

Hepatitis virus and HIV infections in inmates of a state correctional facility in Mexico

C. ALVARADO-ESQUIVEL^{1*}, E. SABLON², S. MARTÍNEZ-GARCÍA¹
AND S. ESTRADA-MARTÍNEZ³

¹ *Facultad de Medicina, Universidad Juárez del Estado de Durango, México*

² *Innogenetics NV, Ghent, Belgium*

³ *Instituto de Investigación Científica, Universidad Juárez del Estado de Durango, México*

(Accepted 5 January 2005)

SUMMARY

We sought to determine the prevalence and associated characteristics of hepatitis A, B, C and D viruses and HIV infections in a prison in Durango, Mexico. Sera from 181 inmates were analysed for HAV antibody, hepatitis B core antibody (HBcAb), hepatitis B surface antigen (HBsAg), HCV antibody, HDV antibody, HIV antibody and HCV genotypes. Prevalence of HAV antibody, HBcAb, HBsAg, HCV antibody, HDV antibody and HIV antibody were 99·4, 4·4, 0·0, 10·0, 0·0 and 0·6% respectively. HCV genotype 1a predominated in HCV-infected inmates (62·5%), followed by HCV genotype 1b (25%) and HCV genotype 3 (12·5%). An association between HBV infection and age > 30 years was found. HCV infection was associated with being born in Durango City, history of hepatitis, ear piercing, tattooing, drug abuse history, intravenous drug use and lack of condom use. We concluded that the prevalence of HAV, HBV, HDV and HIV infections in inmates in Durango, Mexico were comparable to those of the Mexican general population and blood donors, but lower than those reported in other prisons around the world. However, HCV infection in inmates was higher than that reported in Mexican blood donors but lower than those reported in other prisons of the world. These results have implications for the optimal planning of preventive and therapeutic measures.

INTRODUCTION

Hepatitis viruses and human immunodeficiency virus (HIV) infections are responsible for considerable morbidity and mortality worldwide. Hepatitis A virus (HAV) is transmitted by the faecal–oral route and water- and foodborne outbreaks are common in areas lacking proper sanitation [1, 2]. Hepatitis B virus (HBV), hepatitis C virus (HCV), and hepatitis delta virus (HDV) are mainly transmitted parenterally and

are major causes of chronic liver disease, including liver cirrhosis and end-stage liver failure [2–4]. Furthermore, long-lasting HBV and HCV infections can result in hepatocellular carcinoma [2, 3]. Hepatitis A, B and C occur 100–200 times more frequently among prisoners than in the normal population [5]. In addition, the prevalence of HIV infection is approximately five times higher in state and federal prisons than among the general US population [6]. The prevalence of hepatitis viruses and HIV infections among prisoners of different countries varies substantially [7–10]. Reports indicate that the highest prevalence of HBV, HCV and HIV infections in inmates was found in a Brazilian prison (68·1, 41 and

* Author for correspondence: Dr C. Alvarado-Esquivel, Departamento de Microbiología, Facultad de Medicina, Avenida Universidad y Fanny Anitua, 34000 Durango, Dgo, México. (Email: alvaradocosme@yahoo.com)

13.7% respectively) [11]. The lowest HBV and HCV prevalence was reported in an Indian jail (11.1 and 5% respectively) [12], and the lowest HIV prevalence was seen in a prison in England (0.26%) [13]. High-risk practices before incarceration are responsible for an important number of infections. HAV infection in Mexico is high (~90%) [14] whereas the prevalence of HBV, HCV and HIV in Mexican blood donors is low (1.12, 1.14 and 0.11% respectively) [15]. HBV genotypes A, D and F, and HCV genotypes 1a, 1b, 2a, 2b, 2c and 3a have been found in both blood donors and patients with liver disease in most Mexican states, including Durango State [16]. There is a lack of information concerning the prevalence of hepatitis virus and HIV infections as well as HBV and HCV genotypes in Mexican inmates. Therefore, we performed a cross-sectional study in a correctional facility in northern Mexico to determine the HAV, HBV, HCV, HDV and HIV prevalence in inmates, to describe the HCV genotypes and determine whether any socio-demographic or epidemiological characteristics of the inmates were associated with these infections.

