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25. Isoproterenol might increase the macroscopic M current by increasing the number of M channels available to be opened, increasing the probability of existing channels being in the open state, or both. Assuming a simple two-state model of channel gating, where α is the opening and β the closing rate constant (*9*), the time constant of channel deactivation is given by $\tau = 1/(\alpha + \beta)$. Values for τ increase with isoproterenol, indicating a decrease of $(\alpha + \beta)$. Because we are dealing with an increase in macroscopic current, we might assume that α is not decreasing, so β must be decreasing. That is, the slower kinetics of the isoproterenol current might reflect a decrease in the closing rate constant for M channels. Besides increasing time-averaged current through the single channel, this could shift the half-activation potential more negative, which is consistent with our results, since $V_{0.5}$ is more negative than expected, given the junction potential and reversal potential seen in whole-cell recording (*18*).
26. The β-adrenergic effects described here seem insufficient to account completely for the inhibitory actions of catecholamines on smooth muscle, because these effects can be counteracted by the excitatory neurotransmitter ACh. This leaves open the possibility of other cellular responses to β-adrenergic agonists.
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Transmission of HIV in Belle Glade, Florida: Lessons for Other Communities in the United States

KENNETH G. CASTRO,* SPENCER LIEB, HAROLD W. JAFFE, JOHN P. NARKUNAS, CHARLES H. CALISHER, TIMOTHY J. BUSH, JOHN J. WITTE, THE BELLE GLADE FIELD-STUDY GROUP†

The high cumulative incidence of AIDS and the large percentage of AIDS patients with no identified risks in Belle Glade, Florida, were evaluated through case interviews and neighborhood-based seroepidemiologic studies. It was found that of 93 AIDS patients reported between July 1982 and 1 August 1987, 34 could be directly linked to at least one other AIDS patient or to a person with AIDS-related complex by sexual contact, sharing of needles during intravenous drug abuse (or both), or perinatal exposure; of 877 randomly selected adults, 28 had antibodies to HIV; no person over age 60 and none of 138 children aged 2 to 10 years had antibodies to HIV; no clustering of infected persons within households occurred, except in sex partners; and HIV-seropositive adults were more likely than HIV-seronegative adults to be from Haiti, have a lower income, report sex with intravenous drug abusers, and have a history of previous treatment for sexually transmitted diseases. The presence of antibodies to five arboviruses prevalent in South Florida or the Caribbean did not correlate significantly with HIV infection. The high cumulative rate of AIDS in Belle Glade appears to be the result of HIV transmission through sexual contact and intravenous drug abuse; the evidence does not suggest transmission of HIV through insects.

BELLE GLADE, FLORIDA, IS AN AGRICULTURAL community of approximately 16,500 persons. It is located southeast of Lake Okeechobee and 45 miles west of West Palm Beach. Each year, thousands of migrant farm workers, primarily American blacks, British West Indians, Haitians, and Hispanics, enter Belle Glade and surrounding areas during sugarcane and vegetable harvesting months (*1*). From July 1982 through 1 August 1987, 93 persons meeting the surveillance case definition for acquired immunodeficiency syndrome (AIDS) were reported from Belle Glade, for an estimated AIDS cumulative incidence of 564 per 100,000. Seven (8%) of these 93 persons had no identified risk factors associated with human immunodeficiency virus (HIV) infection, compared with 3% of nationally reported AIDS cases (*2*).

The high cumulative rate of AIDS cases and relatively large proportion of persons with no identified risk factors resulted in concern that environmental factors, perhaps including mosquitoes, were contributing to HIV transmission in Belle Glade. The Florida Department of Health and Rehabilitative Services (HRS), the Palm Beach County Health Unit, and the Centers for Disease Control (CDC) initiated a series of studies to determine the prevalence of HIV infection in Belle Glade residents and to define more precisely the risk factors for HIV transmission in this community (*3*).

AIDS patients were interviewed in May 1985 and in May and August 1986 by health professionals affiliated with HRS or CDC. Persons were asked about known risk factors for HIV transmission, including a history of contact with other AIDS patients or other persons at risk for HIV infection. If the patients had died before they could be interviewed, family members or known sexual contacts who provided informed consent were interviewed. Parents of children with AIDS were asked about risk factors for HIV infection and about the child's medical history.

To document the prevalence of HIV infection and modes of HIV transmission in Belle Glade, three seroepidemiologic studies were conducted between February and October 1986. Several groups were enrolled.

