

Correlates of HIV, HBV, and HCV Infections in a Prison Inmate Population: Results From a Multicentre Study in Italy

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A cross-sectional study was undertaken on the correlates of infection for the human immunodeficiency virus (HIV) and hepatitis viruses B and C (HBV and HCV) in a sample of inmates from eight Italian prisons. A total of 973 inmates were enrolled [87.0% males, median age of 36 years, 30.4% intravenous drug users (IDUs), 0.6% men who have sex with men (MSWM)]. In this sample, high seroprevalence rates were found (HIV: 7.5%; HCV: 38.0%; anti-HBc: 52.7%; HBsAg: 6.7%). HIV and HCV seropositivity were associated strongly with intravenous drug use (OR: 5.9 for HIV; 10.5 for HCV); after excluding IDUs and male homosexuals, the HIV prevalence remained nonetheless relatively high (2.6%). HIV prevalence was higher for persons from Northern Italy and Sardinia. The age effect was U-shaped for HIV and HCV infections; HBV prevalence increased with age. Tattoos were associated with HCV positivity (OR: 2.9). The number of imprisonments was associated with HIV infection, whereas the duration of imprisonment was only associated with anti-HBc. The probability of being HIV-seropositive was higher for HCV-seropositive individuals, especially if IDUs. In conclusion, a high prevalence of HIV, HCV, and HBV infections among inmates was observed: these high rates are in part attributable to the high proportion of IDUs. Frequency of imprisonment and tattoos were associated, respectively, with HIV and HCV positivity. Although it is possible that the study

population is not representative of Italy's prison inmate population, the results stress the need to improve infection control measures users was prisons. **J. Med. Virol. 76:311–317, 2005.**

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INTRODUCTION

Prison populations are considered to be at high risk for infection with the human immunodeficiency virus (HIV) and other infections (e.g., viral hepatitis and other sexually transmitted infections), due to the high proportion of intravenous drug users (IDU), commercial sex workers, homeless, and immigrants from resource-poor countries [McMillan, 1988; Spaulding et al., 2002; UNAIDS, 2003]. Studies conducted in prisons in the United Kingdom have shown that drug-injecting practices and man-to-man sex are important modes of transmission of HIV infection and that the HIV

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prevalence among IDU in prison reflects the prevalence among drug users in the inmate's geographical area of origin [McMillan, 1988]. The high proportion of IDU among prisoners may also explain the high prevalence of bloodborne hepatitis viruses [Rich et al., 1997]. In particular, the prevalence of markers of both hepatitis B virus (HBV) and hepatitis C virus (HCV) appears to be high, especially among HIV-positive inmates [Ruiz and Mikanda, 1996]. In the United States, inmates have been shown to be five times more likely to have AIDS than the general population, and an estimated one fourth of North-American HIV-infected inmates enter prison at least once a year [Spaulding et al., 2002; Maruschak, 2001]. A cross-sectional study was undertaken. To assess the extent of HIV, HCV, and HBV infections in selected prisons in Italy and to identify correlates of exposure.

METHODS

The study was designed as a multi-center cross-sectional study and was conducted among male and female inmates of eight prisons in different areas of Italy (convenience sample). On December 31, 2001, there were 5,561 inmates in these prisons [Italian Ministry of Justice, official data, 2002], constituting 10.2% of the entire population of inmates in Italy's 224 prisons at that time. The capacity of the eight prisons varied from 130 to 2,300; those with a capacity exceeding 400 are subdivided into sections of approximately 300 inmates each. These sections are not defined according to any specific criteria.

The inmates were recruited between November 1, 2001 and February 28, 2002 by infectious disease specialists acting as consultants to the prisons. In the four prisons with a capacity exceeding 400, for the sake of simplicity, the study was proposed in a single section, chosen at random; in those prisons with less than 400 inmates, the study was proposed to the entire population. A total of 1,181 inmates were asked to participate in the study (21.2% of the entire inmate population).

