Trends in prevalence of HIV infection, hepatitis B and hepatitis C among Australian prisoners — 2004, 2007, 2010

Joanne M Reekie
PhD, MPhil, BSc
Senior Research Officer[1]

Michael H Levy
MB BS, MPH, FAFPHM
Professor of Medicine[2]

Alun H Richards
MB BCh, FAFPHM, FAChAM
Director, Blood Borne Viruses[3]

Christopher J Wake
MB BCh, MRCP, MForensMed
Clinical Director, Custodial Medicine[4]

Deborah A Siddall
AdDipCommServ, DipCommEduc, DipAppSc
Population Health Coordinator[5]

Holly M Beasley
BSc, PostGradDip(IntHealth)
Blood Borne Virus Consultant[6]

Shalin Kumar
MHlthSc, MAppMan
Manager, Compulsory Drug Treatment Program[7]

Tony G Butler
MSc, MSc, PhD
Head, Justice Health Research Program[1]

1 Kirby Institute, University of New South Wales, Sydney, NSW.

2 ANU College of Medicine, Biology and Environment, Australian National University, Canberra, ACT.

3 Communicable Diseases Unit, Queensland Health, Queensland Government, Brisbane, QLD.

4 Correctional Primary Health Service, Department of Health and Human Services, Tasmanian Government, Hobart, TAS.

5 Forensic Health Services, Australasian Hepatology Association, Hobart, TAS.

6 Department of Corrective Services, Government of Western Australia, Perth, WA.

7 Justice Health and Forensic Mental Health Network, Sydney, NSW.

jreekie@kirby.unsw.edu.au

MJA 2014; 200: 277-280
doi: 10.5694/mja13.11062

Abstract

Objective: To report the prevalence of markers for HIV infection, hepatitis B and hepatitis C among Australian prison entrants.

Design: Cross-sectional survey conducted over 2-week periods in 2004, 2007 and 2010.

Setting: Reception prisons in New South Wales, Queensland, Tasmania and Western Australia.

Participants: Individuals entering prison from the community during the survey periods.

Main outcome measure: Prevalence of anti-HIV antibody (anti-HIV), hepatitis B surface antigen (HBsAg), anti-hepatitis B core antibody (anti-HBc) and anti-hepatitis C virus antibody (anti-HCV).

Results: The study included 1742 prison entrants: 588 (33.8%) in 2004, 536 (30.8%) in 2007 and 618 (35.5%) in 2010. The age-standardised prevalence estimates for anti-HIV, HBsAg and anti-HBc were 0.4%, 2.3% and 21.7% respectively, and remained stable over the three survey periods. The age-standardised prevalence estimate for anti-HCV was 29.0%; it decreased over time (33.3% in 2004 v 23.2% in 2010; $P = 0.001$), and this coincided with a decrease in prison entrants reporting injecting drug use (58.3% [343/588] in 2004 v 45.3% [280/618] in 2010; $P < 0.001$). Among injecting drug users, the prevalence of anti-HCV was 57.2% and did not change significantly over time. Of those who were anti-HCV positive, 33.7% (140/415) were unaware of their infection status, and 74.3% (185/249) of those who tested positive for anti-HBc reported that they had never had hepatitis B.

Conclusions: HIV prevalence is low in the Australian prisoner population but transmission remains a risk. Despite a decrease in the proportion of prison entrants reporting injecting drug use, prevalence of hepatitis B and hepatitis C has remained high. Treatment and prevention initiatives should be prioritised for this population.

Prisoners endure some of the worst health outcomes and are known to engage in various kinds of health-risk behaviour, including substance misuse (eg, injecting drug use), risky sexual behaviour, tattooing and violence.[1-3]

Risky behaviour does not cease on entry to prison. About half of injecting drug users (IDUs) continue to inject illicit drugs while in prison, where access to clean injecting equipment is the exception.[4] Sharing of contaminated injecting equipment, tattooing and other forms of blood-to-blood contact have been implicated in the transmission of HIV and hepatitis viruses among prison inmates,[5] and incarceration is associated with prevalent and incident HIV infection, hepatitis B and hepatitis C, particularly among IDUs.[6-8]

Many prisoners are incarcerated for short periods before they are released back into the community. Recently released IDUs are more likely to report sharing syringes compared with IDUs who have no history of incarceration.[9] Given the potential for incarcerated populations to affect the health of the general community, particularly in the context of infectious diseases, ongoing surveillance of the prisoner population to monitor this risk is important.

