2. Henshaw, S. K., and Von, J. V., editors: Abortion services in the United States, each State and metropolitan area, 1984–1985. Alan Guttmacher Institute, New York, NY, 1988.
3. Cates, W., Jr.: The Hyde Amendment in action: how did the restriction of federal funds for abortion affect low-income women? JAMA 246: 1109–1112, Sept. 4, 1981.
4. Centers for Disease Control: Effects of restricting federal funds for abortion—Texas. MMWR 29: 253–254, June 6, 1980.
5. Rubin, G. L., Gold, I., and Cates, W., Jr.: Response of low-income women and abortion facilities to restriction of public funds for abortion: a study of a large metropolitan area. Am J Public Health 69: 948–950 (1979).
6. Trussel, J., Menken, J., Lindheim, B. L., and Vaughan, B.: The impact of restricting Medicaid financing for abortion. Fam Plann Perspect 12: 120–130 (1980).
7. Torres, A., Donovan, P., Dittes, N., and Forrest, J. D.: Public benefits and costs of government funding for abortion. Fam Plann Perspect 18: 111–118 (1986).
8. Cates, W., Jr., et al.: Health impact of restricting public funds for abortion, October 10, 1977–June 10, 1978. Am J Public Health 69: 945–947 (1979).
9. Colorado Department of Health and State Data Center, Colorado Division of Local Government: Summary characteristics of reported induced terminations of pregnancy: Colorado occurrence, 1982–1987. Denver, 1989.
10. North Carolina Department of Human Resources, Division of Health Services, State Center for Health Statistics: Total resident pregnancies, North Carolina, 1982–1987. Raleigh, 1989.
11. Colorado Department of Health and State Data Center, Colorado Division of Local Government: Live births and birth rates: Colorado residents and United States, selected years, 1910–1987. Denver, 1989.
12. Colorado Department of Health and State Data Center, Colorado Division of Local Government: Live births to unmarried women: Colorado residents and United States, selected years, 1930–1987. Denver, 1989.
13. Colorado Department of Health and State Data Center, Colorado Division of Local Government: Live births by age group of mother: Colorado residents, 1970–1987. Denver, 1989.
14. Pennsylvania Department of Health, State Health Data Center: Abortion statistics. Harrisburg, 1987.
15. Pennsylvania Department of Health, State Health Data Center: Pennsylvania reported pregnancies, 1982–1986. Harrisburg, 1988.
16. Pennsylvania Department of Health, State Health Data Center: Reported pregnancies by women's age group and county of residence, Pennsylvania, 1987. Harrisburg, 1989.
17. California Department of Health Services, Medical Care Statistics Unit: Medi-Cal funded deliveries. Sacramento, 1987.

HIV Antibody Seroprevalence Among Childbearing Women Surveyed in Maryland

DIANE L. MATUSZAK, MD, MPH
SUSAN R. PANNY, MD
JAGDISH PATEL, PhD
EBENEZER ISRAEL, MD, MPH

The authors are affiliated with the Maryland Department of Health and Mental Hygiene. Dr. Matuszak is Chief of the Center for Community Epidemiology. Dr. Panny is Director of the Office for Hereditary Disorders, Local and Family Health Administration. Dr. Patel is Chief of the Division of Virology and Immunology. Dr. Israel is Director of the Epidemiology and Disease Control Program.

Support for the project was provided in part under a cooperative agreement with the Public Health Service, Centers for Disease Control, grant U62/CCU 302047-03.

Tearsheet requests to Diane L. Matuszak, MD, Department of Health and Mental Hygiene, 201 West Preston St., Room 327, Baltimore, MD 21201.

Synopsis

Because blood specimens from newborns reflect the antibody status of the mother, seroprevalence rates among childbearing women are obtainable from analysis of the specimens. A blinded survey of human immunodeficiency virus (HIV) antibody seroprevalence among childbearing women was conducted in Maryland. The survey used 31,273 dried filter paper blood spot specimens obtained from newborns screened for hereditary disorders.