Serological testing was carried out and data were processed using anonymous unlinked procedures. Serum samples were stored at -20°C before processing. All assays were carried out by a reference laboratory at the Infectious Disease Clinic of the "Tor Vergata" University. HIV testing was performed using ELISA (EIAgen HIV-1 E HIV-2 Kit Clonesystems, Biochem Immunosystems Italia s.p.a., Casalecchio di Reno, Italy); reactive sera were confirmed by dot-blot (Chiron RIBA-HIV1/2 Strip Immunoblot Assay-SIA, distributed in Italy by Ortho Diagnostic Systems Inc., Milan, Italy). HCV testing was performed using 3rd generation EIA (Innotest HCV Ab IV^o EIA-Core-NS3-NS4-NS5 antigens, Innogenetics, Pomezia, Italy). HBsAg and anti-HBc (IgG) were detected, respectively, using the HBsAg Micro EIA Kit (Nuclear Laser Medicine, Settala, Italy) and the anti-HBc One ELISA (Nuclear Laser Medicine).

Participating inmates were interviewed using an anonymous standardized questionnaire for collecting demographic data (i.e., age, place of birth and residence, and nationality) and behavioral data (e.g., use and modality of administration of illicit drugs and sexual behavior). A progressive numerical code not including the name of the inmates was used to link questionnaires and serum samples. Written informed consent was obtained from all participants, after having received complete information on the purpose of the study, in accordance with the ethical standards required by the Italian Ministry of Justice and guaranteeing the anonymity of the results.

The statistical analysis was performed using a standard statistical package (STATA/SE version 8). The seroprevalence for the different viral agents was calculated. Odds ratios (OR) and 95% confidence intervals (CI) were also calculated to assess associations with demographic and behavioral variables. Independent associations were evaluated by calculating the adjusted OR by multivariate analysis.

RESULTS

Of the 1,181 inmates asked to participate, 208 (17.6%) refused. Those who refused were more likely to be males (99.5% vs. 87.0% of participants; $P < 0.001$), non-Italian (31.7% vs. 19.4%; $P < 0.001$), and men who have sex with men (MSWM) (1.9% vs. 0.6%; $P = 0.08$); they were less likely to be IDUs (23.6% vs. 30.4%; $P = 0.05$); there was no significant difference in the mean age (36.9 vs. 37.4 years; $P = 0.55$).

Overall, 973 individuals participated in the study (17.5% of the total prison population in the study period; $n = 5,561$); 847 (87.1%) were males; the median age was 36 years (interquartile range: 30–44 years). There were 189 immigrants (19.4% of the participants); most Italian inmates were from Southern Italy (44.8%) and from the island of Sardinia (23.1%). Regarding "at-risk" behavior, 296 (30.4%) inmates reported a history of intravenous drug use, 6 (0.6%) male-to-male sex, 227 (23.3%) unprotected sex, 76 (7.8%) blood transfusion, and 463 (47.6%) tattoos. The median duration of imprisonment was 1.97 months (range 0.6–3.9 months); the median number of imprisonments was 3 (range: 1–5).

HIV Infection

The results of the risk-factor analysis are presented in Table I. Of the 973 study participants, 73 (7.5%) were HIV-positive. According to the univariate analysis, inmates younger than 31 and older than 45 years were less likely to be infected with HIV. Compared to inmates from Southern Italy to those from Northern Italy and Sardinia were more likely to be infected. With regard to exposure category, IDUs, as compared to heterosexual non-IDUs, were 9.1 times more likely to be infected. Men who have sex with men were also much more likely to be infected with HIV, as were persons reporting unprotected sex, tattoos, and blood transfusions. An 11% increase in the probability of HIV infection was