Here, we report the prevalence of exposure to HIV, hepatitis B virus, and hepatitis C virus among prisons entrants in Australia and describe changes between three survey periods (2004, 2007 and 2010).

Methods

The National Prison Entrants' Bloodborne Virus Survey (NPEBBVS) commenced in Australia in 2004 to provide ongoing data on infectious disease prevalence among people entering prisons from the community.[10] It is a cross-sectional survey of prison entrants that has been conducted over 2-week periods in 2004, 2007 and 2010. Detailed methods are published elsewhere.[10] Briefly, prison entrants from up to 29 reception prisons across Australia have contributed to the survey. Four states contributed to the survey in 2004: New South Wales, Queensland, Tasmania and Western Australia. By 2010, prisons in the Australian Capital Territory, the Northern Territory, South Australia, Tasmania and Victoria also contributed. The survey was conducted from 17 May to 30 May in 2004, from 8 October to 29 October in 2007 and from 11 October to 22 November in 2010. In each jurisdiction, the survey was conducted during 2-week periods, although the start date of the 2-week period differed slightly for some jurisdictions in 2007 and 2010.

Participants

All new receptions during the survey periods were invited to participate. New receptions were defined as individuals entering prison from the community and did not include those already in the system and returning from court appearances or prisoners transiting through the survey sites en route to other facilities. Potential participants were briefed on the project by a reception nurse (with emphasis placed on the voluntary nature of the study) and provided with a description of the procedures (ie, a short questionnaire on risk behaviour followed by blood testing). Written consent was required for participation. Participants were informed that they would receive their test results, with appropriate community follow-up and referrals if needed. The response rate was 77% in 2004, and 76% in 2007 and 2010.[10]

Serological markers

Blood testing included screening for the following markers: anti-HIV antibody (anti-HIV), hepatitis B surface antigen (HBsAg), anti-hepatitis B core

Crude and age-standardised prevalence estimates for anti-HIV, HBsAg, anti-HBc and anti-HCV among prisoners in New South Wales, Queensland, Tasmania and Western Australia, overall and by injecting drug use status — 2004, 2007, 2010