METHODS

Study population

This study was performed in a correctional facility in Durango, Mexico. The facility could hold 1150 inmates. A sample size calculation was performed based on the reported prevalence of hepatitis virus [11, 12, 14, 15] and HIV infections [11, 13, 15]. A 99% confidence level sample size of 174 inmates was obtained. A total of 184 of the 1150 inmates were chosen randomly and invited to participate in the study. Inmates were selected from the prison list by random number tables. In total, 181 out of the 184 chosen inmates agreed to participate. General demographic characteristics such as age, gender, birthplace and marital status in selected inmates were comparable to those of unselected inmates. Serum samples collected from the inmates were obtained from December 2001 to January 2002 and kept frozen until analysed. This study was evaluated and accepted by the institutional ethical committee. Written informed consent was obtained from all individuals participating in the study. Results of the tests were given to the inmates by the prison doctor.

The study participants completed an interviewer-administered questionnaire that assessed general socio-demographic and epidemiological characteristics associated with hepatitis virus and HIV

infections. The questionnaire was administered by a specially trained nurse. Data including age, gender, birthplace, marital status, occupation before incarceration, number and duration of incarcerations, history of hepatitis, history of hepatitis in family members or occupational exposures to hepatitis patients, transfusions, surgery, acupuncture, ear piercing, tattooing, history of traumatic injury, sexually transmitted diseases, sexual promiscuity, homosexuality, lack of condom use, haemodialysis, national and international trips, health status, socioeconomic level, consumption of alcohol, and drug abuse history from all 181 subjects studied were obtained. Socioeconomic status was obtained by using Bronfman's criteria [17]. Briefly, six socioeconomic variables were evaluated, namely the number of persons and rooms in the house, type of floor material, drinking water availability, sanitary facilities and education of the head of the family.

Serological markers for hepatitis virus and HIV infections

The sera of the 181 inmates were screened for HAV antibody, hepatitis B core antibody (HBcAb), HBsAg, HCV antibody and HIV antibody by using Microparticle Enzyme Immunoassays (IMx HAVAB, IMx CORE, IMx HBsAg (V2), IMx HCV version 3.0, and IMx HIV-1/HIV-2 III Plus respectively, all manufactured by Abbott Laboratories, Abbott Park, IL, USA). When sera tested positive in the HBsAg and/or HBcAb tests, additional screening for HDV antibody by using the enzyme immunoassay ETI-AB-DELTA-2 (Dia Sorin, Saluggia, Italy) was carried out. In addition, positive HCV or HIV antibody results were confirmed using alternative assays (INNO-LIA HCV Ab III update, Innogenetics NV, Ghent, Belgium, and New Lab Blot I, Bio-Rad, Marnes la Coquette, France respectively).

HBV DNA detection

Serum samples positive for HBsAg by IMx HBsAg (V2) test were further analysed by polymerase chain reaction (PCR). DNA was extracted from 200 μ l of serum by using the High Pure PCR Template Preparation kit (Roche Diagnostics GmbH, Mannheim, Germany) according to the manufacturer's instructions. Extracted DNA was amplified by two-round PCR using HBV pol primers (Innogenetics NV). The amplification profile was as follows: denaturation at

94 °C for 1 min, annealing at 55 °C for 1 min, and extension at 72 °C for 1 min. PCR products were subjected to electrophoresis in 2% agarose gels, stained with ethidium bromide and visualized under ultraviolet illumination.