TABLE I. Risk Factors for HIV Infection Among Prison Inmates in Italy

Variable	HIV-positive/total (%)	COR	95% CI	AOR	95% CI
Total	73/973 (7.5%)				
Age (in years) ^a					
≤30	11/269 (4.1)	0.33*	0.17–0.64	0.36*	0.16–0.80
31–45	57/498 (11.4)	1		1	
>45	5/204 (2.4)	0.19*	0.07–0.49	0.23*	0.06–0.83
Gender					
Female	7/126 (5.6)	1		—	—
Male	66/847 (7.8)	1.43	0.64–3.20	—	—
Area of origin ^a					
Southern Italy	23/436 (5.3)	1		1	
Northern Italy	9/61 (14.7)	3.1*	1.36–7.07	4.81*	1.67–13.83
Central Italy	5/59 (8.5)	1.66	0.6–4.55	1.61	0.49–5.29
Sardinia	28/225 (12.4)	2.55*	1.43–4.54	2.23*	1.13–4.40
Foreign country	8/189 (4.2)	0.79	0.34–1.80	0.89	0.19–4.26
Exposure category					
Heterosexual non-IDUs	16/671 (2.4)	1			
IDUs	54/296 (18.2)	9.13*	5.12–16.26	5.91*	2.78–12.60
MSWM	3/6 (50.0)	40.93*	7.66–218.64	75.00*	7.96–706.05
Other exposure					
Unprotected sex	31/227 (13.7)	2.65*	1.62–4.32	1.56	0.82–2.97
Tattoos	55/463 (11.9)	3.68*	2.13–6.37	1.75	0.80–3.86
Transfusions	11/76 (1.4)	2.28*	1.14–4.53	2.08	0.87–4.93
Imprisonment					
Number of imprisonments ^b		1.11*	1.06–1.15	1.07*	1.01–1.12
Duration of imprisonment (in months) ^c		1.07	0.97–1.18		

Abbreviations: COR, crude odds ratio; AOR, adjusted odds ratio; 95% CI, 95% confidence interval; IDUs, injecting drug users; MSWM, men who have sex with men.

Crude and adjusted odds ratios (OR) and 95% confidence intervals (variables found to be associated at the univariate analysis were entered in the multivariate model).

^aData not available for all inmates.

^bData missing for 315 inmates.

^cData missing for 230 inmates.

*Significant association ($P < 0.05$).

observed for each previous imprisonment. The duration of imprisonment tended to increase the probability (i.e., 7% per each month spent in prison), although not significantly.

According to the multivariate analysis, the probability of infection remained significantly lower for persons aged less than 31 and greater than 45 years. The probability was higher for persons born in Northern Italy or Sardinia, for IDUs, and for male homosexuals. The probability increased by 7% for each previous imprisonment.

When excluding IDUs, the proportion of persons who were HIV-positive was significantly higher among non-Italians (3.4%) compared to Italians (2.6%). As seen in Table II, when excluding both IDU and MSWM, the HIV prevalence in our study population decreased to 2.9% among non-Italians and 2.2% among Italians

(difference between the two populations not significant). Among Italians, the HIV prevalence was significantly higher among men as compared to women (2.5% vs. 0%), whereas among non-Italians no gender difference was found (2.8% vs. 3.3%).

HCV Infection

Three hundred seventy (38.0%) inmates were HCV-positive (Table III). According to the univariate analysis, participants older than 45 years and non-Italians were less likely to be HCV-positive. In fact, the proportion of anti-HCV positive persons was significantly higher among Italians (i.e., 24.6% vs. 14.4% for non-Italians), even after excluding IDUs. Males and persons from Sardinia were more likely to be HCV-positive, as were persons with tattoos, IDUs, and transfusion recipients. Previous imprisonment increased the probability of being HCV-positive (i.e., a 10% increase in probability for each imprisonment). According to the multivariate analysis, HCV infection was associated inversely with age younger than 31 years and older than 45 years, whereas it was associated with intravenous drug use and having tattoos.

