

# Community-based survey of HCV and HIV coinfection in injection drug abusers in Sichuan Province of China

Yu-Hua Ruan, Kun-Xue Hong, Shi-Zhu Liu, Yi-Xin He, Feng Zhou, Guan-Ming Qin, Kang-Lin Chen, Hui Xing, Jian-Ping Chen, Yi-Ming Shao

**Yu-Hua Ruan, Kun-Xue Hong, Shi-Zhu Liu, Yi-Xin He, Feng Zhou, Hui Xing, Jian-Ping Chen, Yi-Ming Shao**, Center for AIDS/STD Control and Prevention, Chinese Center for Disease Control and Prevention, Beijing 100050, China

**Guan-Qming Qin**, Sichuan Provincial Center for Disease Control and Prevention, Chengdu 610031, Sichuan Province, China

**Kang-Lin Chen**, Xichang Center for STD and Leprosy Control, Xichang County 615000, Sichuan Province, China

**Supported by** the National Key Technologies Research and Development Program of China during Tenth Five-Year Plan Period, No. 2001BA705B02 and National Natural Science Foundation of China, No. 30170823

**Correspondence to:** Dr. Yi-Ming Shao, Division of Virology and Immunology, National Center for AIDS/STD Control and Prevention, Chinese Center for Disease Control and Prevention, 27 Nanwei Road, Xuanwu District, Beijing 100050, China. yshao@public3.bta.net.cn

**Telephone:** +86-10-63166184 **Fax:** +86-10-63154638

**Received:** 2003-10-10 **Accepted:** 2003-12-08

## Abstract

**AIM:** To investigate the prevalence and risk factors of HCV/HIV coinfection in injection drug abusers (IDAs) in Lianshan Yi Autonomous Prefecture of Sichuan province, China.

**METHODS:** From November 8, 2002 to November 29, 2002, a community-based survey was conducted to investigate the demographic characteristics, patterns of shared injectors devices and sexual behaviors in IDAs. Blood samples were also collected to test HCV and HIV infection. A total of 379 subjects were recruited in the study through community outreach and peer recruiting methods.

**RESULTS:** Of the 379 IDAs, the HCV prevalence and HIV prevalence were 71.0% and 11.3%, respectively, and HCV/HIV coinfection was 11.3%. HCV infection was found in 100% and 67.3% of HIV-positive and HIV-negative IDAs, respectively. HIV prevalence was 16.0% in HCV positive IDAs while none of the HCV negative IDAs was positive for HIV. Ethnicity, shared needles or syringes and cotton in the past 3 mo and syphilis infection were associated with HCV/HIV coinfection shown by univariate analysis using chi-square test. Multivariate logistic regression analysis showed that shared needles or syringes in the past 3 mo (Odds ratio=3.121, 95% CI: 1.278-7.617,  $P<0.05$ ) and syphilis infection (Odds ratio=2.914, 95% CI: 1.327-6.398,  $P<0.01$ ) were significantly associated with HCV infection. No statistically significant association was found in univariate analysis between sexual behaviors and HCV/HIV coinfection.

**CONCLUSION:** Shared needles and syringes in the past 3 mo and syphilis infection were significantly associated with HCV infection. Further sero-epidemiological prospective cohort studies should be conducted to clarify the impact of syphilis and high risk sexual behaviors on HCV transmission through unprotected sexual intercourse.

Ruan YH, Hong KX, Liu SZ, He YX, Zhou F, Qin GM, Chen KL,

Xing H, Chen JP, Shao YM. Community-based survey of HCV and HIV coinfection in injection drug abusers in Sichuan Province of China. *World J Gastroenterol* 2004; 10(11): 1589-1593  
<http://www.wjgnet.com/1007-9327/10/1589.asp>

