Organization. Technical activities. Injection safety; 2006. Available at: http://www.who.int/patientsafety/activities/technical/injection_safety/en/. Accessed November 13, 2006
25. Kane A, Lloyd J, Zaffran M, Simonsen L, Kane M. Transmission of hepatitis B, hepatitis C and human immunodeficiency viruses through unsafe injections in the developing world: model-based regional estimates. Bull World Health Organ 1999;77(10): 801–807
26. Brandao AB, Fuchs SC. Risk factors for hepatitis C virus infection among blood donors in southern Brazil: a case-control study. BMC Gastroenterol 2002;2:18
27. Mele A, Tosti ME, Marzolini, Moiraghi, Ragni, Gallo, et al. Prevention of hepatitis C in Italy: lessons from surveillance of type-specific acute viral hepatitis. J Viral Hepat 2000;7:30–35
28. Akhtar S, Younus M, Adil S, Jafri SH, Hassan F. Hepatitis C virus infection in asymptomatic male volunteer blood donors in Karachi, Pakistan. J Viral Hepat 2004;11:527–535
29. Domínguez Á, Bruguera M, Vidal J, Plans P, Salleras L. Community-based seroepidemiological survey of HCV infection in Catalonia, Spain. J Med Virol 2001;65:688–693
30. Chiaramonte M, Stroffolini T, Lorenzoni U, Minniti F, Conti S, Floreani A, et al. Risk factors in community-acquired chronic hepatitis C virus infection: a case-control study in Italy. J Hepatol 1996;24:129
31. Forns X, Martínez-Bauer E, Feliu A, García-Retortillo M, Martín M, Gay E, et al. Nosocomial transmission of HCV in the liver unit of a tertiary care center. Hepatology 2005;41:115–122
32. Stefano RD, Stroffolini T, Ferraro D, Usticano A, Valenza LM, Montalbano L, et al. Endemic hepatitis C virus infection in a Sicilian town: further evidence for iatrogenic transmission. J Med Virol 2002;67:339–344
33. Catalani C, Biggeri A, Gottard A, Benvenuti M, Frati E, Cecchini C. Prevalence of HCV infection among health care workers in a hospital in central Italy. Eur J Epidemiol 2004;19:73–77
34. Polish LB, Tong MJ, Co RL, Coleman PJ, Alter MJ. Risk factors for hepatitis C virus infection among health care personnel in a community hospital. Am J Infect Control 1993;21:196–200
35. Yazdanpanah Y, De Carli G, Migueres B, Lot F, Campins M, Colombo C, et al. Risk factors for hepatitis C virus transmission to health care workers after occupational exposure: a European case-control study. Clin Infect Dis 2005;41:1423–1430
36. Luksamijarulkul P, Thammata N, Sujirarat D, Tiloklurs M. Hepatitis C virus infection among Thai blood donors: antibody prevalence, risk factors and development of risk screening form. Southeast Asian J Trop Med Public Health 2004;35:147–154