Trends in Perinatal HIV Prevention in New York City, 1994–2003

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Objectives. We examined trends in perinatal HIV prevention interventions in New York City implemented during 1994 to 2003 to ascertain the success of the interventions in reducing perinatal transmission.

Methods. We used data obtained from infant records at 22 hospitals. We used multiple logistic regression to analyze factors associated with prenatal care and perinatal HIV transmission.

Results. We analyzed data for 4729 perinatally HIV-exposed singleton births. Of mothers with prenatal care data, 92% had prenatal care. The overall proportion who received prenatal care and were diagnosed with HIV before delivery was 86% in 1994 to 1996 and 90% in 1997 to 2003. Use of prenatal antiretrovirals among mothers who received prenatal care was 63% in 1994 to 1996 and 82% in 1997 to 2003. From 1994 to 2003, cesarean births among the entire sample increased from 15% to 55%. During 1997 to 2003, the perinatal HIV transmission rate among the entire sample was 7%; 45% of mothers of infected infants had missed opportunities for perinatal HIV prevention. During 1997 to 2003, maternal illicit drug use was significantly associated with lack of prenatal care. Lack of prenatal, intrapartum, and neonatal antiretrovirals; maternal illicit drug use; and low birthweight were significantly associated with perinatal HIV transmission.

Conclusions. Interventions for perinatal HIV prevention can successfully decrease HIV transmission rates. Ongoing perinatal HIV surveillance allows for monitoring the implementation of guidelines to prevent mother-to-child transmission of HIV and determining factors that may contribute to perinatal HIV transmission. (*Am J Public Health.* 2008;98:1857–1864. doi:10.2105/AJPH.2007.110023)

The perinatal HIV epidemic began in the United States in 1977. Currently, an estimated 6000 to 7000 births occur annually to HIV-infected women.[1–3] Beginning in the mid-1990s, the use of antiretroviral therapies to prevent perinatal HIV transmission resulted in a decline in the number of perinatally HIV-infected infants born each year in the United States, from an estimated 1000 to 2000 in the early 1990s to 100 to 200 in 2005.[3,4] Successes in prevention of perinatal HIV transmission were first shown in 1994 with the landmark Pediatric AIDS Clinical Trials Group Protocol 076 Study of prenatal, intrapartum, and neonatal treatment with zidovudine[5,6] and subsequently with regimens containing prenatal zidovudine in combination with other antiretroviral agents.[7] Short-course antiretroviral therapies were also effective in reducing perinatal HIV transmission.[8–13] In 1999, recommendations were made by the American College of Obstetricians and Gynecologists that HIV-infected pregnant women be offered scheduled cesarean delivery for perinatal HIV prevention.[14] The recommendations were refined in 2000 to offer scheduled cesarean delivery for women with HIV RNA levels above 1000 copies/mL,[14,15] a level that carries an increased risk of perinatal HIV transmission.[16–19]

Since the beginning of the perinatal HIV epidemic in the United States, New York City has been at its epicenter. As of 2003, 22% of the cumulative US pediatric AIDS cases were reported from New York City.[20] Since 1988, the New York State Department of Health has tested all newborns for HIV exposure, initially as a blinded serosurvey and since 1997 through the Comprehensive Newborn Screening Program, allowing for identification of all perinatally HIV-exposed infants.[21,22] We investigated trends in interventions for perinatal HIV prevention in New York City over a 10-year period.

METHODS

The New York City Department of Health and Mental Hygiene HIV Epidemiology Program has been conducting routine citywide surveillance for AIDS since 1981 and for HIV infection since June 2000. Since 1989, the program has participated in Centers for Disease Control and Prevention (CDC)–funded pediatric HIV/AIDS surveillance projects at 22 New York City sites. The 22 sites include both private and public hospitals. The sites provide medical care to approximately two thirds of children exposed to and infected with HIV in New York City.

Study Population and Data Collection

The study population included all known HIV-exposed singleton births that occurred in 1994 to 2003 at the 22 New York City surveillance sites. "HIV-exposed births" were births in which the infant was born to an HIV-infected mother. The percentage of New York City HIV-exposed births evaluated was calculated by using the total number of New York City HIV-exposed births available from New York State's newborn HIV serosurvey and Comprehensive Newborn Screening Program data as the denominator.