## INTRODUCTION

Since the first case in China of an injection drug abuser (IDA) with AIDS was reported in Yunnan Province along the border with Burma (Myanmar) in 1985<sup>[1]</sup>, China has experienced a rapid increase in the number of HIV/AIDS cases. The majority of HIV infections in China were currently found in rural residents in the western provinces. Furthermore, 71% of documented HIV cases were IDAs. The IDA population is at high risk for HIV infection and also has a high prevalence of HCV. The major mode of HCV and HIV transmission among IDAs is through shared drug injection devices<sup>[2-9]</sup>. Because unprotected sexual intercourse is widespread among injection drug abusers, unsafe sexual intercourse is also a notable mode of HIV transmission in IDAs and general population. On the other hand, the association between HCV transmission and high-risk sexual behaviors needs to be clarified<sup>[10-15]</sup>. Some studies have reported that HCV transmission through unsafe sexual intercourse can be enhanced in HIV positive patients due to HCV viremia and more active HCV infection with persistent viremia<sup>[16,17]</sup>. Clinical progression is more rapid in patients with HCV/HIV coinfection than in patients with HIV only. The prognostic value of HCV infection for both clinical and immunological progression is significant at early stages of HIV infection<sup>[18-24]</sup>. Furthermore, HIV coinfection in patients with HCV is associated with more rapid progression to liver failure and liver cancer. The HCV and HIV epidemics are a significant public health problem in China because of high HCV prevalence among HIV-positive IDAs. Studies have investigated HCV/HIV coinfection among IDAs recruited from detoxification centers or re-education centers in China. However, few community- or population-based studies have been performed on HCV/HIV coinfection among IDAs in China, especially in regard to the relationship between risk factors, such as shared injection devices and sexual behaviors, and HCV/HIV coinfection or HCV infection.

A community-based survey of HCV/HIV coinfection among IDAs was conducted in Xichang County, Sichuan Province, China, in November 2002. The aim of the cross-sectional study was to identify the specific risk factors for HCV/HIV coinfection among IDAs in Sichuan Province, China.

## MATERIALS AND METHODS

### Materials

Study participants were recruited through a community-based outreach method that involved the distribution of information materials regarding the study to the community. The outreach campaign was especially targeted to the known IDA groups. During the informed consent process, potential participants in our study were invited to be peer recruiters with the offer of financial incentives for recruiting other IDAs in the community.

After providing written informed consent, potential study participants underwent a screening interview designed to identify IDAs eligible for the study. All participants were at least 18 years of age, and injected drugs at least one time in the past 3 mo. Those who met the inclusion criteria then completed an HCV and HIV risk assessment interview, received HIV pre-test and risk reduction, underwent phlebotomy for HCV and HIV antibody testing, and received HIV post-testing counseling.

Sichuan Province is located in southwest China and the main drug transportation route from Yunnan and Guangxi to Xinjiang. Xichang County is located in Lianshan Yi Autonomous Prefecture of southwest Sichuan. The total population of Xichang County is 617 000. From November 8, 2002 to November 29, 2002, 379 IDAs based in the community of Xichang County were enrolled by the Xichang Center for STD and Leprosy Control to estimate the prevalence of HCV/HIV coinfection and to investigate the risk factors associated with HCV and HIV infection. The study protocol and informed consent were approved by the Institutional Review Board (IRB) of the Center for AIDS/STD Control and Prevention, Chinese Center for Disease Control and Prevention. Informed consent was obtained from all study participants before being interviewed.

### Methods

Each study participant was assigned a unique and confidential identification number that was subsequently used to label questionnaire responses and serum specimens. An interviewer-administrated questionnaire was used to collect data on risk factors for HCV and HIV infection. Questions were concerned with demographic characteristics, drug use and drug injection behaviors, condom use and sexual behaviors. Demographic variables included age, gender, ethnicity, education, employment, marital status, and home ownership. Questions pertaining to drug use investigated the frequency of drug use and drug injection in the past 3 mo and the frequency of shared injection devices in the past 3 mo, including shared needles or syringes, cookers, cotton, rinse water, and use of front- or back-loading. Assessment of sexual behaviors included questions regarding sex behaviors with a steady partner or other partner(s) in the past 6 mo, condom use in the past month, exchange of money for sex partner in the past 6 mo, and the addition of any new sex partners in the past 6 mo. The interview, counseling and blood collection were performed at the site clinic of the Xichang Center for STD and Leprosy Control.