HCV RNA detection and HCV genotyping

These assays were performed as described elsewhere [18]. Briefly, RNA was extracted from 50 µl of serum by modification of a method described previously [19]. After reverse transcription (RT) at 42 °C for 90 min, complementary DNA was amplified by two-round PCR (RT-PCR) using primers from the highly conserved 5'-UR of the HCV genome. The amplification profile was as follows: denaturation at 95 °C for 1 min, annealing at 55 °C for 1 min, and extension at 72 °C for 1 min. PCR products were subjected to electrophoresis in 2% agarose gels, stained with ethidium bromide, and visualized under ultraviolet illumination. HCV genotyping was performed by Versant HCV genotyping assay according to the manufacturer's instructions (Bayer, Tarrytown, NY, USA).

Statistical analysis

Sample size calculations and results analysis were performed using Epi-Info version 6 software [20]. To assess the association between the characteristics of the subjects and the infection, an odds ratio (OR) with a 95% exact confidence interval (CI) was used. We calculated the 'exact' confidence interval because the cell value (number of infected or uninfected inmates) was less than five in some comparisons. For age comparison among the groups, a Student's *t* test was used.

RESULTS

In total, 174 men and seven women participated in the study. The mean age of the inmates studied was 32.2 years (range 17–74 years). Their occupations before incarceration were: three housewives (1.7%), nine students (5%), 39 clerks (21.5%), seven professionals (3.9%), 82 construction workers (45.3%), 10 businessmen (5.5%) and eight agriculturists (17.1%). Their marital status included 73 never married (40.3%), 78 married (43.1%), five divorced (2.8%), 24 lived together (13.3%), and one widowed (0.6%). Sixty-six inmates were born in Durango City (36.5%), 71 in

other towns in Durango State (39.2%), 42 were born in Mexican states other than Durango (23.2%), and two were born abroad (1.1%). Fifty-eight per cent of the inmates lived in Durango City before incarceration, while 27% lived in other towns in Durango State, 13% in Mexican states other than Durango and 2% abroad. In total, 127 seven inmates (70.2%) were screened during their first admission to prison, 36 (19.9%) during their second admission, 11 (6.1%) during their third admission, four (2.2%) in their fourth admission, and three (1.6%) during their fifth to seventh admission. A total of 171 (94.5%) inmates had been incarcerated only in the prison in Durango City and the rest had been incarcerated previously in other Mexican prisons (4.4%) or abroad (1.1%). Median duration of incarceration was 25.5 months (interval 1–168 months). History of hepatitis was present in six inmates (3.3%). History of hepatitis in family members or occupational exposure to hepatitis patients was present in eight inmates (4.4%). Twenty-one of the 181 inmates (11.6%) had received blood transfusions, 57 (31.5%) had undergone surgery, four (2.2%) acupuncture, 47 (26.0%) had ear piercing, 64 (35.4%) had tattoos, 58 (32.0%) had a history of traumatic wounds and none had ever undergone haemodialysis. History of sexually transmitted diseases was present in 25 (13.8%) inmates. Ninety-nine inmates (54.7%) had a history of drug use (any kind of drug and route of administration), nine of whom used intravenous drugs. In addition, 150 inmates (82.9%) had excessive alcohol consumption. With respect to sexual behaviour, 136 inmates (75.1%) had more than one sexual partner, 62 (34.3%) used to use condoms, 11 (6.1%) were homosexuals and three (1.7%) were bisexuals. Twenty-five (13.8%) inmates had had sexual partners from a state other than Durango or from abroad. Eighty-five inmates (47%) had a history of national trips and 48 inmates (26.7%) had had international trips. The health status was good in 127 (70.2%) of the inmates and the rest suffered from diseases of diverse aetiology. The socioeconomic level was low in 26 (14.4%), medium in 87 (48.1%) and high in 68 (37.6%) of the inmates.

HAV antibody was detected in 180 out of 181 inmates (99.4%), therefore, no association between the infection and any characteristic of the inmates could be drawn.