The HIV infection status was determined according to the CDC definition,[23] with a modification for "presumed uninfected," defined as at least 2 negative DNA polymerase chain reaction tests performed at age 1 month or older and at age 2 months or older and no HIV diagnostic tests with positive results.

Medical records of HIV-infected children were reviewed every 6 months unless the child was no longer in care at 1 of the 22 sites or had died. Medical records of HIV-exposed, HIV-uninfected, or HIV-indeterminate children were reviewed until the child

was aged 2 years. Children lost to follow-up before determination of their HIV status remained categorized as indeterminate.

Data on maternal characteristics were obtained from the pediatric medical records and included receipt of prenatal care (care in addition to pregnancy testing), timing of maternal HIV diagnosis, prenatal and intrapartum antiretroviral drug use, and mode of delivery. Data on maternal illicit drug use—including injection drug use, crack cocaine use, and use of other street drugs—were collected. Data were not collected on maternal adherence to prenatal antiretroviral therapies or on maternal clinical, immunologic, or virologic status. Data on infants included race/ethnicity, source of medical insurance if any, gestational age, neonatal antiretroviral drug use, dates of antiretroviral drug use, whether they were breastfed (but not duration), and infant HIV-infection status. "Three-arm therapy" refers to therapy prescribed during the prenatal, intrapartum, and neonatal periods. Pediatric source of medical insurance was used as a proxy for maternal source of medical insurance and infant race/ethnicity as a proxy for maternal race/ethnicity.

Data Analysis

We examined trends in interventions for perinatal HIV prevention over a 10-year period for 1994 to 2003. The first recommendations to use zidovudine to prevent perinatal HIV transmission were made at the beginning of this period.[6] We divided the study period into 2 periods, 1994 to 1996 and 1997 to 2003, representing periods before and after the start of the New York State Comprehensive Newborn Screening Program. Only the 1997 to 2003 cohort was analyzed for perinatal HIV transmission rates. Before 1997 and before the establishment of routine screening for perinatal HIV exposure, the identification of older HIV-infected infants was a more usual finding than the identification of HIV-exposed, HIV-uninfected newborns. Including the 1994 to 1996 cohort in the transmission rate analyses would have artificially increased transmission rates because it would not account for infants who were not known to be exposed and uninfected. Analyses of interventions for perinatal HIV prevention excluded births with unknown receipt of prenatal care. We combined the answers "no report of illicit drug use specified" and "no mention of illicit drug use" into 1 category for analyses.

A 3-step hierarchy based on the Institute of Medicine hierarchy of interventions (routine care, screening, and treatment steps) for perinatal HIV prevention was created to assess the contribution of missed opportunities for perinatal HIV prevention to perinatal HIV transmission[24]: (1) provision of prenatal care, (2) identification of HIV-infected women among women in prenatal care, and (3) provision of prenatal antiretroviral drug therapy among women in prenatal care identified as HIV-infected. "Perinatal HIV-prevention failures" refers to infants who became HIV-infected despite undergoing all 3 steps and the completion of 3-arm antiretroviral therapy. Births with incomplete information on these events were excluded from analysis.

For the 1997 to 2003 birth cohort, we used multiple logistic regression analyses to evaluate factors associated with outcomes of perinatal transmission prevention failures, lack of prenatal care, and perinatal HIV transmission. For the logistic regression analyses, the adjusted odds ratios (ORs) and the corresponding 95% confidence intervals (CIs) are presented with the corresponding data. Variables for the logistic regression models were determined from the available literature,[16] and their significance was determined with univariate analyses. Year of infant birth, source of medical insurance, and race/ethnicity were confounders.

RESULTS

During 1994 to 2003, 5295 HIV-exposed births were identified at the 22 New York City surveillance sites (67% of all New York City HIV-exposed births from 1994 to 2003). During 1994 to 1996, HIV-exposed births at the 22 sites represented 54% of New York City HIV-exposed births, and during 1997 to 2003 represented 74% of such births. Among the 5295 HIV-exposed infants, 4729 (89%) were singleton births, 165 (3%) were multiple births, and 401 (8%) had an unknown birth type. We analyzed only the 4729 singleton births (which comprised 60% of all New York City HIV-exposed births during that time: 1378 births during 1994 to 1996, and 3351 births during 1997 to 2003). Figure 1 depicts the analytic cohorts of this study with regard to prenatal care, mode of delivery, and determination of perinatal HIV transmission rates by type of prenatal, intrapartum, and neonatal antiretroviral use. Table 1 shows infant and maternal characteristics of the 4729 singleton births by birth cohort. Overall, infant race/ethnicity was predominantly Black (n=3080; 65%) and Hispanic (n=1435; 30%). Medical insurance was predominantly provided through Medicaid or other public funding. The percentage of infants with a birthweight of 2500 g or more increased from 70% during 1994 to 1996 to 76% during 1997 to 2003.