Overall, 99 specimens were positive on two enzyme-linked immunoassays and on Western blot, providing a seroprevalence rate of 0.32 percent. The rate for childbearing women residing within the City of Baltimore, 0.7 percent, was significantly higher than the rate for those residing elsewhere in Maryland, 0.1 percent. The statewide rate for nonwhite women, 0.8 percent, was higher than for white women, 0.007 percent. No statistically significant associations were found with residence in an inner city area, as opposed to residence in other areas of the city; birth weight group; reported health of the infant; or the infant having received a transfusion.

AMONG ACQUIRED IMMUNODEFICIENCY SYNDROME (AIDS) patients younger than 13 years of age, the most commonly recorded category of transmission is having a mother with human immunodeficiency virus (HIV) infection or at risk for HIV infection.

In 1988, 68 percent of pediatric cases nationwide (*1*) and 86 percent of Maryland's pediatric cases were in this transmission category (according to a personal

communication from Cyrus Hamidi, Division of AIDS Surveillance, Maryland Department of Health and Mental Hygiene, April 1990).

Data on the prevalence of HIV infection among women of childbearing age have been largely unavailable until recently. Since 1985, the Centers for Disease Control has recommended the screening of pregnant women to assist in preventing prenatally acquired HIV infection (*2*). Beginning in 1987, policies and procedures in the State of Maryland have required STD clinics and maternity clinics of local health departments to offer counseling and HIV antibody testing to all patients and to encourage counseling and testing for those who give histories suggestive of HIV infection risk.

However, these efforts have been unable to detect a significant proportion of young women with HIV infection because many such women do not perceive themselves to be infected or at risk and do not acknowledge their personal risk factors.

In a study of childbearing women at a New York hospital, 5 of 12 HIV seropositive women reported no self-identified risk factors (*3*). Our survey of persons receiving services similarly found that 18 of 37 HIV seropositive women, or 48.7 percent, at Baltimore city health department STD Clinics (*4*), and 4 of 5 at Maryland STD Clinics (*5*), failed to acknowledge a known risk factor for HIV infection.

Because Maryland law requires that parents be offered neonatal screening for several hereditary disorders, and parents of more than 98 percent of newborns avail themselves of this opportunity, the screening offers an opportunity to determine HIV seropositive rates among women who give birth.

In order to obtain accurate baseline seroprevalence rates for childbearing women, a survey was undertaken through blinded serological testing of dried filter paper spot specimens submitted for screening for hereditary disorders among newborns.

Previously published surveys have reported seropositivity rates ranging from 0.02 percent to 0.66 percent in childbearing women, based on testing of specimens obtained from newborn infants (*1, 6–11*).

Methods

The Maryland Department of Health and Mental Hygiene conducted a blinded HIV seroprevalence survey from August 27, 1988, through February 28, 1989. The survey used dried filter paper blood spots submitted for neonatal testing for hereditary disorders.

Filter paper blood spot specimens are collected from infants whose parents consent to screening for hereditary disorders 24 hours after the first milk feeding. The specimens are allowed to air dry. All specimens of satisfactory quality and sufficient quantity were included in the sample. The laboratory request form accompanying the specimens included the names of the mother, the pediatrician, and the hospital; the mother's address and age; the date of birth; date of the specimen; feeding history; infant's history of antibiotic administration or blood transfusion prior to specimen collection; and the infant's health status, birth weight (4 groups), and race (white, nonwhite).

Criteria for Positive Interpretation of Western Blot Tests for HIV Surveillance Purposes[1]

One band from list *A* and one band from list *B*, or:
Two bands from list *B*, or:
One band each from lists *B*, *C*, and *D*.

List *A*: p24 and p31.
List *B*: gp41, gp120, and gp160.
List *C*: p17 and p55.
List *D*: p51 and p66.

[1]Reference 12.
HIV = human immunodeficiency virus.

Specimens submitted to the hereditary disorders laboratory were assigned accession numbers and were batched. Specimens and laboratory slips were separated, but the order within a batch was strictly maintained.