1) *Randomly selected participants.* A comprehensive list of household addresses was obtained for a neighborhood-based survey, and a random list was generated to recruit participants from about 500 of these on a door-to-door basis. Housing units were grouped into 12 locally defined neighborhoods (LDNs) conforming to 1980 census criteria (*4*). Sampling was weighted so that approximately 70% of households were preferentially selected from the LDNs with the largest number of reported AIDS patients. Persons 18 years of age or older who provided written informed consent and children aged 2 to 10 years whose parents or guardians provided consent were interviewed with the standardized questionnaire, asked for a blood sample, and examined for signs of HIV infection.

2) *Self-selected participants.* Persons 18 years or older (and their children if aged 2 to 10 years) who had not been selected to participate in the neighborhood-based survey but requested testing for HIV antibodies were also enrolled in the study.

3) *Clinic participants.* Because the number of participants with HIV infection was expected to be low in the neighborhood-based survey, attendees at the Glades Community Health Center in Belle Glade who were being evaluated for the possibility of HIV-related illness were invited to participate in the study. Since the self-selected participants

K. G. Castro, H. W. Jaffe, J. P. Narkunas, T. J. Bush, AIDS Program, Center for Infectious Diseases, Centers for Disease Control, Atlanta, GA 30333.
S. Lieb and J. J. Witte, AIDS Program, Florida Department of Health and Rehabilitative Services, Tallahassee, FL 32301.
C. H. Calisher, Division of Vector-Borne Viral Diseases, Center for Infectious Diseases, Centers for Disease Control, Fort Collins, CO 80522.

*To whom correspondence should be addressed.
†Project managers: James Cobb, Pete Duke, Kevin Sherman. Interviewers: Deborah Brown, Thomas Brown, Gracia Clarisce, Rev. Pierre Dorleans, Elijah Hatchett, Pauline Lockett, Dana Neff, Alex Simon. Medical interviewers: David Baker, John Hogan, Gregory Meyer, Alvaro O'Campo, W. Russell Woods. Clinic study coordinator: Hetty Waskin.

and clinic participants were not considered representative of all Belle Glade residents, they were excluded from the descriptive analyses of HIV-seroprevalence but included in analyses of risk factors for HIV infection.

Interviews were conducted in private by trained persons using the standardized questionnaire. Information collected included demographic data, income, schooling, living conditions, occupation, medical history, drug-use history, sexual history, estimated exposure to insects, and the availability of door and window screens, open foundations, hours spent outdoors, use of topical insect repellents, and other specific living conditions likely to result in greater exposure to insects. The questionnaire was also translated into Haitian-Creole and Spanish and administered by interviewers fluent in the participant's language of preference. The following information was obtained from parents of children aged 2 to 10 years: parental risk factors for HIV infection, the child's medical history, and known exposure to HIV-infected persons.

Blood was collected by venipuncture for serologic testing for hepatitis B virus, syphilis, selected arboviruses, and HIV infection. Serologic tests for hepatitis B surface antigen, core antibody (anti-HBc), and surface antibody (anti-HBs) were done by solid-phase radioimmunoassay (AUSRIA-II, CORAB, AUSAB: Abbott). Tests for syphilis included the rapid plasma reagin (RPR) card test, the fluorescent treponemal antibody-absorption (FTA-ABS) test, and the microhemagglutination (MHA-TP) test for *Treponema pallidum* (*5*). Antibodies to Tensaw, Maguari, Keystone, dengue 2, and St. Louis encephalitis arboviruses, which are prevalent in South Florida or the Caribbean, were blind tested by means of a serum dilution plaque neutralization technique (*6*). Studies for antibodies to HIV included the enzyme immunoassay (EIA) (Abbott) and the Western blot method (*7*).

All completed interviews were coded and computerized. All descriptive demographic analyses excluded self-selected and clinic participants. Otherwise, risk-factor analyses included interviews of all persons 18 years or older. Statistical associations between HIV-seropositivity and categorical variables were tested by the χ^2 test or Fisher's exact test. Associations with continuous variables were analyzed by the Wilcoxon rank-sum test. Variables that appeared significantly associated with HIV infection were then analyzed by stepwise linear logistic regression models. The analyses were not stratified by participant group or geographic area because such analyses lacked sufficient statistical power.