Maternal injection drug use decreased from 23% in 1994 to 4% in 2003, and the use of crack cocaine and other street drugs decreased from 23% in 1994 to 15% in 2003. Injection drug use was reported for 374 mothers (8%). Any illicit drug use (injection drug use, crack use, and use of other street drugs) was reported for 26% of mothers (37% during 1994–1996 and 21% during 1997–2003).

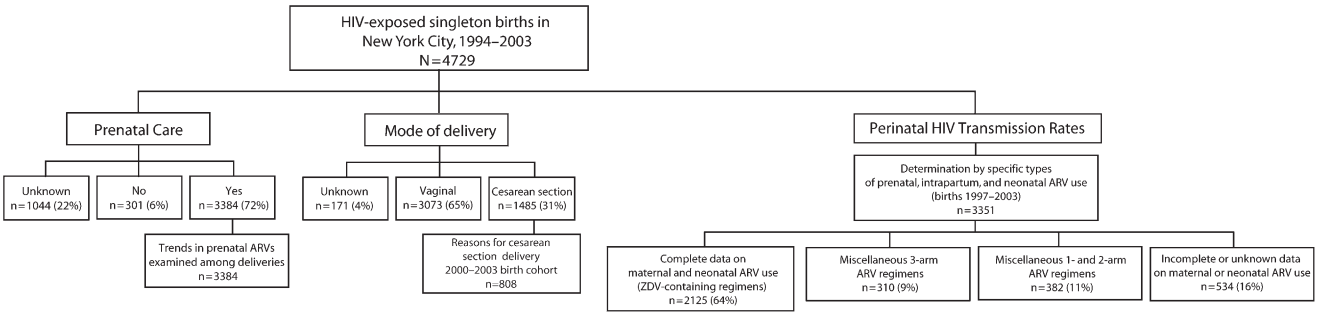
From 1994 to 2003, data on breastfeeding were available for 3923 infants (83%), and 87 of the 3923 infants (2%) were breastfed. No infant was breastfed in 2003.

Receipt of Prenatal Care

Prenatal care data were available for 3685 mothers (78%). Among women with data, 3384 (92%) had received prenatal care and 301 (8%) had received no prenatal care; prenatal care receipt increased from 81% to 87% during 1994 to 1996 and from 89% to 95% during 1997 to 2003.

Timing of Maternal HIV Diagnosis

As shown in Table 1, among the whole sample, timing of diagnosis of HIV infection before or during pregnancy increased from 75% (n=1028 of 1378) during 1994 to 1996 to 83% (n=2770 of 3351) during 1997 to 2003. Among the 3384 HIV-infected women in the study who received prenatal care, the proportion of those diagnosed with HIV before or during pregnancy increased from 86% during 1994 to 1996 to 90% during 1997 to 2003. During 1997 to 2003, 36% of women in the study who received prenatal care were diagnosed with HIV during (vs before) their pregnancies.



Note. ARV = antiretroviral; ZDV = zidovudine. Percentages refer to percentage of total births in each category.

FIGURE 1—Analytic cohorts of HIV-exposed singleton deliveries in 22 Sites, by Prenatal Care, Prenatal Antiretrovirals, Mode of Delivery, and Infant Infection Status: New York City, 1994–2003.

Antiretroviral Therapies

Among the 3384 deliveries in which mothers received prenatal care, 1204 women (36%) were prescribed prenatal antiretroviral regimens containing zidovudine alone (this decreased from 41% in 1994 to 10% in 2003), 1327 women (39%) were prescribed prenatal antiretroviral regimens containing zidovudine in combination with other antiretroviral drugs (this increased from 0% in 1994 to 76% in 2003), 114 women (3%) were prescribed antiretroviral regimens that did not contain zidovudine, 540 women (16%) did not receive antiretrovirals, and 199 women (6%) were missing data on antiretroviral regimens. Among the 1327 zidovudine combination regimens prescribed, 50% contained a protease inhibitor (of which 92% also contained a nucleoside analogue), 27% contained another nucleoside analogue only, 20% contained a nonnucleoside and a nucleoside analogue, and 3% contained unspecified antiretrovirals.