HBV Infection

Five hundred twelve (52.6%) inmates were anti-HBc positive (Table IV); 65 (6.7%) inmates were also HBsAg

TABLE II. Proportion of Non-Intravenous-Drug Using Heterosexual Inmates Found to be HIV Positive, by Gender and Geographic Origin

Area of origin	Males		Females		Total	
	HIV+/total	(%)	HIV+/total	(%)	HIV+/total	(%)
Non-Italian	4/142	2.82	1/30	3.33	5/172	2.91
Italian	11/433	2.54	0/66	0.00	11/499	2.20
Total	15/575	2.61	1/96	1.04	16/671	2.38

TABLE III. Risk Factors for HCV Infection Among Prison Inmates in Italy

Variable	HCV-positive/ total (%)	COR	95% CI	AOR	95% CI
Total	370/973 (38.0)				
Age (in years) ^a					
≤30	105/269 (39.0)	0.83	0.61–1.12	0.49*	0.30–0.80
31–45	217/498 (43.5)	1		1	
>45	48/204 (23.5)	0.40*	0.27–0.57	0.60*	0.36–1.02
Gender					
Female	26/126 (20.6)	1		1	
Male	344/847 (40.6)	2.63*	1.67–4.13	1.11	0.35–3.47
Area of origin ^a					
Southern Italy	171/436 (39.2)	1		1	
Northern Italy	28/61 (45.9)	1.31	0.76–2.25	1.53	0.72–3.25
Central Italy	21/59 (35.6)	0.85	0.48–1.5	0.82	0.38–1.76
Sardinia	116/225 (51.6)	1.64*	1.19–2.28	1.08	0.67–1.73
Foreign country	33/189 (17.5)	0.32*	0.21–0.49	0.54	0.28–1.05
Exposure category					
Heterosexual non-IDUs	148/671 (22.1)	1		1	
IDUs	221/296 (74.7)	10.41*	7.56–14.32	10.56*	6.83–16.34
MSWM	1/6 (16.7)	0.70	0.08–6.09	0.93	0.09–9.57
Other exposure					
Unprotected sex	98/227 (43.2)	1.32	0.96–1.81	1.42	0.92–2.19
Tattoos	237/463 (51.2)	2.97*	2.27–3.88	1.91*	1.26–2.91
Transfusions	37/76 (48.7)	1.60*	0.97–2.64	1.80	0.95–3.41
Imprisonment					
Number of imprisonments ^b		1.09*	1.05–1.33	1.01	0.97–1.06
Duration of imprisonment (in months) ^c		1.04	0.98–1.11		

Abbreviations: COR, crude odds ratio; AOR, adjusted odds ratio; 95% CI, 95% confidence interval; IDUs, injecting drug users; MSWM, men who have sex with men.

Crude and adjusted odds ratios and 95% confidence intervals (variables found to be associated at the univariate analysis were entered in the multivariate model).

^aData not available for all inmates.

^bData missing for 315 inmates.

^cData missing for 230 inmates.

*Significant association ($P < 0.05$).

positive. According to the univariate analysis, a higher probability of infection was found for inmates older than 30 years, males, and those with a longer duration of imprisonment. A lower probability was found for non-Italians. According to the multivariate analysis, significant positive associations remained for age greater than 30 years and duration of imprisonment (a 10% increase in the probability for each month spent in prison); being non-Italian showed only a marginally significant association. Even after excluding IDUs, the proportion of persons who were anti-HBc positive was higher among Italians, compared to non-Italians (54.0% vs. 41.0%).

Overall, 13.2% of the IDUs had markers of all three infections, compared to only 1.2% of non-users. As shown in Table V, HCV-positive IDUs were almost seven times more likely to be HIV-positive than HCV-negative IDUs, whereas the two infections were only marginally associated among non-users. The probability of being HIV-positive among anti-HBc positive inmates was more than twice as high as that among anti-HBc negative inmates, although the association was statistically significant only among IDUs.

DISCUSSION

A high prevalence of parenterally and/or sexually transmitted infections was found among inmates of

eight Italian prisons: antibodies against HIV and HCV were found in 7.5% and 38.0% of the population, respectively; nearly 53% of the participants were anti-HBc-positive (indicating a high level of exposure to HBV); and almost 7% of the inmates were positive for both anti-HBc and HBsAg. The high prevalence of HIV and HCV infections in our study population can, for the most part, be explained by the high proportion of IDU, who represented approximately 30% of the study population and who showed an increased probability of being infected with HIV and HCV, with OR of 5.9 and 10.5, respectively, compared to non-drug-using heterosexual contacts. Nonetheless, after excluding IDUs and male homosexuals, the proportion of HIV-positive persons was still relatively high (i.e., 2.6% among men and 1.0% among women). Regarding the geographical area of origin of the inmates, the overall proportion of HIV-positive inmates was higher among Italians compared to non-Italians. However, when selecting only non-drug-using heterosexual inmates, the proportion was higher among non-Italians, although the difference was no longer significant; none of the 66 Italian women were HIV-positive. A higher proportion of HIV-positive inmates was also found for persons from Northern Italy and Sardinia, compared to persons from Southern Italy, which is consistent with previously observed geographic variations in the incidence of HIV/AIDS [Suligoi et al., 2003; Centro Operativo AIDS,