Each serum or plasma sample was collected from IDAs by venipuncture and tested for antibodies to HIV by enzyme-linked immunosorbent assay (ELISA; Beijing Wantai Biological Medicine Company, China). Positive results were confirmed by an HIV-1/HIV-2 Western immunoblot assay (HIV BLOT 2.2 WB; Genelabs, Singapore). Samples were considered as HIV-positive when both ELISA and Western immunoblot results were positive. Samples were tested for antibodies to HCV by ELISA (Beijing Jinhao Biological Production Company, China). The presence of antibodies to syphilis was tested by ELISA (Beijing Jinhao Biological Production Company, China), positivity was confirmed by passive particle agglutination test for detection of antibodies to *Treponema pallidum* (TPPA; Fujirebio, Inc., Japan).

EpiData software (EpiData 2.1 for Windows; The EpiData Association, Odense, Denmark) was used for data double entry and validation. Statistical analysis of chi-square test or Fisher's exact test was performed to screen behaviors and demographic characteristics associated with high risk for HCV and HIV infection. A multivariate logistic regression model was constructed to select independent risk factors of HCV infection and to control confoundings among various risk factors which provided both *P*-values and 95% confidence intervals for the Odds ratio (OR) point estimates. Data analyses were carried

out using the statistical analysis system (SAS 8.2 for Windows; SAS Institute Inc., North Carolina, USA).

## RESULTS

### Prevalence of HCV and HIV coinfection in IDAs

A total of 379 IDAs were investigated in this study. As shown in Table 1, HCV prevalence and HIV prevalence were 71.0% and 11.3%, respectively. HCV/HIV coinfection was 11.3%. HCV infection was found in 100% and 67.3% of HIV-positive and HIV-negative IDAs, respectively. HIV prevalence was 16.0% among HCV-positive IDAs and none of the HCV-negative IDAs was found to be HIV-positive.

**Table 1** Prevalence of HCV/HIV coinfection in IDAs in Xichang County, Sichuan Province, China

HCV	HIV		Total
	Positive	Negative	
Positive	43	226	269
Negative	0	110	110
Total	43	336	379

### Risk factors for HCV and HIV infection in IDAs

Table 2 presents the results of univariate analysis of demographics, risk variables of injection drug abusers in the past 3 mo, sexual behaviors in the past 6 mo, and syphilis infection. HCV/HIV coinfection showed a statistically significant association with ethnicity ( $P < 0.01$ ), frequency of shared needles or syringes ( $P < 0.05$ ) and cotton in the past 3 mo ( $P < 0.05$ ) and syphilis infection ( $P < 0.01$ ). The frequency of drug injection, shared rinse water and cooker in the past 3 mo all showed a strong but not statistically significant correlation with HCV/HIV coinfection, with *P* values near 0.05.

Stepwise multivariate logistic regression analyses were performed using risk factors of ethnicity; Frequency of drug injection, shared needles or syringes, rinse water, cooker and cotton in the past 3 mo and syphilis infection were included in the initial model to investigate the association with HCV infection. As shown in Table 3, shared needles or syringes in the past 3 mo ( $P < 0.05$ ) and syphilis infection ( $P < 0.01$ ) were independently associated with HCV infection.

## DISCUSSION

Among male IDAs in preparatory cohorts for HIV vaccine trials in Thailand, the prevalence of HCV and HCV/HIV coinfection was 96.4% and 50.7%<sup>[25]</sup>. In a study on IDAs from drug detoxification centers in Yunnan Province of China in 2000, the prevalence of HCV was 99.3% in HIV-positive IDAs<sup>[26]</sup>. Lai *et al.*<sup>[27]</sup> reported 15.4% HIV infection and 63.5% HCV infection in IDAs in Guangxi Zhuang Autonomous Region of China; HCV incidence was about 10 times more than HIV incidence. These studies showed that the prevalence of HCV and HIV was high in IDAs, and that HCV transmission was more rapid than HIV transmission.

In previous studies of HIV-positive populations in Xichang County in Sichuan Province, the prevalence of HCV was found to be approximately 60% in HIV-positive individuals<sup>[28,29]</sup>. In this study, we found a relatively high prevalence (11.3%) of HCV/HIV coinfection in IDAs in Xichang County. Shared needles or syringes in the past 3 mo ( $P < 0.05$ ) was significantly associated with HCV infection after demographic characteristics and other risk factors were controlled. However, multivariate analysis showed that shared devices were indirectly related to drug injection, such as cotton, rinse water, cookers, and front- or back-loading, while not significantly associated with HCV/HIV coinfection or with HCV infection. Univariate analysis showed

