

- health education for intravenous drug users. *Health Educ Q* 13: 383-393 (1986).
8. Des Jarlais, D. C.: HIV infection among intravenous drug users: epidemiology and risk reduction. *AIDS* 1: 67-79 (1987).
 9. Emmons, C. A., et al.: Psychosocial predictors of reported behavior change in homosexual men at risk for AIDS. *Health Educ Q* 13: 331-345 (1986).
 10. Becker, M. H., et al.: Selected psychosocial models and correlates of individual health-related behaviors. *Med Care* 15: 27-46 (1977).
 11. Tirell, B. E., and Hart, L. U.: The relationship of health beliefs and knowledge to exercise compliance in patients after coronary bypass. *Heart Lung* 9: 487-493 (1980).
 12. Weinberger, M., et al.: Health beliefs and smoking behavior.

Am J Public Health 71: 1353-1355 (1981).

13. Sennie, R., et al.: AIDS risk reduction study—interim methadone clinic. Paper presented at the meeting of the International Epidemiological Association, Helsinki, Finland, August 1987.
14. Bandura, A.: *Social learning theory*. Prentice Hall and Co., New York, NY, 1977.

Equipment

- A. Statistical Package for the Social Sciences (SPSS-X). SPSS, Inc., 444 N. Michigan Ave., Chicago, IL 60611. Tel. (312) 329-3300.

Sentinel Surveillance of HIV Infection Among New Inmates and Implications for Policies of Corrections Facilities

KONIKA K. PATEL, BA
 CRAIG HUTCHINSON, MD
 DEAN G. SIENKO, MD, MS

Ms. Patel is a medical student who completed an internship in epidemiology at the Special Office on AIDS Prevention, Center for Health Promotion, Michigan Department of Public Health, Lansing. Dr. Hutchinson is the Medical Director, Riverside Correctional Facility, Michigan Department of Corrections, Lansing. Dr. Sienko was a Medical Epidemiologist with the Michigan Department of Public Health; currently he is the Medical Director, Ingham County Health Department, 5303 South Cedar Street, Lansing, MI 48909.

Tearsheet requests to Dr. Sienko.

Synopsis

Seroprevalence surveys of incoming inmates provide useful sentinel information on human immunodeficiency virus (HIV) infection rates among groups that practice HIV-associated high-risk behaviors. In addition, such data are beneficial to corrections officials in the for-

mulation of institutional policies to prevent HIV infection.

Inmates entering the Michigan corrections system from December 1987 to March 1988 participated in blind, anonymous serosurveys for HIV infection. Eight of 802 entering inmates (1.0 percent) were seropositive: most seropositive persons reported intravenous drug use. The most common risk behaviors reported by study participants were intravenous drug use (20.0 percent), multiple sexual partners (37.1 percent), and infrequent (that is, never or seldom) use of condoms (82.6 percent). Women reported the highest rates of intravenous drug use (35.1 percent) and needle-sharing (19.4 percent).

Results from this study indicate that in spite of widespread HIV-associated risk behaviors, the extent of HIV-seropositivity among incoming inmates in Michigan is relatively low. Such data suggest that there is still time to impact the course of the AIDS epidemic among high-risk groups in States where the prevalence of HIV infection is relatively low. The data also indicate that the potential for HIV spread in correctional facilities is noteworthy and that HIV prevention education and substance abuse treatment services are needed in corrections facilities.

PRISONS ARE VALUABLE sites for sentinel surveys of human immunodeficiency virus (HIV) infection. Because incoming inmates are probably more likely to practice behaviors associated with risk of HIV, especially intravenous drug use, than the general population, seroepidemiologic surveys at correctional intake facilities provide an opportunity to measure HIV infection rates among persons who engage in high-risk behaviors associated with HIV infection. An increase in

HIV seroprevalence among incoming prisoners could alert public health officials to an escalation of HIV infection among groups at risk, particularly intravenous drug users, in the general population.

Another benefit of HIV seroepidemiologic surveys of incoming inmates is that they provide corrections officials with data upon which to formulate policies and programs to prevent HIV infection. Moreover, surveys of inmate cohorts can be repeated at intervals to deter-

mine the effectiveness of these efforts. This information can help corrections officials plan or modify strategies to prevent the spread of HIV infection among the inmate population.