			Overall prevalence (95% CI)		Prevalence among IDUs (95% CI)		Prevalence among non-IDUs (95% CI)	
	No. tested	No. positive	Crude	Age-standardised	Crude	Age-standardised	Crude	Age-standardised
Anti-HIV								
Total	1394	7	0.5%	0.4% (0.1%–0.6%)	0.7%	0.4% (0.1%–0.7%)	0.3%	0.3% (0.0%–0.7%)
2004	436	3	0.7%	0.6% (0.0%–1.4%)	0.8%	0.4% (0.0%–1.0%)	0.6%	0.7% (0.0%–2.1%)
2007	437	4	0.9%	0.6% (0.0%–1.1%)	0.9%	0.6% (0.0%–1.3%)	0.5%	0.2% (0.0%–0.6%)
2010	521	0	0	—	0	—	0	—
HBsAg								
Total	1388	31	2.2%	2.3% (1.4%–3.2%)	3.0%	3.1% (1.5%–4.7%)	1.4%	1.4% (0.4%–2.4%)
2004	440	13	3.0%	2.8% (1.1%–4.4%)	5.0%	4.7% (1.9%–7.6%)	0	—
2007	438	10	2.3%	2.3% (0.7%–3.9%)	2.9%	3.0% (0.3%–5.6%)	1.5%	1.2% (0.0%–2.7%)
2010	510	8	1.6%	1.9% (0.4%–3.3%)	0.9%	0.6% (0.0%–1.5%)	2.1%	2.6% (0.4%–4.8%)
Anti-HBc								
Total	1285	249	19.4%	21.7% (19.1%–24.3%)	25.3%	29.7% (24.7%–34.6%)	12.7%	14.6% (11.4%–17.7%)
2004	433	85	19.6%	21.4% (17.0%–25.7%)	26.9%	33.3% (24.2%–42.4%)	9.4%	10.5% (5.7%–15.2%)
2007	441	91	20.6%	22.6% (18.0%–27.1%)	29.1%	37.9% (31.5%–44.3%)	10.5%	11.6% (6.6%–16.6%)
2010	411	73	17.8%	20.7% (16.2%–25.3%)	18.4%	17.3% (11.8%–22.7%)	17.3%	21.5% (15.2%–27.7%)
Anti-HCV								
Total	1393	415	29.8%	29.0% (26.4%–31.6%)	55.6%	57.2% (52.6%–61.9%)	2.2%	2.7% (1.2%–4.2%)
2004	440	151	34.3%	33.3% (28.6%–37.9%)	56.6%	62.3% (54.7%–69.8%)	3.3%	4.0% (0.8%–7.2%)
2007	437	145	33.2%	31.6% (26.8%–36.4%)	57.7%	59.3% (50.9%–67.6%)	3.5%	4.0% (0.6%–7.3%)
2010	516	119	23.1%	23.2% (19.3%–27.1%)	52.0%	51.9% (43.8%–59.9%)	0.7%	0.9% (0.0%–2.2%)

Anti-HIV = anti-HIV antibody. HBsAg = hepatitis B surface antigen. Anti-HBc = anti-hepatitis B core antibody. Anti-HCV = anti-hepatitis C virus antibody. IDUs = injecting drug users. ◆

antibody (anti-HBc) and anti-hepatitis C virus antibody (anti-HCV).

Statistical methods

Only participants from the four states that contributed to all iterations of the survey were included in the analysis. As injecting drug use is a key risk factor for transmission of many bloodborne viruses (BBVs), prisoners were excluded from the analysis if their injecting drug use status was unknown. The sample size differed slightly for each serological marker as not all participants were successfully tested for all four markers.

Crude and age-standardised prevalence estimates were calculated for anti-HIV, HBsAg, anti-HBc and anti-HCV. Age-standardised prevalence estimates were calculated using the Australian Bureau of Statistics Standard Population for Use in Age-Standardisation Table.

Where a sufficient number of events (>30) were present, Poisson regression was used to assess trends over time after accounting for potentially confounding variables. The following demographic and criminological factors, collected via the questionnaire, were considered for inclusion in the multivariate models: sex, age, Indigenous status, region of birth (Australia, Asia, other Oceania, and other or unknown), sexual identity, tattoos, injecting drug use, number of times in prison, jurisdiction of prison, and postcode in which the participant had spent the most time before entering prison. Postcodes were classified according to the Accessibility/Remoteness Index of Australia and categorised as "highly accessible" or "not highly accessible".[11]

Logistic regression was used to assess factors associated with having previously been tested for HIV or hepatitis C. Stepwise selection was used to develop the multivariate model; a significance level of 0.5 was used for entry and retention in the model.

Analyses were performed using SAS 9.3 (SAS Institute) and Stata 12 (StataCorp).

Ethics approval

Approval for the project was obtained from the human research and ethics committees in the ACT, NSW, SA, Tas and WA. In addition to the health-based ethics committees, approval was sought separately from the corrective services' ethics committees in NSW, QLD, Vic and WA. In WA, approval was granted by the Western Australia Aboriginal Health and Information Ethics Committee. The study was also approved by the Curtin University of Technology Human Research Ethics Committees.