**Table 2** Risk factors associated with HCV/HIV coinfection in IDAs in Xichang County, Sichuan Province, China

	Factor	Total <i>n</i>	HCV/HIV coinfection		HCV infection		$\chi^2$	<i>P</i>
			<i>n</i>	Prevalence (%)	<i>n</i>	Prevalence (%)		
General								
Gender	Male	313	38	12.1	180	57.5	3.45	0.178
	Female	66	5	7.6	46	69.7		
Age(yr)	<29	208	25	12.0	123	59.1	0.21	0.901
	≥29	171	18	10.5	103	60.2		
Ethnicity	Han	243	20	8.2	142	58.4	10.29	0.006
	Other	136	23	16.9	84	61.8		
Years of education	≤6	158	22	13.9	94	59.5	2.93	0.231
	>6	221	21	9.5	130	58.8		
Marriage	Yes	113	16	14.2	66	58.4	1.30	0.521
	No	266	27	10.2	160	60.2		
Employed	Yes	167	20	12.0	91	54.5	3.52	0.172
	No	212	23	10.8	135	63.7		
Own home	Yes	132	20	15.2	76	57.6	2.94	0.23
	No	247	23	9.3	150	60.7		
Drug abuse and drug injection behaviors (past 3 mo)								
Frequency of Drug injection	<1 time/d	79	6	7.6	42	53.2	5.53	0.063
	≥1 time/d	300	37	12.3	184	61.3		
Frequency of shared Needles or syringes	<2 times/wk	332	35	10.5	193	58.1	7.42	0.025
	≥2 times/wk	47	8	17.0	33	70.2		
Frequency of Shared rinse water	<2 times/wk	336	36	10.7	196	58.3	5.67	0.059
	≥2 times/wk	43	7	16.3	30	69.8		
Frequency of Shared cooker	<2 times/wk	335	36	10.7	195	58.2	5.95	0.051
	≥2 times/wk	44	7	15.9	31	70.5		
Frequency of shared cotton	No	352	36	10.2	213	60.5	6.19	0.045
	Yes	27	7	25.9	13	48.1		
Front- or back-loading	No	364	40	11.0	220	60.4		0.180 <sup>1</sup>
	Yes	15	3	20.0	6	40.0		
Sexual behaviors (past 6 mo)								
Steady sex partner	No	209	25	12.0	124	59.3	0.18	0.914
	Yes	170	18	10.6	102	60.0		
Sex behavior with non-steady sex partner	No	241	25	10.4	144	59.8	0.72	0.698
	Yes	138	18	13.0	82	59.4		
Steady sex partner of IDU	No	308	35	11.4	182	59.1	0.24	0.889
	Yes	71	8	11.3	44	62.0		
Gave money for sex behavior	No	303	32	10.6	186	61.4	2.09	0.351
	Yes	76	11	14.5	40	52.6		
Received money for sex Behavior	No	334	39	11.7	195	58.4	1.82	0.403
	Yes	45	4	8.9	31	68.9		
Addition of new sex partner(s)	No	264	25	9.5	160	60.6	3.08	0.214
	Yes	115	18	15.7	66	57.4		
Presence of syphilis infection	No	321	30	9.3	189	58.9	13.07	0.001
	Yes	58	13	22.4	37	63.8		

Note:<sup>1</sup> $\chi^2$  Fisher's exact test.

**Table 3** Multivariate logistic regression analyses of risk factors associated with HCV prevalence in IDAs in Xichang County, Sichuan Province, China

Factor	$\beta$	SEM	<i>P</i> -value	Odds ratio	95% CI
Shared needle or syringe in the past 3 mo	1.1380	0.4553	0.0124	3.121	1.278-7.617
Syphilis infection	1.0695	0.4013	0.0077	2.914	1.327-6.398

that shared cotton in the past 3 mo was associated with HCV/HIV coinfection. Some studies reported that factors of indirectly shared injection devices, including cotton, rinse water, and cookers, posed significant risks for HIV infection in IDAs<sup>[30-32]</sup>.