After the blood spot punches for hereditary disorder screening were obtained, a quarter-inch punch of each specimen was obtained for testing for HIV antibodies. Trays were labeled with a batch number and date and were stored until released by the laboratory as having had all required tests completed. An anonymous computer-generated summary of information on each specimen in each batch listed demographic data, infant feeding history, health status, and history of blood transfusion.

When microtiter trays were released by the hereditary disorders screening laboratory, the batch number and date were removed from both the tray and the computer generated line listing, and were destroyed. To maintain confidentiality, each was labeled with a four-digit, computer generated random number, breaking the link to individual identifiers before submitting specimens for HIV antibody testing.

The microtiter trays were sent to a separate retrovirology laboratory for HIV antibody testing. All specimens were eluted, extracting the serum from the filter paper, and tested according to protocols developed by the Centers for Disease Control (*12*).

The enzyme-linked immunoassays (ELISA) were performed using commercial reagents (*A*). Specimens having an optical density to cut-off value ratio of greater than one were considered reactive and were retested using ELISA.

Specimens found to be reactive on the second ELISA were tested using the Western blot (*B*). The results were

Table 1. Maryland regional distribution of HIV seropositivity

Region of residence[1]	Number of positives	Percent of all seropositives	Number of specimens	Rate (percent)
City of Baltimore	50	50.5	7,507	0.7
Metropolitan District of Columbia	15	15.2	7,300	0.2
Eastern Shore	2	2.0	1,636	0.1
Southern	2	2.0	1,215	0.2
Suburban Baltimore	1	1.0	5,389	0.02
Western	0	0.0	2,320	0.0
Out of State	1	1.0	1,713	0.06
Unknown	28	28.3	4,193	0.7
Total	99	100.0	31,273	0.32

[1]Based on zip code of mother's residence.
NOTE: HIV = human immunodeficiency virus.

Table 2. Univariate analysis showing percent of HIV seropositivity in Maryland by age and race of mother, and by infant's health and birth weight

Variable	Number of positives	Number of specimens	Percent
Age of mother in years:			
Younger than 15	0	90	0.0
15–19	2	2,104	0.1
20–24	14	4,760	0.3
25–29	19	5,933	0.3
30–34	5	4,129	0.1
35–39	3	1,357	0.2
Older than 40	1	186	0.5
Unknown	55	12,709	0.4
Race of mother:			
White	13	19,354	0.07
Nonwhite	74	9,619	[1]0.77
Unknown	12	2,300	0.5
Reported health of infant:			
Well	74	21,855	0.34
Sick	2	416	0.48
Unknown	23	9,002	0.26
Infant birth weight:			
Less than 1,000 grams	0	199	0.0
1,001–1,500 grams	2	80	2.5
1,501–2,000 grams	1	228	0.44
More than 2,000 grams	78	27,471	0.28
Unknown	18	3,295	0.5

[1]*P* less than 0.0001.
NOTE: HIV = human immunodeficiency virus.

interpreted by criteria established by the Centers for Disease Control for surveillance purposes (see accompanying box).

Results were reported to the survey coordinator by tray and position number and entered in a separate database. The two databases were merged by tray and position number to yield the final master file. Statistical comparisons were done on an IBM Model 50 microcomputer using the Epi Info program (*C*) to calculate odds ratios and 95 percent confidence intervals.

Chi-square analysis and Fishers exact test (two-tailed) were used to compare demographic information and serological test results between groups. The survey protocol was approved by the Institutional Review Board of the Maryland Department of Health and Mental Hygiene.

Results

Preliminary reports from the Maryland Division of Vital Records indicate that 33,899 births occurred in the State in the survey period. The hereditary disorders screening laboratory received 33,388 specimens taken from infants during this period, representing 98.5 percent of births.

Of these, 31,273 specimens, representing 92.3 percent of births, were of sufficient quality and quantity to permit HIV antibody testing. Ninety-nine specimens were reactive on two ELISAs and positive by Western blot, for an overall rate of 0.32 percent.