TABLE IV. Risk Factors for Exposure to HBV Infection, as Defined by HBcAb Positivity, Among Prison Inmates

Variable	HBcAb-positive/ total (%)	COR	95% CI	AOR	95% CI
Total	512/973 (52.6)				
Age (in years) ^a					
≤30	115/269 (42.7)	1		1	
31–45	277/498 (55.62)	1.67*	1.24–2.26	1.58*	1.08–2.29
>45	118/204 (57.84)	1.83*	1.27–2.65	1.92*	1.20–3.09
Gender					
Female	58/126 (46.03)	1		—	—
Male	454/847 (53.60)	1.35	0.93–1.97	—	—
Area of origin ^a					
Southern Italy	243/436 (55.7)	1		1	
Northern Italy	36/61 (59.1)	1.14	0.66–1.97	1.03	0.55–1.94
Central Italy	27/59 (45.8)	0.67	0.38–1.15	0.68	0.37–1.2
Sardinia	126/225 (56.0)	1.01	0.73–1.39	1.10	0.75–1.61
Foreign country	79/189 (41.8)	0.57*	0.40–0.80	0.68	0.44–1.05
Exposure category					
Heterosexual non-IDUs	340/671 (50.7)	1		—	—
IDUs	169/296 (57.1)	1.29	0.98–1.70	—	—
MSWM	3/6 (50.0)	0.97	0.19–4.85	—	—
Other exposure					
Unprotected sex	117/227 (51.5)	0.94	0.69–1.28	—	—
Tattoos	252/463 (54.4)	1.14	0.89–1.47	—	—
Transfusions	42/76 (55.3)	1.12	0.68–1.85	—	—
Imprisonment					
Number of imprisonments ^b		1.05	1.02–1.09	—	—
Duration of imprisonment (in months) ^c		1.14*	1.07–1.22	1.10*	1.03–1.18

Abbreviations: COR, crude odds ratio; AOR, adjusted odds ratio; 95% CI, 95% confidence interval; IDUs, injecting drug users; MSWM, men who have sex with men.

Crude and adjusted odds ratios and 95% confidence intervals, from univariate and multivariate analysis. Variables found associated at the univariate analysis entered the multivariate model.

^aData not available for all inmates.

^bData missing for 315 inmates.

^cData missing for 230 inmates.

*Significant association ($P < 0.05$).

2003]. The age effect was similar for HIV and HCV infection, showing a U form, with the highest risk in the 31–45-year age group, whereas the risk of HBV infection increased with age. No gender difference was observed for the three infections.

According to the Italian Ministry of Justice, the prevalence of HIV infection among drug-using inmates of Italian prisons is 2.4%, which, compared to the results of this study represents an apparent underestimate, considering that the proportion of inmates who are IDUs is similar when comparing the two populations (27% and 30.4%, respectively) [Ministero Della Giustizia Italiano, 2002]. The proportion of HIV-positive drug-using inmates in our study is similar to the proportion of

HIV-positive non-incarcerated IDUs attending public drug dependency centers in Italy (18% versus 16%) [Suligoi et al., 2004]. Although it is not possible to generalize the results to the entire Italian inmate population, this latter finding suggests that the HIV prevalence estimated in this study is not an underestimate of the prevalence among Italian inmates.