The modes of HCV transmission have been a matter of important controversy in literature<sup>[10-15]</sup>. Although a high prevalence of HCV was found in STD patients, female workers and homosexual partners might be suggestive of sexual transmission, drug injection might also play a significant role in HCV transmission<sup>[14]</sup>. Furthermore, drug injection was the

main risk factor associated with HCV infection in homosexual and bisexual men, while the other risk factors after adjusting injection drug abuse included the number of sexual partners in the past year, anal sex and oral sex behaviors<sup>[33]</sup>. Moreover, Alter *et al.*<sup>[15]</sup> reported that unsafe heterosexual behavior, anal sex and oral sex behavior were associated with HCV infection, suggesting that both sex behavior and injection drug abuse may play significant roles in HCV transmission. Univariate and multivariate analysis showed that syphilis infection was associated with HCV/HIV coinfection and HCV infection.

However, univariate analysis showed that high risk sexual behaviors were not associated with HCV/HIV coinfection. Lai *et al.*<sup>[27]</sup> reported that history of sexually transmitted diseases was independently associated with HIV infection in Guangxi Zhuang Autonomous Region. A study showed that the total number of past sexual partners was associated with HCV infection, but there was no relationship between HCV infection and the total number of sexual partners or sexual behaviors in the past several months<sup>[34]</sup>. Two studies of STD individuals confirmed the important role that IDA played a role in HCV infection and sexual transmission played a minor role in HCV epidemiologies, such as homosexuality/bisexuality, syphilis seropositivity, and a history of syphilis<sup>[35,36]</sup>. In our study, persistent use of condom (vaginal sex only) and non-use of condom in IDAs with steady sex partners, and non steady sex partners accounted for 7.6% (9/119) and 88.2% (105/119), 14.6% (13/89) and 68.5% (61/89) in the past month, respectively. This was the first evidence in our study that syphilis infection might contribute to HCV infection in IDAs in Sichuan Province, and syphilis infection is a significant indicator of past high risk sexual behaviors, which increase risk for HCV sexual transmission.

Further sero-epidemiological prospective cohort studies should be conducted to clarify the impact of syphilis and high risk sexual behaviors on HCV transmission through unprotected sexual intercourse.

#### ACKNOWLEDGEMENTS

The authors would like to thank Dr. Jon L. Yang, School of Medicine, University of California, San Francisco, for his comments.