Ascertainment of neonatal antiretroviral prescription for all infants began in 1995; use of neonatal zidovudine alone increased from 65% in 1995 to 72% in 2003. Use of neonatal zidovudine in combination with other antiretrovirals began in 1998 and increased from 0.2% in 1998 to 24% in 2003.

Cesarean Delivery

The proportion of births by cesarean delivery increased from 15% in 1994 to 39% in 1999 (when the American College of Obstetricians and Gynecologists began recommending that scheduled cesarean deliveries be offered to HIV-infected pregnant women), and from 47% in 2000 to 55% in 2003. Among the 808 cesarean deliveries performed during 2000 to 2003, 59% (479) were performed for HIV transmission prevention only and 5% (41) were planned for HIV transmission prevention and became necessary for other medical reasons. Other reasons were obstetric or neonatal complications (145 births; 18%), repeat-elective cesarean delivery (88; 11%), and reasons unknown (55; 7%).

Perinatal HIV Transmission Rates

Among the 3351 infants born to women in the sample during 1997 to 2003, 239 were HIV-infected (7%) and 2588 were HIV-exposed but uninfected (77%). For 524 infants (16%), HIV status could not be ascertained through medical record review. The overall perinatal HIV transmission rate decreased from 12% in 1997 to 1% in 2003. The perinatal HIV transmission rate was 4% among the 2432 infants whose mothers received any prenatal antiretroviral drugs, 16% among the 611 infants whose mothers did not receive any prenatal antiretroviral drugs, and 17% among the 308 infants whose mothers' prenatal antiretroviral use was unknown (regardless of intrapartum and neonatal antiretroviral therapies).

Perinatal HIV transmission rates were examined by prenatal, intrapartum, and neonatal antiretroviral use in 2125 infants (64%) born during 1997 to 2003 for whom complete data on maternal and neonatal antiretroviral drug use were available and for whom zidovudine was included in the regimen. The rate was 2% (95% CI=0.81, 2.34) for the 1014 deliveries with prenatal zidovudine regimens with other antiretroviral drugs and intrapartum and neonatal zidovudine alone; 5% (95% CI=3.09, 6.17) for the 713 deliveries with prenatal, intrapartum, and neonatal zidovudine alone; 13% (95% CI=5.25, 19.75) for the 80 deliveries with intrapartum and neonatal zidovudine alone; and 10% (95% CI=3.67, 15.69) for the 93 deliveries with neonatal zidovudine alone prescribed within 24 hours of birth. The rate was 20% (95% CI=15.17, 25.71) for the 225 deliveries with no prenatal, intrapartum, or neonatal antiretroviral treatment and in which the infants were evaluated for HIV exposure within 2 months of birth. The rate was 5% for the 119 deliveries with a variety of 3-arm prenatal antiretroviral regimens not containing zidovudine; 5% for the 191 deliveries with prenatal and neonatal zidovudine in combination with other antiretroviral drugs and intrapartum zidovudine; 8% for the 382 deliveries with a variety of 1- or 2-arm regimens; and 15% for the remaining 534 deliveries with incomplete data on maternal and neonatal antiretroviral use.

Infant HIV infection status was further analyzed by mode of delivery in a subset of 854 infants born during 2000 to 2003 (341 cesarean deliveries for HIV transmission prevention as sole indication and 513 vaginal deliveries). All deliveries involved 3-arm therapies (prenatal zidovudine in combination with other antiretroviral drugs in 261 of the cesarean deliveries and 404 of the vaginal deliveries) or prenatal zidovudine only (80 of

TABLE 1—Sample Infant and Maternal Characteristics of HIV-Exposed Singleton Births (N=4729), by Birth Cohort: New York City, 1994–1996 and 1997–2003