Results

During the survey periods, an estimated 2247 individuals entered prison in NSW, Qld, Tas and WA; 1742 (77.5%) completed the study questionnaire and were included in the analysis (588 [33.8%] in 2004, 536 [30.8%] in 2007 and 618 [35.5%] in 2010). Most participants were men (1567; 90.0%), aged ⩾25 years (1249; 71.7%), heterosexual (1680; 96.4%), and born in Australia (1438; 82.5%). About half of the participants had previously injected drugs (914; 52.5%) (Appendix 1; all appendices online at mja.com.au).

Of the 1394 participants who were tested for anti-HIV, seven tested positive, giving an overall age-standardised prevalence of anti-HIV of 0.4% (Box). The age-standardised prevalence of anti-HIV did not vary significantly between 2004 and 2007 ($P = 0.70$). Due to the small number of events, no multivariate analysis was undertaken.

The overall age-standardised prevalence of HBsAg was 2.3%; there was a non-significant decrease from 2.8% in

2004 to 1.9% in 2010 ($P = 0.15$). In the multivariate analysis, the risk of testing positive for HBsAg did not vary significantly between 2004 and 2007 ($P = 0.51$) or between 2004 and 2010 ($P = 0.19$). Factors associated with an increased risk of testing positive for HBsAg included being born in Oceania (excluding Australia) ($P = 0.03$) or Asia ($P < 0.001$), being Indigenous ($P = 0.003$), and having ever injected drugs ($P = 0.04$) (Appendix 2).

The overall age-standardised prevalence of anti-HBc was 21.7% which remained stable over time (Box) (2004 v 2007, $P = 0.74$; 2004 v 2010, $P = 0.53$). In the multivariate analysis, there was no significant difference in the risk of testing positive for anti-HBc in 2007 ($P = 0.90$) or 2010 ($P = 0.75$) compared with 2004. Participants who were aged ⩾ 25 years ($P < 0.001$), born in Oceania (excluding Australia) ($P < 0.001$) or Asia ($P < 0.001$) or were Indigenous ($P < 0.001$), and those who had ever injected drugs ($P < 0.001$) or had previously been in prison ($P = 0.01$ for 2–4 times in prison, $P = 0.004$ for 5–9 times, $P = 0.03$ for ⩾ 10 times), had an increased risk of testing positive for anti-HBc (Appendix 3). Participants in Qld had a lower risk of testing positive for anti-HBc than those in NSW ($P < 0.001$).

Hepatitis C was the most prevalent BBV; 415 participants tested positive for anti-HCV, giving an overall age-standardised prevalence of 29.0% (Box). The age-standardised prevalence of anti-HCV was similar in 2004 (33.3%) and 2007 (31.6%) ($P = 0.77$) and lower in 2010 (23.2%) compared with 2004 ($P = 0.001$); this coincided with a decrease in prison entrants reporting injecting drug use (58.3% [343/588] in 2004 v 45.3% [280/618] in 2010; $P < 0.001$). However, in the multivariate analysis, there was no significant difference in the risk of testing positive for anti-HCV in 2007 ($P = 0.86$) or 2010 ($P = 0.99$) compared with 2004 (Appendix 4).

The predominant factor associated with testing positive for anti-HCV was injecting drug use (Appendix 4). The proportion of participants who had ever injected drugs declined over time, so the analysis was stratified by injecting drug use status (Box). The overall age-standardised prevalence of anti-HCV among IDUs was 57.2% and this did not vary significantly across the three survey periods: 62.3% in 2004, 59.3% in 2007, and 51.9% in 2010 ($P = 0.67$). Among non-IDUs the overall age-standardised prevalence was 2.7%, and there was a small decrease over time: 4.0% in 2004, 4.0% in 2007, and 0.9% in 2010 ($P = 0.04$).

In addition, participants who were women ($P = 0.05$), aged ⩾ 25 years ($P = 0.001$) or living in highly accessible areas ($P = 0.01$), and those who had previously been in prison ($P = 0.001$ for 2–4 times in prison, $P < 0.001$ for 5–9 times, $P < 0.001$ for ⩾ 10 times), had an increased risk of testing positive for anti-HCV (Appendix 4). Participants in WA had a lower risk of testing positive for anti-HCV compared with those in NSW ($P = 0.003$).