#### REFERENCES

- 1 **Ma Y**, Li ZZ, Zhang KX, Yang WQ, Ren XH, Yang YF, Ning DM, Cun SZ, Wang BH, Liu SQ, Zhang JP, Zhao SD. Identification of HIV infection among drug users in China. *Zhonghua Liuxing Bingxue Zazhi* 1990; **11**: 184-185
- 2 **Yin N**, Mei S, Li L, Wei FL, Zhang LQ, Cao YZ. Study on the epidemiology and distribution of human immunodeficiency virus-1 and hepatitis C virus infection among intravenous drug users and illegal blood donors in China. *Zhonghua Liuxing Bingxue Zazhi* 2003; **24**: 962-965
- 3 **Zhong RX**, Luo HT, Zhang RX, Li GR, Lu L. Investigation on infection of hepatitis G virus in 105 cases of drug abusers. *World J Gastroenterol* 2000; **6**(Suppl 3): 63-63
- 4 **Hahn JA**, Page-Shafer K, Lum PJ, Ochoa K, Moss AR. Hepatitis C virus infection and needle exchange use among young injection drug users in San Francisco. *Hepatology* 2001; **34**: 180-187
- 5 **Maier I**, Wu GY. Hepatitis C and HIV co-infection: a review. *World J Gastroenterol* 2002; **8**: 577-579
- 6 **Murray JM**, Law MG, Gao Z, Kaldor JM. The impact of behavioural changes on the prevalence of human immunodeficiency virus and hepatitis C among injecting drug users. *Int J Epidemiol* 2003; **32**: 708-714
- 7 **Wu NP**, Li D, Zhu B, Zou W. Preliminary research on the co-infection of human immunodeficiency virus and hepatitis virus in intravenous drug users. *Chin Med J* 2003; **116**: 1318-1320
- 8 **Quaglio GL**, Lugoboni F, Pajusco B, Sarti M, Talamini G, Mezzelani P, Des Jarlais DC. Hepatitis C virus infection: prevalence, predictor variables and prevention opportunities among drug users in Italy. *J Viral Hepat* 2003; **10**: 394-400
- 9 **Taketa K**, Ikeda S, Suganuma N, Phornphutkul K, Peerakome S, Sitvacharanum K, Jittiwutikarn J. Differential seroprevalences of hepatitis C virus, hepatitis B virus and human immunodeficiency virus among intravenous drug users, commercial sex workers and patients with sexually transmitted diseases in Chiang Mai, Thailand. *Hepatol Res* 2003; **27**: 6-12
- 10 **Valdivia JA**, Rivera S, Ramirez D, De Los Rios R, Bussalleu A, Huerta-Mercado J, Pinto J, Piscocoy A. Hepatitis C virus infection in female sexual workers from northern lima. *Rev Gastroenterol Peru* 2003; **23**: 265-268
- 11 **Hammer GP**, Kellogg TA, McFarland WC, Wong E, Louie B, Williams I, Dille J, Page-Shafer K, Klausner JD. Low incidence and prevalence of hepatitis C virus infection among sexually active non-intravenous drug-using adults, San Francisco, 1997-2000. *Sex Transm Dis* 2003; **30**: 919-924
- 12 **Fletcher S**. Sexual transmission of hepatitis C and early intervention. *J Assoc Nurses Aids Care* 2003; **14**(Suppl 5): S87-S94
- 13 **Russi JC**, Serra M, Vinales J, Perez MT, Ruchansky D, Alonso G, Sanchez JL, Russell KL, Montano SM, Negrete M, Weissenbacher M. Sexual transmission of hepatitis B virus, hepatitis C virus, and human immunodeficiency virus type 1 infections among male transvestite commercial sex workers in Montevideo, Uruguay. *Am J Trop Med Hyg* 2003; **68**: 716-720
- 14 **Brettler DB**, Mannucci PM, Gringeri A, Rasko JE, Forsberg AD, Rumi MG, Garsia RJ, Rickard KA, Colombo M. The low risk of hepatitis C virus transmission among sexual partners of hepatitis C-infected hemophilic males: an international multicenter study. *Blood* 1992; **80**: 540-543
- 15 **Alter MJ**, Coleman PJ, Alexander WJ, Kramer E, Miller JK, Mandel E, Hadler SC, Margolis HS. Importance of heterosexual activity in the transmission of hepatitis B and non-A, non-B hepatitis. *JAMA* 1989; **262**: 1201-1205
- 16 **Mendes-Correa MC**, Barone AA, Guastini C. Hepatitis C virus seroprevalence and risk factors among patients with HIV infection. *Rev Inst Med Trop Sao Paulo* 2001; **43**: 15-19
- 17 **Lissen E**, Alter HJ, Abad MA, Torres Y, Perez-Romero M, Leal M, Pineda JA, Torronteras R, Sanchez-Quijano A. Hepatitis C virus infection among sexually promiscuous groups and the heterosexual partners of hepatitis C virus infected index cases. *Eur J Clin Microbiol Infect Dis* 1993; **12**: 827-831
- 18 **Romero M**, Perez-Olmeda M, Garcia-Samaniego J, Soriano V. Management of chronic hepatitis C in patients co-infected with HIV: Focus on safety considerations. *Drug Saf* 2004; **27**: 7-24
- 19 **Livry C**, Binquet C, Sgro C, Froidure M, Duong M, Buisson M, Grappin M, Quantin C, Portier H, Chavanet P, Piroth L. Acute liver enzyme elevations in HIV-1-infected patients. *HIV Clin Trials* 2003; **4**: 400-410
- 20 **Quintana M**, del Amo J, Barrasa A, Perez-Hoyos S, Ferreros I, Hernandez F, Villar A, Jimenez V, Bolumar F. Progression of HIV infection and mortality by hepatitis C infection in patients with haemophilia over 20 years. *Haemophilia* 2003; **9**: 605-612
- 21 **Hisada M**, Chatterjee N, Zhang M, Battjes RJ, Goedert JJ. Increased hepatitis C virus load among injection drug users infected with human immunodeficiency virus and human T lymphotropic virus type II. *J Infect Dis* 2003; **188**: 891-897
- 22 **Klein MB**, Lalonde RG, Suissa S. The impact of hepatitis C virus coinfection on HIV progression before and after highly active antiretroviral therapy. *J Acquir Immune Defic Syndr* 2003; **33**: 365-372
- 23 **Greub G**, Ledergerber B, Battegay M, Grob P, Perrin L, Furrer H, Burgisser P, Erb P, Boggian K, Piffaretti JC, Hirschel B, Janin P, Francioli P, Flepp M, Telent A. Clinical progression, survival, and immune recovery during antiretroviral therapy in patients with HIV-1 and hepatitis C virus coinfection: the Swiss HIV Cohort Study. *Lancet* 2000; **356**: 1800-1805
- 24 **Piroth L**, Duong M, Quantin C, Abrahamowicz M, Michardiere R, Aho LS, Grappin M, Buisson M, Waldner A, Portier H, Chavanet P. Does hepatitis C virus co-infection accelerate clinical and immunological evolution of HIV-infected patients? *AIDS* 1998; **12**: 381-388
- 25 **Paris R**, Sirisopana N, Benenson M, Amphaiphis R, Tuntichaivanich C, Myint KSA, Brown AE. The association between hepatitis C virus and HIV-1 in preparatory cohorts for HIV vaccine trials in Thailand. *AIDS* 2003; **17**: 1363-1367
- 26 **Zhang CY**, Yang RG, Xia XS, Qin SY, Dai JP, Zhang ZB, Peng ZZ, Wei T, Liu H, Pu DC, Luo JH, Takebe YT, Ben KL. High