We conducted a blind, anonymous seroepidemiologic survey of 802 consecutive inmates at intake to the Michigan Department of Corrections during late 1987 and early 1988. Serologic results were matched to HIV-associated risk behavior questionnaires through the use of anonymous identification numbers. Our findings provide an indication of the extent of HIV infection and risk behavior practices for this subset of the general population, and they also give public health and corrections officials baseline data to use in the development and evaluation of strategies to minimize institutional HIV transmission.

Methods

The Michigan Department of Corrections operates three inmate intake facilities: facility A for men (21 and older), facility B for youthful male offenders (under 21), and facility C for women. Our goal was to include 800 persons in the study: 500 men, 200 youthful offenders, and 100 women. From December 1987 through March 1988, consecutive newly incarcerated persons who had not been previously imprisoned in the State corrections system in the past year participated in the study until the desired numbers were attained.

At intake, inmates received their customary medical evaluation, which included a physical examination and standard laboratory tests. For each of the 802 inmates, a 1-milliliter serum sample of blood, leftover from that drawn for the laboratory tests, was retained and coded with a nonidentifying number. Specimens were sent to the Michigan Department of Public Health Laboratories for HIV antibody testing; those repeatedly reactive to the enzyme-linked-immunosorbent-assay (ELISA) were tested by the confirmatory Western blot analysis. Only those specimens confirmed by Western blot were considered positive for HIV antibodies.

At the time of blood collection, each of the 802 inmates was asked to complete a self-administered HIV-associated risk behavior questionnaire. Inmates were instructed not to place their names on the questionnaire. The questionnaire instrument included questions on demographics, the sex and number of different sexual partners in the past year, condom use, sexual contact with a prostitute or intravenous drug user, the personal use of intravenous drugs and needle-sharing, and a history of having received a blood transfusion since 1980. Participants were defined as homosexual or bisexual males if they reported having sex with other men or with both men and women.

'An increase in HIV seroprevalence among incoming prisoners could alert public health officials to an escalation of HIV infection among groups at risk, particularly intravenous drug users, in the general population.'

The same nonidentifying code number placed on the HIV serum sample was also placed on the questionnaire; this allowed linkage of blood specimen and questionnaire, while preserving the anonymity of the study participant. Each participant was instructed to seal the completed questionnaire in an envelope and place it in a collection box located in the same room. Envelopes were then sent to the Michigan Department of Public Health for data analysis.

Statistical differences between populations for categorical data were calculated using the chi-square test or the Fisher's exact test. Ninety-five percent confidence intervals for binomial proportions were calculated using the normal approximation or the exact binomial distribution method (1).

Results

A total of 802 inmates participated in the study: 504 men, 202 youthful offenders, and 96 women. The majority of study participants were male (82.0 percent), black (53.4 percent), and between the ages of 19 and 34 years (69.8 percent); between 5.5 and 6.4 percent of participants did not answer these demographic questions. Table 1 provides a complete demographic profile of the study population.

Eight of the 802 (1.0 percent; 95 percent confidence interval (CI) 0.2, 1.8) inmates were seropositive for HIV antibodies. (The normal approximation was used to calculate the 95 percent confidence interval.) Among the 151 inmates reporting a history of intravenous drug use, 4 were seropositive (2.7 percent; 95 percent CI 1.0, 8.0). Of these four, one person reported sharing needles; this was the only seropositive person among the 46 (2.2 percent; 95 percent CI 0.0, 13.0) who reported sharing needles during intravenous drug use. Among the 131 persons who reported sex with an intravenous drug user, 3 were found to be seropositive (2.4 percent; 95 percent CI 0.0, 7.0).