Of note is the finding that tattoos appear to increase the risk of HCV infection. The finding that the risk of HCV infection was nearly twice as high among persons with tattoos is consistent with the findings of studies carried out in Ireland, United States, and Australia [Long et al., 2001; Samuel et al., 2001; Hellard et al., 2004]. However, additional research will be needed to

TABLE V. Proportion of Italian Inmates (IDUs and non-IDUs) Found to be HIV-Positive, by HCV and HBcAb Serostatus (AOR and 95% CI)

Serostatus	IDUs				Non-IDUs			
	HIV-positive/ total	(%)	AOR*	95% CI	HIV-positive/ total	(%)	AOR*	95% CI
HCVAb–	3/75	4.00			11/528	2.08		
HCVAb+	51/221	23.08	6.89	1.98–23.89	8/149	5.37	2.45	0.96–6.25
HBcAb–	13/127	10.24			6/334	1.80		
HBcAb+	41/169	24.26	2.60	1.29–5.26	13/343	3.79	2.05	0.77–5.42

Abbreviations: IDUs, injecting drug users; AOR, adjusted odds ratio; 95% CI, 95% confidence interval; HCVAb, antibodies against HCV; HBcAb, antibodies against core antigen of HBV.

*Adjusted by age.

determine whether tattooing is a true risk factor or whether the association with HCV infection is the result of confounding from other factors, such as the sharing of utensils for personal hygiene or unreported needle sharing.

An association between the number of imprisonments and a higher risk of infection was only found for HIV infection, whereas the duration of imprisonment was only associated with an increased risk of anti-HBc positivity. These findings are somewhat inconsistent with those of a study conducted in Ireland, in which the duration of imprisonment was associated with both HIV and HCV infections but not with HBV infection [Long et al., 2001]. The reasons for this inconsistency are difficult to interpret. They could be related to the fact that the current study was cross-sectional in design, which did not allow us to assess the risk of acquiring the infections while in prison, whereas the Irish study included only new inmates. In this regard, a study conducted in Maryland, USA reported that the incidence of HIV-1 infection increased by 0.41% per year of imprisonment [Brewer et al., 1988], whereas a study conducted in Denmark noted a high incidence per 100 person-years in prison for HBV infection (16 per 100 person-years in prison) and HCV infection (25 per 100 person-years in prison) among male IDUs [Christensen et al., 2000]. A recent Scottish study found that the incidence of HCV ranged from 1 per 100 person-years in prison among non-intravenous-drug-using inmates to 27 per 100 person-years of imprisonment among those who shared needles while in prison [Champion et al., 2003]. These data suggest that the transmission of infections in prison does occur, although the rates of transmission can be considered as relatively low, which is consistent with the findings that the frequency with which inmates engage in risk behavior increases when they are not actually in prison [Carvell and Hart, 1990].

The proportion of persons who had all 3 infections was 11 times higher among IDUs, compared to those who did not report drug use, and among IDUs the probability of infection with HIV was greater for those who were HCV-positive, suggesting that the two infections were transmitted through similar means (i.e., needle sharing). A weaker association was found between HIV and anti-HBc positivity.

In an attempt to interpret the results of this study, some obvious limitations should be considered. First, it is not known whether the study population is representative of the entire prison population in Italy or even of the population of the eight participating prisons. In fact, the prisons included in this study simply consisted of those who agreed to participate. Furthermore, in the four largest prisons, enrollment was limited to one section, whose populations may have differed from those of the sections in which enrolment was not performed. Although an attempt was made to enroll all of the inmates in the selected sections, those who refused to participate somewhat differed from those who agreed. Furthermore, the larger prisons, whose staff members

tend to have a greater workload, enrolled lower proportions of the prison population than did smaller prisons. Moreover, the information on sexual risk factors, collected by a direct interview and reported on the questionnaire, may have been inaccurate, which could have led to misclassification of the inmates in terms of exposure category. In particular, only six of the inmates reported man-to-man sex; assuming that this is a gross underestimate, then the prevalence of HIV infection among non-intravenous drug using heterosexual men can be considered as an overestimate. That the high proportion (i.e., 1.2%) of the three combined infections may be due, at least in part, to misclassification of IDUs as non users cannot be completely excluded.