- prevalence of HIV-1 and hepatitis C virus coinfection among injection drug users in the southeastern region of Yunnan, China. *JAIDS* 2002; **29**: 191-196
- 27 **Lai SH**, Liu W, Chen J, Yang JY, Li ZI, Li RJ, Liang FX, Liang SL, Zhu QY, Yu XF. Changes in HIV-1 incidence in Heroin Users in Guangxi province, China. *JAIDS* 2001; **26**: 365-370
- 28 **Yang TL**, Xu YC, Hu XH. The prevalence of HIV, HBC and HCV among drug users in Xichang county of Sichuan province. *Yufang Yixue Qingbao Zazhi* 2001; **17**: 170-171
- 29 **Wei DY**, Ma MJ, Gong WH, Han YH. The survey of HIV, HBV and HCV infection. *Yufang Yixue Qingbao Zazhi* 2000; **16**: 187
- 30 **Denis B**, Dedobbeleer M, Collet T, Petit J, Jamouille M, Hayani A, Brenard R. High prevalence of hepatitis C virus infection in belgian intravenous drug users and potential role of the "cotton-filter" in transmission: the GEMT study. *Acta Gastroenterol Belg* 2000; **63**: 147-153
- 31 **Hagan H**, Thiede H, Weiss NS, Hopkins SG, Duchin JS, Alexander ER. Sharing of drug preparation equipment as a risk factor for hepatitis C. *Am J Public Health* 2001; **91**: 42-46
- 32 **Thorpe L**, Ouellet L, Hershov R, Bailey S, Williams II, Monerrosso E. The multiperson use of non-syringe injection equipment and risk of hepatitis C infection in a cohort of young adult injection drug users, Chicago 1997-1999. *Ann Epidemiol* 2000; **10**: 472-473
- 33 **Osmoda DH**, Charlebois E, Sheppard HW, Page K, Winkelstein W, Moss AR, Reingold A. Comparison of risk factors for hepatitis C and hepatitis B virus infection in homosexual men. *J Infect Dis* 1993; **167**: 66-71
- 34 **Zhou PY**, Xu JH, Liao KH, Xu M, Wang JS. A survey of HCV prevalence and sexual behavior among STD patients in STD clinic. *Zhonghua Pifuke Zazhi* 1999; **32**: 403-404
- 35 **Fiscus SA**, Kelly WF, Battigelli DA, Weber DJ, Schoenbach VJ, Landis SE, Wilber JC, Van der Horst CM. Hepatitis C virus seroprevalence in clients of sexually transmitted disease clinics in North Carolina. *Sex Transm Dis* 1994; **21**: 155-160
- 36 **Bodsworth NJ**, Cunningham P, Kaldor J, Donovan B. Hepatitis C virus infection in a large cohort of homosexually active men: independent associations with HIV-1 infection and injecting drug use but not sexual behaviour. *Genitourin Med* 1996; **72**: 118-122

Edited by Wang XL and Xu FM