Of the eight seropositive inmates, five completed the risk behavior questionnaire; this yields a seroprevalence of 0.7 percent (5 of 759) for questionnaire completers compared with 7 percent (3 of 44) for noncompleters

Table 1. Demographic characteristics of inmates entering State corrections facilities in Michigan, December 1987–March 1988

Characteristic	Total (N=802)		Facility A (N=504)		Facility B (N=202)		Facility C (N=96)	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Sex:								
Male	658	82.0	464	92.1	194	96.0	0	0.0
Female	93	11.6	0	0.0	0	0.0	93	96.9
No answer	51	6.4	40	7.9	8	4.0	3	3.1
Race:								
White	277	34.5	183	36.3	63	31.2	31	32.3
Black	428	53.4	251	49.8	121	59.8	56	58.3
Other	48	6.0	30	6.0	11	5.5	7	7.3
No answer.....	49	6.1	40	7.9	7	3.5	2	2.1
Age (years):								
18 and younger	73	9.1	0	0.0	70	34.7	3	3.1
19–24.....	294	35.6	136	27.0	124	61.3	34	35.4
25–34.....	274	34.2	238	47.2	1	0.5	35	36.5
35 and older	117	14.6	94	18.7	1	0.5	22	22.9
No answer	44	5.5	36	7.1	6	3.0	2	2.1

NOTE: facility A: men ages 21 and older; facility B: male offenders, under 21 years; facility C: women.

Table 2. HIV-associated risk behaviors as reported by inmates entering State corrections facilities, Michigan, December 1987–March 1988

Risky behavior	All inmates (N=802)			Facility A (N=504)			Facility B (N=202)			Facility C (N=96)		
	Total reporting	Reported risk		Total reporting	Reported risk		Total reporting	Reported risk		Total reporting	Reported risk	
		Number	Percent		Number	Percent		Number	Percent		Number	Percent
Male homosexual-bisexual	648	27	4.2	454	13	2.8	193	14	7.3	0
Had a blood transfusion since 1980 ...	752	70	9.3	467	39	8.4	191	19	9.9	94	12	12.8
Ever used a needle for drugs ¹	756	151	20.0	469	108	23.0	193	10	5.2	94	33	35.1
Used a needle for drugs in 1987 ¹	756	82	10.9	468	58	12.4	195	6	3.1	93	18	19.4
Shared works in 1987 ¹	756	46	6.1	467	28	6.0	195	7	3.6	94	11	11.7
Sex partner of intravenous drug user ¹ ..	752	61	8.1	463	35	7.6	195	8	4.1	94	18	19.2
Don't know—sex partner of intravenous drug user. ¹	752	71	9.4	463	37	8.0	195	28	14.4	94	6	6.4
Sex with a prostitute in 1987 ¹	755	79	10.5	467	53	11.4	195	26	13.3	93	0	...
Don't know—sex with a prostitute in 1987 ¹	755	51	6.8	467	34	7.3	195	16	8.2	93	1	1.1
Anal intercourse in 1987 or later ²	756	21	2.8	467	5	1.1	194	5	2.6	95	11	11.6
5 or more sex partners in 1987 ¹	745	276	37.1	461	166	36.0	192	92	47.9	92	18	19.7
Never or seldom use condoms ¹	742	613	82.6	458	392	85.6	191	144	75.4	93	77	82.8

¹P<0.05, chi square test. ²P<0.005, Fisher's exact test. NOTE: facility A: men ages 21 and older; facility B: male offenders under 21 years; facility C: women.

($P < 0.01$, Fisher's exact test). Of the five seropositive persons who completed the questionnaire, four reported a history of intravenous drug use; two reported using intravenous drugs in 1987. The remaining seropositive person did not report a personal history of intravenous drug use, although he was unsure whether or not he had had prior sexual relations with an intravenous drug user; he also reported having received a blood transfusion since 1980. None of the five seropositive persons reported homosexual partners, and four of the five reported "never" or "seldom" using condoms.

Risk factors reported by the entire study population are shown in table 2. A history of intravenous drug use was reported by one-fifth of the overall study popula-

tion and by more than one-third of the women ($P < 0.05$, chi-square test). More than half of the inmates who reported using intravenous drugs during 1987 also reported sharing needles; women were more likely to report sharing needles than men ($P < 0.05$, chi-square test). The rate of needle-sharing was 6.1 percent for all study participants; the rate for women inmates was 11.7 percent (11 of 94) compared with 5.3 percent (35 of 662) for male inmates ($P < 0.05$, chi-square test).