	1994–1996, No. (%)	1997–2003, No. (%)
Total births	1378 (100)	3351 (100)
Infant race/ethnicity		
Black	856 (62)	2224 (66)
Hispanic	463 (34)	972 (29)
White	43 (3)	103 (3)
Asian/Pacific Islander or American Indian	4 (<1)	24 (1)
Unknown	12 (<1)	28 (1)
Birthweight, g		
≥2500	963 (70)	2546 (76)
1500–2499	268 (19)	576 (17)
<1500	67 (5)	119 (4)
Unknown	80 (6)	110 (3)
Infant medical insurance		
Medicaid or public funding	682 (49)	2785 (83)
Private	29 (2)	182 (6)
None	21 (2)	103 (3)
Unknown	646 (47)	281 (8)
Receipt of prenatal care		
Yes	725 (53)	2659 (79)
No	124 (9)	177 (5)
Unknown	529 (38)	515 (16)
Mode of delivery		
Vaginal	1078 (78)	1995 (60)
Cesarean section	229 (17)	1256 (37)
Unknown	71 (5)	100 (3)
Timing of maternal HIV diagnosis		
Before delivery	1028 (75)	2770 (83)
At delivery	9 (<1)	71 (2)
After delivery	142 (10)	175 (5)
Timing unknown	159 (12)	282 (9)
Mother refused testing during pregnancy	3 (<1)	8 (<1)
Testing information unknown	37 (3)	45 (1)

the cesarean deliveries and 109 of the vaginal deliveries); all deliveries involved intrapartum and neonatal zidovudine alone. We did not find a significant difference in transmission rates between cesarean deliveries for HIV transmission prevention as sole indication and vaginal deliveries, stratified by prenatal antiretroviral therapy.

Missed Opportunities and Failures of Perinatal HIV Prevention

We performed a hierarchical evaluation of the relative contribution of perinatal HIV prevention interventions to describe missed opportunities and failures of perinatal HIV prevention for infants born during 1997 to 2003. As shown in Table 2, 2547 (76%) of the 3351 infants born to HIV-infected women during 1997 to 2003 had complete data on prenatal and neonatal events. Of the births, 363 (14.3%) had at least 1 missed opportunity; an additional 337 (13.2%) had incomplete (1- or 2-arm) antiretroviral regimens. Among the 363 births with at least 1 missed opportunity, 63 infants (17.4%) were HIV-infected versus 53 infants (2.9%) among the 1847 deliveries in which all the recommended perinatal HIV prevention components were provided (i.e., perinatal HIV prevention failures). As shown in Table 2, of the 140 HIV-infected infants born to HIV-infected women during 1997 to 2003, 45% of their mothers had missed opportunities, and of the 2013 uninfected infants from the same group, 11% of their mothers had missed opportunities (OR=8.25; 95% CI=5.48, 12.43). The most common missed opportunities were lack of prenatal care and failure to make a prenatal HIV diagnosis despite prenatal care (Table 2). Among the 337 births with incomplete antiretroviral regimens, 7% of infants were infected.

We examined possible factors associated with perinatal HIV prevention failures, such as maternal illicit drug use and incomplete prenatal antiretroviral regimens, in a multivariate analysis adjusted for race/ethnicity, source of medical insurance, mode of delivery, birthweight (<2500 g vs ≥2500 g), and year of infant birth (analysis not shown). Of 1472 deliveries in which perinatal HIV prevention was provided and complete data on all factors were available (50 of the 53 infected infants [94%] and 1422 of the 1540 uninfected infants [92%]; Table 2), maternal illicit drug use was significantly associated with perinatal HIV prevention failures (adjusted OR=2.45; 95% CI=1.30, 4.62) compared with the group with no report or no mention of illicit drug use, as were 3-arm antiretroviral regimens with prenatal zidovudine alone versus 3-arm antiretroviral regimens with prenatal zidovudine in combination with other antiretroviral drugs (adjusted OR=1.88; 95% CI=1.01, 4.62).

Multivariate Analyses

We performed a multivariate analysis to examine the association between lack of prenatal care and characteristics including maternal illicit drug use, race/ethnicity, source of infant's medical insurance, and year of infant birth. Among the 2187 deliveries with complete data on all characteristics during 1997 to 2003, maternal illicit drug use was significantly associated with lack of prenatal care (adjusted OR=5.71; 95% CI=3.83, 8.51) as

TABLE 2—Infant HIV Infection Status Among HIV-Exposed Singleton Births (n = 2547), by Perinatal HIV Prevention Method: New York City, 1997–2003