Table 1 shows the regional distribution and rates of seropositivity for births. The rate for childbearing women residing within the City of Baltimore, 0.7 percent, was significantly higher than the rate for other regions in Maryland, 0.1 percent (OR = 5.98; 95 percent CI, 3.47, 10.40; $P < 0.0001$).

For the 4,193 records lacking the zip code of residence of the mother, the hospital's region was recorded in 4,028 instances (96 percent). In 2,229 cases, the hospital's region was in the City of Baltimore, accounting for 24 of 28 HIV seropositives for whom the mother's residence zip code was unknown.

Overall, 75 percent of seropositive childbearing women were either city residents or gave birth in city hospitals. Table 2 shows the variables examined for association with seropositivity. The only statistically significant association is with race. Nonwhite childbearing women were more likely to be seropositive, 0.8 percent, than white childbearing women, 0.007 percent (OR = 10.58; 95 percent CI, 5.85, 20.52; $P < 0.00001$).

The difference remained significant even when women of unknown race were assumed to have been white. Overall, 74.7 percent of the seropositive women were nonwhite, while births to nonwhite women accounted for only 30.7 percent of the total number of births.

Within the City of Baltimore, the HIV antibody seropositivity rate for nonwhite childbearing women was 1.4 percent, while the corresponding rate for white city residents was 0.05 percent (OR = 25.89; 95 percent CI, 6.15, 154.46; $P < 0.00001$).

When stratified by race, there was no significant difference in rates by geographic location detected for white women or women of unknown race. For nonwhite women, residence within the City of Baltimore was associated with an increased seropositivity rate (table 3).

Since more than 50 percent of the seropositive women had a residential zip code within the City of Baltimore, we analyzed rates to determine whether they were more specific geographically. Baltimore area zip codes were grouped into inner city (the downtown and immediate environs), outer city (within city limits but outside the inner city area), and county (zip code areas immediately outside of and contingent with city borders). Incidence rates in these areas by race were calculated for reportable conditions with similar transmission patterns. Table 4 summarizes the findings.

The racial distribution of HIV seropositivity prevalence rates among childbearing women is similar to the pattern of incidence rates among females for AIDS, gonorrhea, and primary and secondary syphillis, but not for hepatitis B within the City of Baltimore.

Table 3. HIV seroprevalence rates in Maryland, by race and location

Race	Area of residence	Number of specimens	Number of positives	Rates (percent)
White.....	City of Baltimore	3,793	2	0.05
	Elsewhere in Maryland	12,661	6	0.05
Nonwhite...	City of Baltimore	3,265	44	1.4
	Elsewhere in Maryland	4,073	11	[1]0.3
Unknown...	City of Baltimore	446	4	0.9
	Elsewhere in Maryland	809	3	0.4

[1]OR = 4.99; 95 CI, 2.49, 10.25; *P* less than 0.0001.
NOTE: HIV = human immunodeficiency virus.

Discussion

The rate of HIV seropositivity among childbearing women is cause for concern. Each year, from 65,000 to 75,000 births are expected among Maryland residents. At an HIV infection rate of 0.32 percent, we could expect that between 200 and 240 infants would be born to infected mothers annually, and 24 to 50 percent of those infants could be expected to be infected (*13–15*).

If the pattern seen in this survey persists, nearly 75 percent of the infants born to HIV-positive mothers would be nonwhite and 75 percent would be born in the City of Baltimore or to mothers who live there. Nonwhite residents constitute only 22 percent of Maryland's population, while the City of Baltimore accounts for less than 20 percent of the State's population.

In Maryland, 51 percent of AIDS cases among women are attributable to intravenous drug abuse and 88 percent of the women are black. Among children with AIDS, there were 51 cases reported in the period 1983–89 resulting from perinatal transmission, and 90 percent of them were children of women who used drugs intravenously. Eighty percent of those with pediatric AIDS were black, and 63 percent lived in the City of Baltimore at the time of diagnosis (personal communication from John Paul Clark, Division of Seroprevalence, AIDS Administration, Maryland Department of Health and Mental Hygiene, May 15, 1990).