Approximately 3 percent of the adult male participants reported homosexual or bisexual behavior compared with 7.3 percent of the youthful male offenders ($P < 0.05$, chi-square test). More than one-third of all new inmates, especially youthful male offenders (facil-

ity B), reported having five or more sexual partners in 1987; approximately four-fifths of this group reported that they "never" or "seldom" used condoms.

Discussion

This study's findings concur with data from previous studies that indicate an HIV seroprevalence rate of between 0.0 and 1.5 percent among incoming inmate populations (2-4). Although these reports of relatively low seroprevalence among incoming prisoners are reassuring, our findings indicate that incoming inmates are practicing behaviors that have high levels of HIV-associated risk, particularly behaviors related to intravenous drug use. Such data can be used for sentinel purposes to alert public health officials about the extent of HIV infection among groups that are often outside the mainstream of health care services.

Continued expansion of the AIDS epidemic in the general population can be expected to lead to higher HIV seroprevalence rates among incoming inmates. Thus, the potential for spread of HIV infection within prisons will be an increasing concern for corrections officials. Four of the five seropositive persons completing our risk-behavior questionnaire reported prior use of intravenous drugs, and one-fifth of the study population also reported prior intravenous drug use. Infected persons who continue to use intravenous drugs while incarcerated could transmit the virus to other prisoners, particularly through sharing needles. Data suggest that intravenous drug using inmates who did not engage in needle-sharing prior to incarceration may adopt this behavior, given the scarcity of needles in prison (5). The lack of access to bleach for sterilization adds to the potential for transmission.

The reported prevalence of intravenous drug use by female inmates was particularly disturbing. In corrections systems where inmates have been tested for HIV antibody, seropositivity rates among women were approximately twice as high as among men (2). Risk behavior data from our study suggest that female inmates were more likely than male inmates to report a history of intravenous drug use, recent intravenous drug use, sex with an intravenous drug user, and needle-sharing. It follows that, as the AIDS epidemic progresses, the potential for HIV transmission among female inmates may be greater than among male inmates.

Apart from intravenous drug use, the potential for HIV transmission through homosexual-bisexual intercourse merits comment. While none of the seropositive persons in our study reported prior homosexual-bisexual intercourse, 4.2 percent of the males in the study population did report same-sex partners. A study done in the

'Risk behavior data from our study suggest that female inmates were more likely than male inmates to report a history of intravenous drug use, recent intravenous drug use, sex with an intravenous drug user, and needle-sharing. It follows that, as the AIDS epidemic progresses, the potential for HIV transmission among female inmates may be greater than among male inmates.'

Tennessee corrections system documented a rise in homosexual intercourse after 1 year of incarceration (6). Also, the Federal Bureau of Prisons reported that 9 to 20 percent of inmates, particularly new inmates and openly homosexual inmates, are either coerced into sexual activity or are the victims of sexual aggression (2). If up to one-fifth of the inmate population is engaging in unprotected homosexual intercourse, this could become a major route of HIV transmission among inmates. This statistic causes particular concern given the low levels of condom use reported among inmates in this Michigan study.

Interventions to prevent the spread of HIV infection in prison are warranted; we suggest a three-phase approach. First, at intake, all incoming inmates should be instructed on the modes of HIV transmission and on measures to protect themselves against infection. Voluntary HIV testing with pre- and post-test counseling may be an important adjunct to this educational process.

Second, while serving their sentences, inmates should receive periodic reinforcement of AIDS prevention messages. Additionally, prisons should maintain adequate substance abuse prevention and treatment services (7). The closed prison environment may afford an opportunity to provide substance abuse counseling and treatment for persons otherwise outside the mainstream of the health care delivery system.

Third, upon discharge inmates should be reeducated in methods to protect themselves and their sexual partners from HIV transmission. Data suggest that persons with knowledge of needle sterilization techniques and access to bleach may be more likely to clean the needles they are sharing. One study reported a 40 percent increase in needle sterilization practices among drug users who shared needles after educational interventions (8). Adoption of HIV-associated risk-reducing be-

haviors will make inmates less vulnerable to contracting the virus once outside of prison. In addition, inmates who know how to protect themselves against transmission may be valuable carriers of the AIDS prevention message to their families and friends.