Risk factors were not identified for seven adult patients (six men and one woman) who died before the studies were completed (Table 1). Seven additional AIDS cases initially reported with undetermined risk factors were reclassified as associated with blood transfusion (one), intravenous (IV) drug abuse (one), or male heterosexual contact with female IV drug abusers (five) on the basis of follow-up information. Compared with other AIDS patients reported from Florida, those from Belle Glade were significantly more likely to be reported as heterosexual IV drug abusers or as sex partners of persons at increased risk for AIDS

Table 1. AIDS cases in Belle Glade and elsewhere in Florida selected by patient history and sex as of 1 August 1987.

History	Belle Glade		Elsewhere	
	Male *n* (%)	Female *n* (%)	Male *n* (%)	Female *n* (%)
Adult patients				
Homosexuality/bisexuality	17 (23.3)	0	1634 (71.3)	0
History of IV drug abuse	13 (17.8)	8 (40.0)	257 (11.2)	92 (31.8)
Transfusion	1 (1.4)	2 (10.0)	51 (2.2)	24 (8.3)
Heterosexual contacts*	35 (47.9)	7 (35.0)	250 (10.9)	119 (41.2)
None of above	6 (8.2)	1 (5.0)	82 (3.6)	27 (9.3)
Pediatric patients				
Increased risk or AIDS in mother	1 (1.4)	2 (10.0)	19 (0.8)	27 (9.3)
Total	73 (100)	20 (100)	2293 (100)	289 (100)

*Includes sexual contact with a person with AIDS or at increased risk for AIDS and persons born in Haiti, where HIV infection is largely the result of heterosexual transmission.

Table 2. Selected demographic characteristics and HIV seroprevalence of three study populations in Belle Glade, Florida.

Characteristics	Study population		
	Randomly selected (*n* = 877)	Self-selected (*n* = 115)	Clinic attendees (*n* = 28)
Sex, *n* (%)			
Male	441 (50)	74 (64)	20 (71)
Female	431 (50)	41 (36)	8 (29)
Age (years)			
Range	2–86	3–79	19–53
Mean	36.6	34.8	31.1
Median	36	34	31.5
Racial/ethnic group, *n* (%)			
White, non-Hispanic	163 (19)	24 (21)	0
Black, non-Hispanic	466 (53)	35 (30)	19 (68)
Hispanic	118 (13)	15 (13)	0
Haitian	124 (14)	40 (35)	9 (32)
Other	6 (1)	1 (1)	0
Number with HIV antibody			
n	28	4	24
%	3.2	3.5	85.7
95% confidence limit	2.0–4.4	0.1–6.9	72.7–98.7

Table 3. HIV prevalence rates by sex, age range, racial or ethnic group, and neighborhood for randomly selected study participants in Belle Glade, Florida.

Group	Proportion with HIV antibodies
Sex	
Male	16/441 (3.6%)
Female	12/436 (2.8%)
Age range (years)	
2–10	0/138
18–29	14/193 (7.3%)
30–39	9/180 (5.0%)
40–49	2/132 (1.5%)
50–59	3/103 (2.9%)
≥60	0/131
Racial/ethnic group	
White, non-Hispanic	0/163
Black, non-Hispanic	13/466 (2.8%)
Hispanic	0/118
Haitian	15/124 (12.1%)
Other	0/6
Locally defined neighborhoods*	
1	4/47 (8.5%)
2	14/148 (9.5%)
3	2/58 (3.4%)
4	5/194 (2.6%)
5	2/73 (2.7%)
6–11	0/253
12	1/101 (1.0%)

*Information missing for three HIV-seronegative persons.

($P < 0.05$ in each case). Eighty-five (91%) of the 93 AIDS patients from Belle Glade resided in the southwest-central part of town (LDN 1–5). Social and sexual interactions, as well as needle sharing, limited to persons living in close proximity most probably account for this.

Thirty-four of the AIDS patients could be linked directly to at least one other reported AIDS patient or to a person with AIDS-related complex (ARC) (for which symptoms include persistent fever, weight loss, diarrhea, or unexplained lymphadenopathy) by sexual contact, sharing of needles during IV drug abuse (or both), or perinatal exposure. Linked patients accounted for 37% of the 93 with AIDS reported from Belle Glade through 1 August 1987. Nine of the 14 adult women with AIDS or ARC were IV drug abusers who had engaged in prostitution. All three pediatric patients were born to mothers with AIDS.

Table 4. Bivariate analyses of adult male study participants significantly associated with HIV infection. (A) The proportion and percentage (in parentheses) of the number of participants with listed characteristics as compared to the total number evaluated. (B) Median values of significant variables by the Wilcoxon rank-sum test.