Despite these limitations, the results of this study show that inmates of Italian prisons are at high risk of HIV, HCV, and HBV infections and that much of this risk can be explained by the fact that a high proportion of inmates are IDUs, who are generally at high risk of HIV and HCV infections. To understand better the potential association between the risk of infection and the duration and frequency of imprisonment, incidence studies will need to be conducted.

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REFERENCES

- Brewer TF, Vlahov D, Taylor E, Hall D, Munoz A, Polk BF. 1988. Transmission of HIV-1 within statewide prison system. *AIDS* 2:363–367.
- Carvell ALM, Hart GJ. 1990. Risk behaviours for HIV infection among drug users in prison. *BMJ* 300:1383–1384.
- Centro Operativo AIDS. 2003. Istituto Superiore di Sanità: Aggiornamento dei casi di AIDS notificati in Italia al 31 dicembre 2002. *Notiziario Ist Super Sanità* 16:1–18.
- Champion JK, Taylor A, Hutchinson S, et al. 2003. Incidence of hepatitis C virus infection and associated risk factors among Scottish prison inmates: A cohort study. *Am J Epidemiol* 159:514–519.
- Christensen PB, Krarup HB, Niesters HG, Norder H, Georgsen J. 2000. Prevalence and incidence of bloodborne viral infections among Danish prisoners. *Eur J Epidemiol* 16:1043–1049.
- Hellard ME, Hocking JS, Crofts N. 2004. The prevalence and the risk behaviours associated with the transmission of hepatitis C virus in Australian correctional facilities. *Epidemiol Infect* 132: 409–415.
- Long J, Allwright S, Barry J, Reynolds SR, Thornton L, Bradley F, Parry JV. 2001. Prevalence of antibodies to hepatitis B, hepatitis C, and HIV and risk factors in entrants to Irish prisons: A national cross sectional survey. *Br Med J* 323:1–6.
- Maruschak LM. 2001. Bureau of Justice Statistics Bulletin: HIV in prisons and jails, 1999. 2001 Document NCJ187456 Available at: <http://www.ojp.usdoj.gov/bjs/pubalp2.htm> Accessed May 31, 2001.
- McMillan A. 1988. HIV in prisons. *BMJ* 297:873–874.
- Ministero della Giustizia Italiano–Dipartimento dell'Amministrazione Penitenziaria. 2002. Indagine nazionale sui soggetti tossicodipendenti e affetti da virus HIV negli Istituti Penitenziari Italiani. Rilevamento al 31/12/2001. Available at: <http://www.giustizia.it/> Accessed June 20, 2002.
- Rich JD, Chin-Hong PV, Busi KA, Mayer KH, Flanagan TP. 1997. Hepatitis C and HIV in male prisoners [letter]. *J Acquir Immune Defic Syndr Hum Retrovirol* 16:408–409.
- Ruiz JD, Mikanda J. 1996. Seroprevalence of HIV, hepatitis B, hepatitis C, and risk behaviors among inmates entering the California correctional system. Sacramento, CA: California Department of Health Services.

- Samuel MC, Doherty PM, Bulterys M, Jenison SA. 2001. Association between heroin use, needle sharing and tattoos received in prison with hepatitis B and C positivity among street-recruited injecting drug users in New Mexico, USA. *Epidemiol Infect* 127:475–484.
- Spaulding A, Stephenson B, Macalino G, Ruby W, Clarke JG, Flanigan TP. 2002. Human immunodeficiency virus in correctional facilities: A review. *Clin Infect Dis* 35:305–312.
- Suligoi B, Pezzotti P, Boros S, Urciuoli R, Rezza G and the HIV Study Group. 2003. The epidemiological changes of AIDS and HIV infection in Italy. *Scand J Infect Dis* 35:12–16.
- Suligoi B, Magliochetti N, Nicoletti G, Pezzotti P, Rezza G. 2004. Trends in HIV prevalence among drug-users attending public drug-treatment centres in Italy: 1990–2000. *J Med Virol* 73:1–6.
- UNAIDS. 2003. AIDS. epidemic update 2003; <http://www.unaids.org>