Testing for and detection of HIV seropositivity in correctional facilities will also allow medical personnel to monitor the progress of the inmate's infection and render appropriate medical care. Periodic T-cell assessments of HIV-infected persons have become standard medical practice; infected inmates should undergo such tests to provide direction for appropriate clinical management. For example, zidovudine (AZT), aerosolized pentamidine, and other agents have demonstrated the ability to decrease morbidity from HIV infection and slow disease progression (9-11). Such benefits to knowing HIV infection status should be explained to prisoners at entry, and HIV testing, with pre- and post-testing counseling, should be readily available.

An interesting methodological lesson can be learned from the disparity in HIV seroprevalence among inmates who completed the risk-behavior questionnaire (0.7 percent) compared with those who did not complete the questionnaire (7.0 percent). The 10-fold difference in HIV seroprevalence among the nonresponders suggests that HIV seropositive persons may be unwilling to acknowledge HIV-associated risk behaviors or participate in seroepidemiologic surveys. It follows that survey designs that eliminate selection bias are needed and that the blind, anonymous study design may offer the only pragmatic and ethical solution to this difficult problem.

Blind, anonymous seroprevalence surveys in correctional facilities provide public health officials with useful information about HIV infection rates and the evolution of the AIDS epidemic. In our study, we analyzed self-reports of behaviors. One arguable weakness with such a methodology concerns the validity of responses. However, we believed that self-reported responses were necessary given the sensitive nature of the questions asked in our survey. Furthermore, self-reports minimized any potential threat to our participants by further disassociating their identities from the responses to the questionnaire.

In Michigan, it appears that the HIV has infected only a small proportion of incoming inmates. Intervention efforts need to be established in corrections facilities, not only because there is an opportunity to reach a population that acknowledges HIV-associated risk behaviors, but also because incoming inmates may not otherwise seek access to the health care system for preventive services. These interventions are not likely to eradicate risk behaviors; however the frequency of these behaviors may be reduced, and this could decrease HIV

transmission (12). While the epidemic is still young, we should not allow this opportunity to pass.

References

1. Woolson, R. F.: Statistical methods for the analysis of biomedical data. John Wiley and Sons, New York, 1987, pp. 123-126.
2. Hammet, T. M.: AIDS in correctional facilities: issues and options. Ed. 3. National Institute of Justice, Washington, DC, 1988, pp. 21-29.
3. Glass, G. E., et al.: Seroprevalence of HIV antibody among individuals entering the Iowa prison system. *Am J Public Health* 78: 447-449, April 1988.
4. Kelley, P. W., et al.: Prevalence and incidence of HTLV-III infection in a prison (letter). *JAMA* 256: 2198-2199, October 24/31, 1986.
5. Anda, R. F., et al.: Hepatitis B in Wisconsin male prisoners: considerations for serologic screening and vaccination. *Am J Public Health* 75: 1182-1185, October 1985.
6. Decker, M. D., et al.: Seroepidemiology of hepatitis B in Tennessee prisons. *J Infect Dis* 150: 450-459, September 1984.
7. Additional recommendations to reduce sexual and drug abuse-related transmission of human T-lymphotropic virus III/lymphadenopathy-associated virus. *MMWR* 35: 152-155, Mar. 28, 1986.
8. Chaisson, R. E., et al.: Human immunodeficiency virus infection in heterosexual intravenous drug users in San Francisco. *Am J Public Health* 77: 169-172, February 1987.
9. Hirsch, M.S.: Acidothymidine. *J Infect Dis* 157: 427-431, March 1988.
10. Armstrong, D., and Bernard, E.: Aerosol pentamidine. *Ann Intern Med* 109: 852, Dec. 1, 1988.
11. Fischl, M. A., Dickinson, D. M., and La Voie, L.: Safety and efficacy of sulfamethoxazole and trimethoprim chemoprophylaxis for pneumocystis carinii pneumonia in AIDS. *JAMA* 259: 1185-1189, Feb. 26, 1988.
12. Becker, M. H., and Joseph, J. G.: AIDS and behavioral change to reduce risk: a review. *Am J Public Health* 78: 394-406, April 1988.