	Characteristics or significant variables	HIV-positive (n = 37)	HIV-negative (n = 426)	P value
A	Born in Haiti	16/37 (43.2)	79/426 (18.5)	<0.001
	Income ≤$10,000 per year	31/37 (83.8)	210/421 (49.9)	<0.001
	Never married	19/37 (51.4)	86/426 (20.2)	<0.001
	Sex with men	7/36 (19.4)	14/423 (3.3)	<0.001
	Sex with IV drug abuser	9/29 (31.0)	14/388 (3.6)	0.002
	Prevalence of non-IV drug use	15/37 (40.5)	102/424 (24.1)	0.027
	Prevalence of IV drug use	3/37 (8.1)	2/423 (0.5)	0.004*
	Prevalence of paying for sex	12/36 (33.3)	76/418 (18.2)	0.027
	Prevalence of getting paid for sex	3/35 (8.6)	8/416 (1.9)	0.014
	History of gonorrhea	18/34 (52.9)	149/420 (35.5)	0.042
	History of gonorrhea since 1978	11/16 (68.8)	60/147 (40.8)	0.032
	History of other STD	10/35 (28.6)	28/425 (6.6)	<0.001
	Positive RPR and MHA-TP	9/33 (27.3)	56/425 (13.2)	0.025
	Positive MHA-TP and FTA-ABS†	14/33 (42.4)	98/425 (23.1)	0.013
	Anti-HBc and anti-HBs	18/30 (60.0)	154/420 (36.7)	0.011
B	Age (years)	33	41	<0.001
	Number of lifetime sex partners	24	10	0.030
	Number of IV drug abusers as sex partners	3	0	0.009
	Number of one-night female sex partners	1.5	0	0.007
	Number of female sex partners in last 5 years	6	3	0.001

*Fisher's exact test. †Includes both RPR positive and negative specimens.

Table 5. Bivariate analyses of adult female study participants significantly associated with HIV infection. (A) The proportion and percentage (in parentheses) of the number of participants with listed characteristics as compared to the total number evaluated. (B) Median values of significant variables by the Wilcoxon rank-sum test.

	Characteristics or significant variables	HIV-positive (n = 19)	HIV-negative (n = 389)	P value
A	Born in Haiti	7/19 (36.8)	60/389 (15.4)	<0.001
	Income ≤$10,000 per year	16/19 (84.2)	211/379 (55.7)	0.034
	Never married	10/19 (52.6)	85/388 (21.9)	0.039
	Children from more than one father	11/17 (64.7)	111/314 (35.4)	0.015
	Sex with IV drug abuser	4/19 (21.1)	17/389 (4.4)	0.005
	Male sex partners who had sex with prostitutes	6/19 (31.6)	23/341 (6.7)	<0.001
	Male sex partners who had sex with other women	7/16 (43.8)	53/326 (16.3)	0.037
	Prevalence of getting paid for sex	5/18 (27.8)	20/385 (5.2)	<0.001
	History of gonorrhea	6/18 (33.3)	37/382 (9.7)	0.002
	History of other STD	5/18 (27.8)	31/386 (8.0)	0.004
	History of tattoo	2/19 (10.5)	5/387 (1.3)	0.003*
	History of transfusion	7/18 (38.9)	61/384 (15.9)	0.020
	Positive RPR and MHA-TP	9/17 (52.9)	47/388 (12.1)	<0.001
	Positive MHA-TP and FTA-ABS†	11/17 (64.7)	84/388 (21.6)	<0.001
	Anti-HBc and anti-HBs	10/16 (62.5)	111/385 (28.8)	0.004
B	Age (years)	27	37	0.006
	Number of lifetime sex partners	6.5	3	<0.001
	Number of episodes of gonorrhea	2	1	0.006
	Number of one-night male sex partners	1	0	<0.001
	Number of male sex partners in last 5 years	3	1	<0.001
	Number of years living in Belle Glade	5	7	0.008

*Fisher's exact test. †Includes both RPR-positive and -negative specimens.

A total of 557 randomly selected households were visited while someone was there. Residents from 407 (73%) of those 557 households agreed to participate in the study. These randomly selected participants were not significantly different from self-selected participants (Table 2). In contrast, clinic participants tended to be significantly younger and nonwhite ($P < 0.05$ in each case). Prevalence of HIV antibodies in randomly selected participants (3.2%) and self-selected participants (3.5%) was similar, while, as expected, prevalence in clinic attendees was much higher (85.7%).