Co-infection

One participant, recruited in 2004, tested positive for both anti-HIV and anti-HCV, but no participants tested positive for both anti-HIV and anti-HBc. Of 1271 participants who were tested for anti-HBc and anti-HCV, 131 (10.3%) tested positive for both (51 in 2004, 52 in 2007, 28 in 2010). Thirteen participants tested positive for both anti-HCV and HBsAg (six in 2004, five in 2007, two in 2010).

Self-reporting versus serological testing

In the questionnaire, 1173 participants (67.3%) reported that they had been tested for HIV (626 [35.9%] in the past year) and 1150 (66.0%) reported that they had been tested for hepatitis C (595 [34.2%] in the past year). One participant who tested positive for anti-HIV was aware of their HIV status, 64 of those who tested positive for anti-HBc (25.7%) reported that they had been infected with HBV and 275 of those who tested positive for anti-HCV (66.3%) reported that they had had hepatitis C.

Those more likely to have had a previous test for HIV and/or hepatitis C were: women (adjusted odds ratio [AOR], 2.47; 95% CI, 1.51–4.05; $P < 0.001$), aged ⩾ 25 years (AOR, 2.00; 95% CI, 1.54–2.59; $P < 0.001$), homosexual or bisexual (AOR, 10.65; 95% CI, 2.34–48.50; $P = 0.002$) and IDUs (AOR, 3.99; 95% CI, 3.06–5.20; $P < 0.001$). Also, participants recruited in 2007 were more likely to have previously been tested than those recruited in 2004 (AOR, 1.54; 95% CI, 1.13–2.10; $P = 0.006$). However, no significant difference was observed between 2004 and 2010 (AOR, 1.24; 95% CI, 0.93–1.68; $P = 0.14$). Participants who had been in prison 2–4 times (AOR, 1.90; 95% CI, 1.45–2.50; $P < 0.001$) and ⩾ 5 times (AOR, 5.62; 95% CI, 3.63–8.72; $P < 0.001$) were more likely to have been tested than first-time prison entrants.

Discussion

The NPEBBVS included about 80% of people entering prisons in Australia during 2-week periods in 2004, 2007 and 2010. Overall, the prevalence of HIV was low. However, despite a decline in the proportion of prisoners who reported injecting drug use, the prevalence of hepatitis B and hepatitis C remained high among prison entrants. Many of those tested were unaware of their infection status.

We estimated the overall anti-HIV prevalence to be 0.4%, which is lower than the rates of HIV infection among prisoners in North America and Europe[12,13] but comparable to anti-HIV prevalence among prisoners in the United Kingdom (0.4%).[14] This reflects the low anti-HIV prevalence among IDUs in Australia (1.5%)[15] and has been attributed to the early adoption of HIV prevention measures such as widespread access to clean injecting equipment, access to methadone, and free and anonymous HIV testing.[16]

We estimated the prevalence of HBsAg to be 2.3% and the prevalence of anti-HBc to be 21.7%, compared with Australian community estimates of 1% and 6.1%, respectively.[17,18] Injecting drug use was associated with an increased risk of testing positive for HBsAg and anti-HBc. About 50% of prison entrants reported a history of injecting drug use, among whom prevalence of HBsAg was 3.1% and prevalence of anti-HBc was 29.7%. In comparison, 20% anti-HBc prevalence has been reported for IDUs in UK prisons.[14]

Birth in Oceania (excluding Australia) and Asia increased the risk of testing positive for HBsAg and anti-HBc, which is consistent with the epidemiological data on hepatitis B in Australia.[19] An increased risk of hepatitis B infection was observed among Indigenous prison entrants, and is

likely due to higher rates in this population in the community.[20] Vaccination is the primary measure used to control the transmission of hepatitis B and uptake among prison entrants should be encouraged.