Eight inmates (4.4%) were reactive for HBcAb by IMx CORE test, and five (2.8%) for HBsAg by IMx HBsAg (V2) test. All five sera reactive for HBsAg by IMx HBsAg (V2) test were further analysed and were

Table. Characteristics of the inmates and their association with HCV infection

Characteristic	Inmates No. (%)	Test for HCV		OR	95% CI
		Positive No. (%)	Negative No. (%)		
Characteristic	180 (100)	18 (10.0)	162 (90.0)		
Place of birth					
Durango State (except Durango City)	70 (38.9)	2 (2.9)	68 (97.1)	6.07	1.21–58.56
Durango City	66 (36.7)	10 (15.2)	56 (84.8)	1.00	
Other Mexican states and abroad	44 (24.4)	6 (13.6)	38 (86.4)	1.13	0.34–4.12
History of hepatitis					
Yes	6 (3.3)	3 (50.0)	3 (50.0)	10.6	1.27–84.05
No	174 (96.7)	15 (8.6)	159 (91.4)	1.00	
Ear piercing					
Yes	47 (26.1)	9 (19.1)	38 (26.1)	3.26	1.08–9.87
No	133 (73.9)	9 (6.8)	124 (93.2)	1.00	
Tattooing					
Yes	64 (35.6)	17 (26.6)	47 (73.4)	41.6	6.06–1752.87
No	116 (64.4)	1 (0.9)	115 (99.1)	1.00	
Drug abuse history					
Yes	98 (54.4)	17 (17.3)	81 (82.7)	17.0	2.52–719.03
No	82 (45.6)	1 (1.2)	81 (98.8)	1.00	
Intravenous drug use					
Yes	9 (5)	6 (66.7)	3 (33.3)	26.5	4.74–176.24
No	171 (95)	12 (7)	159 (93)	1.00	
Lack of condom use					
Yes	118 (65.6)	17 (14.4)	101 (85.6)	10.27	1.52–435.99
No	62 (34.4)	1 (1.6)	61 (98.4)	1.00	

OR, Odds ratio; CI, confidence interval.

found to be negative. Sera of all eight inmates positive for HBcAb by IMx CORE test were HDV antibody negative. When the general characteristics of the HBV positive and negative subjects were compared, an association between HBV infection and age >30 years was found (OR 6.52, 95% CI 1.11–37.03).

Nineteen of the 181 inmates' sera were positive for HCV antibody in the screening test. Sera of these 19 inmates were analysed by the confirmatory INNO-LIA HCV Ab III update test and RT-PCR. Eighteen of the 19 sera were positive and one was indeterminate in the immunoblot, and 16 of the 19 sera were positive for HCV RNA. Amplification products of all 16 HCV RNA-positive sera were genotyped by INNO-LiPA HCV II. HCV genotype 1a was found in 10 subjects, HCV genotype 1b in four subjects and HCV genotype 3 was observed in two subjects. Since one out of the 19 HCV screening test-positive sera was indeterminate in the immunoblot assay and negative by RT-PCR, we could not assess the HCV status and excluded this sample for statistical analysis. We calculated the

prevalence of HCV infection in 180 subjects; thus, the prevalence of confirmed HCV antibody in the inmates was 10%.

A summary of the general characteristics of the inmates associated with HCV infection is shown in the Table. We found that 10% of the inmates had HCV antibody, and the prevalence of HCV antibody in those having a drug use history in general and intravenous drug addicts in particular were 17.3% (OR 17.0, 95% CI 2.52–719.03) and 66.7% (OR 26.5, 95% CI 4.74–176.24) respectively. HCV infection was also associated with being born in Durango City (OR 6.07, 95% CI 1.21–58.56), and history of hepatitis (OR 10.6, 95% CI 1.27–84.05). We found also an association with ear piercing (OR 3.26, 95% CI 1.08–9.87) and tattooing (OR 41.6, 95% CI 6.06–1752.87). Interpretation of the latter association should be made carefully because a quite wide 95% CI was obtained. Subjects not using condoms had a higher prevalence of HCV infection (14.4%) than those who did (1.6%) (OR 10.27, 95% CI 1.52–435.99). Nevertheless, a careful interpretation of

this result must also be made because the 95% CI was similarly quite wide.