Seroprevalences in males and females were similar ($P > 0.15$, Table 3). None of 136 children aged 2 to 10 years and none of 130 persons over 60 years of age had antibodies to HIV. The highest age-specific seroprevalence (7.3%) was observed in adults 18 to 29 years of age. All persons seropositive for HIV were black and born in Haiti or the United States. All but one HIV-seropositive person resided in the southwest-central part of Belle Glade (LDN 1–5), which is characterized by crowded living conditions and high rates of drug abuse, sexually transmitted diseases (STDs), and prostitution (*8*). Most (91%) of the AIDS patients also resided there. Except for six cases of HIV infection of sex partners (three couples), there was no clustering of infection within households.

HIV-seropositive adults were more likely than HIV-seronegative adults to be from Haiti (*9, 10*), have a lower income, have never married, have a younger median age, report a history of previous treatment for sexually transmitted diseases, and have serologic markers for *Treponema pallidum* and hepatitis B virus infection (Tables 4 and 5). HIV-seropositive men and women were also more likely to report sexual contact with IV drug abusers, to have more sex partners within the last 5 years as well as more lifetime sex partners, and to have been paid for sexual favors.

HIV-seropositive men were significantly more likely than HIV-seronegative men to report previous sexual contacts with persons

Table 6. Results of linear logistic regression analyses showing significant variables for HIV infection in men and women.

Significant variable	Adjusted odds ratio	*P* value
Men		
History of STDs	6.85	0.002
Income <$10,000	6.27	0.002
Median age (33 versus 41 years)	4.00	0.013
History of sex with men	5.87	0.022
Women		
Positive RPR and MHA-TP	10.93	0.0001
Median number of male sex partners in last 5 years (three versus one)	5.38	0.009
Male sex partner known to have sex with prostitutes	5.09	0.023

at increased risk for HIV infection and a history of IV drug abuse. They were also more likely to have paid for sex and to have been treated for gonorrhea (*11*).

HIV-seropositive women were more likely than HIV-seronegative women to have given birth to children of different fathers, to report being paid for sex, and to report sexual contacts with IV drug abusers, men known to have additional (extramarital) sex partners, and men who frequented prostitutes. They were also more likely to report treatment for gonorrhea and to have received blood transfusions or tattoos.

Risk factor variables significant in bivariate analyses were analyzed with a stepwise logistic regression model that excluded Haitian origin (Table 6). For men, a history of STDs, lower income, sex with homosexual or bisexual men, and a younger median age remained significantly associated with HIV infection. For women, a positive antibody test for syphilis, more male sex partners within the last 5 years, and sexual contact with men who frequented prostitutes remained significantly associated with HIV infection.

HIV infection was not significantly associated with a history of exposure to mosquitoes or other insects; hours spent outdoors; use of insect repellents; living in houses with open foundations; presence of antibodies to Tensaw, Maguari, dengue 2, St. Louis encephalitis, or Keystone viruses; history of seasonal farm work; receipt of human immune globulin preparations; or history of occupational contact with human blood (Table 7).

Incomplete information is the most likely explanation for Belle Glade AIDS patients not falling into one of the recognized risk categories, since risks for HIV were present in all patients interviewed. Nationally, when additional information has become available for AIDS patients initially reported without risk factors, it has been possible to classify 72% into recognized transmission categories (*12*). Although it is not possible to state how each of the seven Belle Glade AIDS patients with undetermined risks became infected, it is unlikely that they represent instances of HIV transmission through unrecognized modes. This conclusion is supported by the lack of HIV infections in children aged 2 to 10 years and adults older than 60 years and the lack of household clustering of infections.

The HIV-seropositivity rate for Belle Glade is considerably higher than that for volunteer blood donors and military recruit applicants (*13*). In Belle Glade, the large proportion of AIDS cases in nonwhite heterosexual IV drug abusers and their sexual partners resembles the AIDS situation in several large metropolitan areas in the northeastern United States, such as New York City and Newark, New Jersey. In those areas AIDS patients have been overrepresented in black and Hispanic minorities because of IV drug abuse and subsequent heterosexual transmission of HIV (*14*).

HIV infection was probably introduced into Belle Glade by homosexual or bisexual men and male IV drug abusers with contacts from outside this community; subsequent heterosexual transmission of HIV to women then occurred at a faster rate than transmission to other men. This is suggested by the difference in the sex distribution of AIDS patients (infected several years ago), with a male to female ratio of 3.7:1, and that of the HIV-seropositive persons enrolled in the cross-sectional surveys during 1986, with a male to female ratio of 1.3:1.