In Australia, the prevalence of anti-HCV is about 1%–2% and has been reported as decreasing in recent years; 82% of hepatitis C virus infections are attributed to injecting drug use.[21] In our study, one-third of prison entrants tested positive for anti-HCV — 55.6% of IDUs and 2.2% of non-IDUs. This is comparable to estimates from the Australian Needle and Syringe Program Survey (anti-HCV prevalence of 50%–70%),[15] and for prisoners in the United States (16%–41%)[22] and the UK (30% for IDUs, 7% overall).[14]

We estimated that prevalence of anti-HCV among prison entrants declined from 33.3% in 2004 to 23.2% in 2010. However, after accounting for injecting drug use, this difference was not significant. This finding is supported by studies modelling the hepatitis C epidemic in Australia, which show that the incidence of new hepatitis C infections peaked in 1999.[21,23]

Self-reported HIV and hepatitis C testing rates were over 65% in our study. However, one-third of participants who were anti-HCV positive were unaware of their infection status, and three-quarters of those who tested positive for anti-HBc reported they had never had hepatitis B. These data are similar to those from the 1996 NSW Inmate Health Survey, in which 35% of participants were unaware that they were anti-HCV positive and 72% were unaware they were anti-HBc positive, indicating little change in awareness levels over time.[24] Women, IDUs, and those previously incarcerated were all more likely to be aware of their infection status, suggesting that these groups may have increased access to health services and testing. Increased awareness among those with a history of incarceration highlights the important role that prisons play in screening for, treating and preventing BBVs.

There are some limitations to this analysis. While the NPEBBVS has expanded its coverage to include all jurisdictions in Australia, the demographic and criminological characteristics of prison entrants may differ between jurisdictions in ways that we are unable to account for. Thus, we restricted the analysis to the states that were involved in all iterations of the survey. Only variables collected in the same format at each survey period were included, and there may be other unmeasured or unknown confounders that we were unable to adjust for.

Testing strategies for BBVs and test coverage vary between jurisdictions: Qld, SA and WA use voluntary screening, but NSW uses a targeted approach. This supports the need for ongoing surveillance using a standardised approach to reliably report prevalence. Ideally, surveillance should include collection of data on incident cases.

In Australia, the full-time prisoner population is about 30 000, and about 50 000 people cycle through the prison system annually.[25] Prisons are potentially important in the control of BBVs in the community given the high number of people who pass through correctional facilities each year and the high prevalence of BBVs in this population.

Acknowledgements: The cost of the data collection and screening was borne by the respective state and territory governments. Support for coordination of the study and report writing was provided by Justice Health (NSW), WA Department of Corrective Services, NT Department of Correctional Services, Queensland Health, South Australian Prison Health Service, Correctional Primary Health Services (Tas), Justice Health Services (ACT), and Justice Health (Vic). Tony Butler is supported by an Australian Research Council Future Fellowship (0991864). We are particularly grateful to the prisoners who participated in the survey and willingly provided the information necessary to make the survey a success.

Competing interests: No relevant disclosures.

Received 14 Aug 2013, accepted 2 Feb 2014.

1 Indig D, Topp L, Ross B, et al. 2009 NSW Inmate Health Survey. Sydney: Justice Health (NSW), 2009.

2 Fazel S, Baillargeon J. The health of prisoners. *Lancet* 2011; 377: 956-965.

3 Butler T, Malacova E, Richters J, et al. Sexual behaviour and sexual health of Australian prisoners. *Sex Health* 2013; 10: 64-73.

4 Butler T, Levy M, Dolan K, Kaldor J. Drug use and its correlates in an Australian prisoner population. *Addict Res Theory* 2003; 11: 89-101.

5 Vescio MF, Longo B, Babudieri S, et al. Correlates of hepatitis C virus seropositivity in prison inmates: a meta-analysis. *J Epidemiol Community Health* 2008; 62: 305-313.

6 Jürgens R, Nowak M, Day M. HIV and incarceration: prisons and detention. *J Int AIDS Soc* 2011; 14: 26.

7 Butler T, Kariminia A, Levy M, Kaldor J. Prisoners are at risk for hepatitis C transmission. *Eur J Epidemiol* 2004; 19: 1119-1122.