One of the 181 inmates (0.6%) was HIV antibody positive and no association could be drawn.

DISCUSSION

The 99.4% prevalence figure for HAV infection among the inmates was much higher than that reported in other prisons in the world (<38%) [21, 22] but comparable to that reported in the general population of Mexico. In a recent study, nearly 90% of Mexican children aged between 11 and 15 years showed serological evidence of HAV infection [14]. Therefore, it is highly likely that HAV infection in the inmates examined occurred before incarceration.

With respect to HBV infection, the 4.4% prevalence was based on HBcAb results, since all five HBsAg reactive samples by IMx HBsAg (V2) test turned out to be negative by HBV PCR. The prevalence found in the inmates was comparable with that reported in Mexican blood donors [15]. On the other hand, the prevalence of HBV infection found in our study is lower than that reported in other prisons in the world (29.5–66.5%) [8, 23–26]. In the present study, we found an association between HBV infection and age >30 years (OR 6.52, 95% CI 1.11–37.03). This observation agrees with that reported by Butler et al. [27] in which age >25 years was a significant predictor for HBV infection in inmates entering a correctional facility. Other characteristics of the inmates reported as strongly associated with HBV marker presence, such as intravenous drug use [28, 29] and duration of current imprisonment [23], did not show any association with HBV infection in our study. Concerning HDV infection, none of the inmates with evidence of HBV infection had HDV antibody. This frequency is relatively lower than that reported in an American study [28] where researchers found that 8% of HBV-infected inmates had HDV markers.

The frequency of HCV antibody found in inmates of Durango (10%) was higher than that found in Mexican blood donors [15], but lower than those reported in prisons from abroad where the prevalence is >30% [7, 8, 11]. There are no studies showing the prevalence of HCV infection in the Mexican general population. Several studies indicate that the majority of HCV infections in inmates occur before incarceration [7, 11]. We think that most, if not all,

HCV-infected subjects in our study population acquired HCV infection before incarceration as we did not find enough evidence to support infection during incarceration. The high frequency of HCV infection among intravenous drug users found in this study agrees well with previous observations [5, 7, 30]. The higher frequency of HCV infection among inmates born in Durango City than those born in other towns or cities in Durango State may be explained by the higher frequency of tattoos, ear piercing, lack of condom use and drug use in subjects born in Durango City than those born elsewhere. We found that HCV genotype 1a was predominant in HCV-infected inmates (62.5%), followed by HCV genotype 1b (25%) and HCV genotype 3 (12.5%). The prevalence of HCV genotype 1a found in the inmates was higher than that reported in blood donors and patients with liver disease in Mexico [16] in whom HCV genotype 1b is predominant. Differences in these genotype prevalences might be due to differences in frequencies of risk factors. Reports on HCV genotypes found in inmates are scarce. One study showed that HCV genotypes 1a and 1b were also predominant in HCV-infected inmates in Manila [31].

The prevalence of HIV antibody in the inmates was 0.6%, which was comparable with that reported in Mexican blood donors [15] and in an Indian [32] and English prison [33], where 1.3 and 0.26% of the inmates were HIV infected respectively. Nevertheless, the frequency was lower than that reported in a Brazilian [34] and French prison [24], where 16 and 6% of the inmates had HIV infections respectively. The 99% confidence level sample size allows us to obtain reliable prevalence figures for hepatitis virus and HIV infections in inmates of the correctional facility studied. Nevertheless, the relatively low frequency of HBV, HCV and HIV infections and the extremely high frequency of HAV infection found in the inmates limited the study in detecting associations by multivariate analysis.

We conclude that the prevalence of HAV, HBV, HDV and HIV infections in inmates in Durango, Mexico was comparable with those reported in other Mexican populations. However, HCV prevalence in inmates was higher than that reported in Mexican blood donors. This high prevalence of HCV infection in inmates may reflect an increased frequency of high-risk behaviour in the community outside prison, and it should be of concern to apply optimal preventive and therapy measures inside as well as outside prison.