Given the existing incidence data for AIDS cases among women and children, we compared our serosurvey data to incidence data for a disease transmitted both by needle sharing and by sexual activity (hepatitis B), and diseases transmitted almost exclusively sexually (such as syphilis and gonorrhea).

The mode of transmission of HIV infection appears to resemble that of syphilis and gonorrhea more than that of hepatitis B virus, at least among women. The lack of racial differences in hepatitis B rates among women is unexplained. Rates of hepatitis B infection among men do show racial differences (the rate per 100,000 men is 26.1 for whites and 47.2 for blacks in inner city zip code areas (OR = 1.81; 95 percent CI, 0.99, 3.36; $P = 0.04$).

Table 4. Rates of reported cases of HIV infection in childbearing women in Maryland, and rates of other reported diseases, by race[1]

Category	Rates per 100,000 white women	Rates per 100,000 nonwhite women
Inner city zip codes:		
HIV in childbearing women.....	0.0	1,760.3
AIDS.....	3.5	49.2
Primary and secondary syphilis..	7.6	54.5
Hepatitis B.....	10.5	10.9
Gonorrhea.....	([2])	([2])
Outer city zip codes:		
HIV in childbearing women.....	79.9	1,317.4
AIDS.....	0.8	40.6
Primary and secondary syphilis..	1.6	42.6
Hepatitis B.....	12.4	12.7
Gonorrhea (all city cases).....	22.2	397.2
Baltimore County zip codes:		
HIV in childbearing women.....	46.6	324.7
AIDS.....	1.4	12.8
Primary and secondary syphilis	0.3	15.1
Hepatitis B.....	0.0	6.4
Gonorrhea.....	19.9	218.3

[1]Rates of reported cases of AIDS provided by the Maryland Department of Health and Mental Hygiene, AIDS Administration. Rates of reported cases of primary and secondary syphilis, gonorrhea, and hepatitis B provided by the Maryland Department of Health and Mental Hygiene, Epidemiology and Disease Control Program.
[2]Rates by zip code or census tract not available.
NOTE: HIV = human immunodeficiency virus, AIDS = acquired immunodeficiency syndrome.

The Second National Health and Nutrition Examination Survey (NHANES II) found statistically significant racial differences in the prevalence of serologic markers for hepatitis B in both sexes ages 12–74 years (*16*). We are not able to postulate a systematic underreporting of

hepatitis B infections that would affect black women but not black men.

Whatever the reason for the lack of racial differences in hepatitis B rates for women, it does not appear to be owing to the prevalence of intravenous drug use. There are no reliable data on the prevalence rates by race and sex of intravenous drug use in the general population of Maryland, but admission rates for nonwhite males and females to programs for treatment of intravenous drug use consistently exceed those for white males and females (*17*).

For the past 2 years, the Division of Maternal Health has recommended offering HIV antibody counseling and testing to all maternity patients in local health department clinics and has encouraged all pregnant women with histories of behavioral risk factors to be tested. Entry into drug treatment for pregnant intravenous users has been expedited. While this policy has led to the detection and followup of a few HIV-infected women and their infants, the overall rate of acceptance of counseling and testing has remained low, approximately 11 percent (calculated from data provided by Steve Jaffe, Counseling and Testing Services, AIDS Administration, Maryland Department of Health and Mental Hygiene, April 1990; and Bonnie Birkel, Maternal Health and Family Planning, Local and Family Health Administration, Maryland Department of Health and Mental Hygiene, April 1990). The low acceptance rate may be secondary to the low rates at which women recognize themselves to be at risk of HIV infection.

Outreach efforts for HIV prevention are being planned and undertaken, and they are directed at women living in the City of Baltimore in census tracts and zip codes with recorded high incidence rates of syphilis and high HIV seroprevalence rates (as reflected in this survey and counseling and testing site data). All local health department STD, family planning, and maternity clinics are now offering HIV counseling and testing to all women regardless of risk behavior history. Informational materials on HIV testing have been developed for distribution to new mothers. HIV counseling and antibody testing on a voluntary basis is available to women delivering in Maryland.