8 Weinbaum CM, Sabin KM, Santibanez SS. Hepatitis B, hepatitis C, and HIV in correctional populations: a review of epidemiology and prevention. *AIDS* 2005; 19 Suppl 3: S41-S46.

9 Hayashi K, Milloy MJ, Fairbairn N, et al. Incarceration experiences among a community-recruited sample of injection drug users in Bangkok, Thailand. *BMC Public Health* 2009; 9: 492.

10 Butler T, Lim D, Callander D. National prison entrants' bloodborne virus and risk behaviour survey report 2004, 2007, and 2010. Sydney: Kirby Institute, 2011. http://www.kirby.unsw.edu.au/sites/default/files/hiv/attachment/2010npebbvs.pdf (accessed Feb 2014).

11 Australian Government Department of Health. Measuring remoteness: Accessibility/Remoteness Index of Australia (ARIA) revised edition. Occasional papers: new series number 14. Canberra: DOH, 2001. https://www.health.gov.au/internet/main/publishing.nsf/Content/health-historicpubs-hfsocc-ocpanew14a.htm (accessed Feb 2014).

12 Okie S. Sex, drugs, prisons, and HIV. *N Engl J Med* 2007; 356: 105-108.

13 United Nations Office on Drugs and Crime. HIV and AIDS in places of detention. New York: United Nations, 2008. https://www.unodc.org/documents/hiv-aids/V0855768.pdf (accessed Feb 2014).

14 Weild AR, Gill ON, Bennett D, et al. Prevalence of HIV, hepatitis B, and hepatitis C antibodies in prisoners in England and Wales: a national survey. *Commun Dis Public Health* 2000; 3: 121-126.

15 Iversen J, Maher L. Australian NSP Survey: National Data Report 2007-2011. Sydney: Kirby Institute, University of New South Wales, 2012.

16 Bowtell W. Australia's response to HIV/AIDS 1982-2005. Sydney: Lowy Institute for International Policy, 2005. http://www.lowyinstitute.org/files/pubfiles/Bowtell%2C_Australia%27s_Response_to_HIV_AIDS_logo.pdf (accessed Feb 2014).

17 MacLachlan JH, Allard N, Towell V, Cowie BC. The burden of chronic hepatitis B virus infection in Australia, 2011. *Aust N Z J Public Health* 2013; 37: 416-422.

18 Gidding HF, Warlow M, MacIntyre CR, et al. The impact of a new universal infant and school-based adolescent hepatitis B vaccination program in Australia. *Vaccine* 2007; 25: 8637-8641.

19 O'Sullivan BG, Gidding HF, Law M, et al. Estimates of chronic hepatitis B virus infection in Australia, 2000. *Aust N Z J Public Health* 2004; 28: 212-216.

20 Graham S, Guy RJ, Cowie B, et al. Chronic hepatitis B prevalence among Aboriginal and Torres Strait Islander Australians since universal vaccination: a systematic review and meta-analysis. *BMC Infect Dis* 2013; 13: 403.

21 Razali K, Thein HH, Bell J, et al. Modelling the hepatitis C virus epidemic in Australia. *Drug Alcohol Depend* 2007; 91: 228-235.

22 Spaulding AC, Thomas DL. Screening for HCV infection in jails. *JAMA* 2012; 307: 1259-1260.

23 Razali K, Amin J, Dore GJ, Law MG. Modelling and calibration of the hepatitis C epidemic in Australia. *Stat Methods Med Res* 2009; 18: 253-270.

24 Butler T, Spencer J, Cui J, et al. Seroprevalence of markers for hepatitis B, C and G in male and female prisoners -- NSW, 1996. *Aust N Z J Public Health* 1999; 23: 377-384.

25 Martire KA, Larney S. Inadequate data collection prevents health planning for released prisoners. *Med J Aust* 2009; 191: 408-409. ❑