ACKNOWLEDGEMENTS

This work was supported by a grant from Sistema de Investigación Francisco Villa (SIVILLA). Grant no. 20000402011.

REFERENCES

- Lappalainen M, Chen RW, Maunula L, von Bonsdorff C, Plyusnin A, Vaheri A. Molecular epidemiology of viral pathogens and tracing of transmission routes: hepatitis-, calici- and hantaviruses. *J Clin Virol* 2001; **21**: 177–185.
- Poovorawan Y, Chatchatee P, Chongsrisawat V. Epidemiology and prophylaxis of viral hepatitis: a global perspective. *J Gastroenterol Hepatol* 2002; **17**: S155–166.
- Befeler AS, Di Bisceglie AM. Hepatitis B. *Infect Dis Clin North Am* 2000; **14**: 617–632.
- Gerken G, Meyer zum Buschenfelde KH. Chronic hepatitis delta virus (HDV) infection. *Hepatogastroenterology* 1991; **38**: 29–32.
- Gaube J, Feucht HH, Laufs R, Polywka S, Fingscheidt E, Muller HE. Hepatitis A, B and C as desmotic infections. *Gesundheitswesen* 1993; **55**: 246–249.
- Krebs CP, Simmons M. Intraprison HIV transmission: an assessment of whether it occurs, how it occurs, and who is at risk. *AIDS Educ Prev* 2002; **14**: 53–64.
- Reindollar RW. Hepatitis C and the correctional population. *Am J Med* 1999; **107**: 100–103S.
- Butler T, Spencer J, Cui J, Vickery K, Zou J, Kaldor J. Seroprevalence of markers for hepatitis B, C and G in male and female prisoners – NSW, 1996. *Aust NZ J Public Health* 1999; **23**: 377–384.
- Gore SM, Bird AG, Cameron SO, Hutchinson SJ, Burns SM, Goldberg DJ. Prevalence of hepatitis C in prisons: WASH-C surveillance linked to self-reported risk behaviours. *QJM* 1999; **92**: 25–32.
- Ford PM, White C, Kaufmann H, et al. Voluntary anonymous linked study of the prevalence of HIV infection and hepatitis C among inmates in a Canadian federal penitentiary for women. *Can Med Assoc J* 1995; **153**: 1605–1609.
- Guimaraes T, Granato CF, Varella D, Ferraz ML, Castelo A, Kallas EG. High prevalence of hepatitis C infection in a Brazilian prison: identification of risk factors for infection. *Braz J Infect Dis* 2001; **5**: 111–118.
- Singh S, Prasad R, Mohanty A. High prevalence of sexually transmitted and blood-borne infections amongst the inmates of a district jail in Northern India. *Int J STD AIDS* 1999; **10**: 475–478.
- Edwards A, Curtis S, Sherrard J. Survey of risk behaviour and HIV prevalence in an English prison. *Int J STD AIDS* 1999; **10**: 464–466.
- Tanaka J. Hepatitis A shifting epidemiology in Latin America. *Vaccine* 2000; **18**: S57–60.
- Carreto-Velez MA, Carrada Bravo T, Martínez Magdaleno A. Seroprevalence of HBV, HCV, and HIV among blood donors in Irapuato, Mexico. *Salud Publica Mex* 2003; **45**: S690–S693.
- Alvarado-Esquivel C, Wyseur A, Herrera-Ortiz FM, et al. Hepatitis B and C virus infections in Mexico: genotypes and geographical distribution in blood donors and patients with liver disease. In: *Therapies for Viral Hepatitis*, chapter 5. London: International Medical Press, 1998: 35–41.
- Bronfman M, Guiscafré H, Castro V, Castro R, Gutiérrez G. Measuring inequality: a methodological approach, analysis of social and economic characteristics of the sample studied. *Arch Invest Med* 1988; **19**: 351–360.
- Stuyver L, Rossau R, Wyseur A, et al. Typing of hepatitis C virus isolates and characterization of new subtypes using a line probe assay. *J Gen Virol* 1993; **74**: 1093–1102.
- Chomczynski P, Sacchi N. Single-step method of RNA isolation by acid guanidinium thiocyanate-phenol-chloroform extraction. *Anal Biochem* 1987; **162**: 156–159.
- Epi-Info [computer program]. Version 6. Atlanta, GA: Centers for Disease Control and Prevention, 1994.
- Skidmore S, Parry JV, Nottage P. An investigation of the potential risk of an HAV outbreak in a prison population following the introduction of cases from a community outbreak. *Commun Dis Public Health* 2001; **4**: 133–135.
- Whiteman D, McCall B, Falconer A. Prevalence and determinants of hepatitis A virus exposure among prison entrants in Queensland, Australia: implications for public health control. *J Viral Hepat* 1998; **5**: 277–283.
- Decker MD, Vaughn WK, Brodie JS, Hutcheson Jr. RH, Schaffner W. Seroepidemiology of hepatitis B in Tennessee prisoners. *J Infect Dis* 1984; **150**: 450–459.
- Rotily M, Vernay-Vaisse C, Bourliere M, Galinier-Pujol A, Rousseau S, Obadia Y. HBV and HIV screening, and hepatitis B immunization programme in the prison of Marseille, France. *Int J STD AIDS* 1997; **8**: 753–759.
- Schwarz TF, Kam CC, Min GL, et al. Prevalence of antibodies against hepatitis A virus, hepatitis B virus, and *Treponema pallidum* in Mauritius. *Scand J Infect Dis* 1991; **23**: 535–541.
- del Olmo JA, Llovet F, Rodrigo JM, et al. Prevalence of liver disease and infection by hepatitis B, delta virus, and human immunodeficiency virus in two Spanish penitentiaries. *Med Microbiol Immunol* 1990; **179**: 43–48.
- Butler TG, Dolan KA, Ferson MJ, McGuinness LM, Brown PR, Robertson PW. Hepatitis B and C in New South Wales prisons: prevalence and risk factors. *Med J Aust* 1997; **166**: 127–130.
- Barry MA, Gleavy D, Herd K, Schwingl PJ, Werner BG. Prevalence of markers for hepatitis B and hepatitis D in a municipal house of correction. *Am J Public Health* 1990; **80**: 471–473.