The association between HIV infection and historic or laboratory evidence of other STDs is consistent with other data from the United States and Africa indicating that genital ulcers caused by other STDs (for example, herpes, syphilis, and chancroid) are significantly associated with HIV transmission (*15*).

Studies of female prostitutes in this country suggest that the major risk factor for HIV infection and AIDS in these women is IV drug abuse (*16*). Of female IV drug abusers attending drug rehabilitation programs in New York City, approximately 30% have engaged in prostitution (*17*). Thus, in Belle Glade, the observed epidemiologic association between HIV and sex with female prostitutes (many of whom are IV drug abusers) probably indirectly reflects heterosexual transmission of HIV through exposure to IV drug abusers. This is also suggested by other studies showing bidirectional (male-to-female and female-to-male) heterosexual transmission of HIV in sex

Table 7. Selected variables not significantly associated with HIV infection in men and women. Proportion represents the ratio of the number of participants with a history of the variable to the number evaluated.

Selected variable	Proportion and percentage			
	Men		Women	
	HIV-positive	HIV-negative	HIV-positive	HIV-negative
Bitten by mosquitoes inside house	7/37 (18.9)	40/420 (9.5)	2/19 (10.5)	57/380 (15.0)
Lice in house	1/35 (2.9)	8/423 (1.9)	0/19	10/388 (2.6)
"Itch mites" in house	0/34	6/423 (1.4)	1/19 (5.3)	5/386 (1.3)
Fleas in house	2/36 (5.6)	32/420 (7.6)	2/19 (10.5)	42/388 (10.8)
Bedbugs in house	0/37	4/424 (0.9)	1/19 (5.3)	4/388 (1.0)
Average number of hours spent outdoors per week	6.9	5.2	2.7	2.4
Never used topical insect repellents	18/22 (81.8)	166/243 (68.3)	10/22 (45.5)	150/218 (68.8)
House with open foundations	13/35 (37.1)	179/416 (43.0)	4/17 (23.5)	153/382 (40.0)
Tensaw virus antibodies	4/36 (11.1)	80/419 (19.1)	0/16	45/379 (11.9)
Maguari virus antibodies	7/36 (19.4)	98/419 (23.4)	0/16	57/379 (15.0)
Dengue 2 virus antibodies	8/36 (22.2)	75/419 (17.9)	4/16 (25.0)	44/379 (11.6)
St. Louis encephalitis virus antibodies	6/36 (16.7)	62/419 (14.8)	0/16	39/379 (10.3)
Keystone virus antibodies	4/36 (11.1)	64/419 (15.3)	0/16	46/379 (12.1)
History of seasonal migrant farmwork	19/31 (61.3)	138/299 (46.2)	7/15 (46.7)	89/251 (35.5)
History of travel outside United States	3/31 (9.7)	66/372 (17.7)	0/17	50/355 (14.1)
Received immune globulin preparations	2/37 (5.4)	19/426 (4.5)	0/19	28/389 (7.2)
Contact with human blood at work	2/36 (5.6)	21/422 (5.0)	1/19 (5.3)	28/382 (7.3)

partners of IV drug abusers (*18*). Alternatively, some men who reported sex with IV drug–abusing prostitutes as their only risk factor may have been reluctant to volunteer a history of IV drug abuse.

Despite hypotheses of HIV transmission through mosquitoes and reports of homologous HIV genetic sequences in insects and of HIV survival in bedbugs (*19*), neither the epidemiologic measures of insect exposure in Belle Glade nor the laboratory measures of mosquito exposure were significantly associated with the presence of HIV antibodies. Epidemiologic studies have failed to establish associations between the presence of malaria antibodies and HIV in either Haitians or Africans (*10, 20*). Information from developing countries, where insects theoretically would be more likely to play a role in transmission, suggests that HIV is not spread by insects (*21*). Experiments with fruit flies, ticks, moths, and mosquito cells have shown that HIV does not replicate in those arthropod cells (*22*).

Observations in Belle Glade, Florida, indicate how HIV transmission is likely to continue in other parts of the United States and the world. Conditions that lead to increased sexual activity with multiple partners, prostitution, and needle sharing among IV drug abusers are likely to facilitate further HIV transmission. These factors must be taken into account when programs are developed to prevent HIV infection in populations that are predictably hard to reach through conventional methods.

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