We believe it appropriate to encourage all pregnant women in Maryland to be HIV-antibody tested, after obtaining informed consent, and to provide adequate counseling. The need is particularly acute for the minority population and in urban areas.

References

1. AIDS and human immunodeficiency virus infection in the United States: 1988 update. MMWR Supplement 38 (S-4): 1–38, May 12, 1989.
2. Recommendations for assisting in the prevention of perinatal transmission of HTLV-III/LAV and acquired immunodeficiency syndrome. MMWR 34: 721–726, 731–732, Dec. 6, 1985.
3. Landesman, S., et al.: Serosurvey of human immunodeficiency virus infection in parturients. JAMA 258: 2701–2703, Nov. 20, 1987.
4. Quinn, T. C., et al.: Human immunodeficiency virus infection among patients attending clinics for sexually transmitted diseases. N Engl J Med 318: 197–203, Jan. 28, 1988.
5. Matuszak, D. L., et al.: Prevalence of risk behaviors and human immunodeficiency virus infection in Maryland sexually transmitted disease clinics. Maryland Med J 38: 1019–1026, (1989).
6. Hoff, R., et al.: Seroprevalence of human immunodeficiency virus among childbearing women. N Engl J Med 318: 525–530, Mar. 3, 1988.
7. Novick, L. F., et al.: HIV seroprevalence in newborns in New York State. JAMA 261: 1745–1750, Mar. 24/31, 1989.
8. Maine's anonymous newborn HIV seroprevalence study. Epi-Gram. Division of Disease Control, Department of Human Services, Maine Bureau of Health, Augusta, February 1989, pp. 1–2.
9. HIV infection in children. Epi-Gram. Epidemiology Program, Florida Department of Health and Rehabilitative Services, July 1989.
10. HIV infection in Louisiana. Louisiana Morbidity Report. Louisiana Department of Health and Hospitals, Office of Public Health, New Orleans, July/August 1989, pp. 1–5.
11. HIV Seroprevalence Studies—Utah. Communicable Disease Newsletter. Utah Department of Health, Division of Community Health Services, January 1990, pp. 1–4.
12. Centers for Disease Control: Serological assays for human immunodeficiency antibodies in dried blood specimens collected on filter paper. Technical report, Center for Infectious Diseases, Division of HIV/AIDS, Laboratory Investigations Branch, Developmental Technology Section, March 1988.
13. The European Collaborative Study: Mother to child transmission of HIV infection. Lancet No. 8619: 1039–1043, Nov. 5, 1988.
14. Blanche, S., et al.: A prospective study of infants born to women seropositive for human immunodeficiency virus type I. N Engl J Med: 1643–1648, June 22, 1989.
15. Selwyn, P. A., et al.: Perinatal transmission of HIV in intravenous drug abusers (IVDAS) presented at the Third International Conference on AIDS, Washington, DC, June 1–5, 1987.
16. Racial differences in rates of Hepatitis B virus infection—United States, 1976–1980. MMWR 38: 818–821, Dec. 1, 1989.
17. Maryland Department of Health and Mental Hygiene: Trends and patterns in alcohol and drug abuse in Maryland—fiscal year 1988. Alcohol and Drug Abuse Administration, Baltimore, June 1989.

Equipment

A. Enzyme immunoassay: LAV EIA, Genetic Systems Corp., 3005 1st Ave., Seattle, WA 98121.

B. Western blot: HIV antigen preblotted membrane, Immunetics, 145 Bishop Allen Dr., Cambridge, MA 02139; tel. (800) 227-4765; conjugate, Centers for Disease Control; substrate, BCIP, 5 bromo, 4 chloro, 3 indolyl phosphate, Kirkgaard and Perry Laboratories, 2 Cessna Ct., Gaithersburg, MD 20879.

C. Dean, J. A., Dean, A. G., Burton, A., and Dicker, R.: Epi Info, version 3, computer programs for epidemiology, for IBM-PC or compatible. Centers for Disease Control, Epidemiology Program Office, Atlanta, GA, January 1988. Available from USD, Inc., 2075A West Park Pl., Stone Mountain, GA 30087; tel. (404) 469-4098.