29. **Tucker RM, Gaffey MJ, Fisch MJ, Kaiser DL, Guerrant RL, Normansell DE.** Seroepidemiology of hepatitis D (delta agent) and hepatitis B among Virginia State prisoners. *Clin Ther* 1987; **9**: 622–628.
30. **Gore SM, Bird AG, Cameron SO, Hutchinson SJ, Burns SM, Goldberg DJ.** Prevalence of hepatitis C in prisons: WASH-C surveillance linked to self-reported risk behaviors. *QJM* 1999; **92**: 25–32.
31. **Katayama Y, Barzaga NG, Alipio A, et al.** Genotype analysis of hepatitis C virus among blood donors and inmates in Metro Manila, The Philippines. *Microbiol Immunol* 1996; **40**: 525–529.
32. **Singh S, Prasad R, Mohanty A.** High prevalence of sexually transmitted and blood-borne infections amongst the inmates of a district jail in Northern India. *Int J STD AIDS* 1999; **10**: 475–478.
33. **Edwards A, Curtis S, Sherrard J.** Survey of risk behaviour and HIV prevalence in an English prison. *Int J STD AIDS* 1999; **10**: 464–466.
34. **Burattini M, Massad E, Rozman M, Azevedo R, Carvalho H.** Correlation between HIV and HCV in Brazilian prisoners: evidence for parenteral transmission inside prison. *Rev Saude Publica* 2000; **34**: 431–436.