	Infected, No. (%)	Uninfected, No. (%)	Indeterminate, No. (%)	Total, No. (%)
Total	140	2013	394	2547
Missed opportunities for perinatal HIV prevention				
No prenatal care (Step 1)[a]	25 (17.8)	109 (5.4)	43 (10.9)	177 (7.0)
Prenatal care but no prenatal HIV diagnosis (Step 2)[a]	34 (24.3)	98 (4.9)	28 (7.1)	160 (6.3)
Prenatal care and prenatal HIV diagnosis but no antiretrovirals (Step 3)[a]	4 (2.9)	15 (0.7)	7 (1.8)	26 (1.0)
Any missed opportunity[b]	63 (45.0)	222 (11.0)	78 (19.8)	363 (14.3)
Incomplete antiretroviral regimens for perinatal HIV prevention[c]	24 (17.1)	251 (12.5)	62 (15.7)	337 (13.2)
Perinatal HIV prevention provided[d]	53 (37.9)	1540 (76.5)	254 (64.5)	1847 (72.5)

Note. Eight hundred four (24%) of 3351 infants born in the same period have incomplete data.
[a]Three-step hierarchy based on the Institute of Medicine hierarchy of interventions: (1) provision of prenatal care, (2) identification of HIV-infected women in prenatal care, and (3) provision of prenatal antiretroviral drug therapy among women in prenatal care identified as HIV infected.
[b]Any missed opportunity among infected compared with uninfected infants: odds ratio = 8.25; 95% confidence interval = 5.48, 12.43.
[c]Prenatal care, prenatal HIV diagnosis, 1- or 2-arm antiretrovirals.
[d]Prenatal care, prenatal HIV diagnosis, 3-arm antiretrovirals.

well as with lack of medical insurance (adjusted OR=2.81; 95% CI=1.32, 5.94).

We also conducted a multivariate analysis to examine factors associated with preventing perinatal HIV transmission, including the use of prenatal antiretroviral therapies and the delivery type. Among the 2059 births during 1997 to 2003 with prenatal care and known infant HIV status (Table 3), the strongest factor associated with prevention of perinatal HIV transmission was use of a 3-arm antiretroviral regimen, particularly regimens containing prenatal zidovudine in combination with other antiretroviral drugs. Maternal illicit drug use and a birthweight of less than 2500 g were significantly associated with transmission. Transmission rates were similar for Black and Hispanic infants, but White infants were 3 times more likely to be infected with HIV than were Black infants. Compared with infants in the sample who were born in 2003, those born during 1997 to 1999 were 3 to 4 times more likely to be infected. Delivery mode had no significant effect. Eight of the 138 infected and 21 of the 1921 uninfected infants in this analysis were breastfed, but breastfeeding was not included in the analysis because duration data were not collected.

DISCUSSION

Successes in Perinatal HIV Prevention

We provide a comprehensive, historical perspective on efforts to eliminate perinatal HIV infection in New York City during a 10-year period. The successful reduction of perinatal HIV transmission in New York City is a result of the culmination of efforts on the part of the medical community and local and national public health institutions. Improved identification of HIV infection status before delivery and prenatal treatment with combination antiretroviral therapies during pregnancy contributed to a significant diminution in perinatal HIV transmission. With effective interventions, perinatal HIV transmission can be almost completely prevented.[25,26]

Successes in preventing perinatal HIV transmission have not been mirrored in resource-poor countries.[27] Breastfeeding is a known risk factor for perinatal HIV transmission[28]; the recommendation to avoid breastfeeding presents challenges when safe alternatives to breastfeeding are not readily available and where breastfeeding is the cultural norm. Nevertheless, the prevention of perinatal HIV transmission remains an important goal for public health throughout the world.[27]

There were declines in both the number of HIV-exposed deliveries and in perinatal HIV transmission rates. In New York City, the decrease in the number of HIV-exposed deliveries began after 1990 and coincided with the decrease in the number of mothers with a history of injection drug use. Although New York City has the largest HIV-infection epidemic among injection drug users of any city in the world, the incidence and the prevalence of HIV infection among injection drug users decreased during 1990 to 2001.[29] We observed a decrease in perinatal transmission rates starting in 1997, coinciding with the introduction of prenatal combination antiretroviral therapy. Similar trends in decreasing perinatal HIV transmission rates have been observed throughout the United States.[2,3,30,31] A population-based observational study showed similar declines throughout New York State during 1997 to 2000.[32]

Cesarean deliveries have increased notably starting in 1999. There was no significant difference in perinatal HIV transmission rates with cesarean deliveries compared with vaginal deliveries when stratified by type of prenatal antiretrovirals. In the multivariate analysis, type of delivery did not have an effect on HIV transmission. The interpretation of the data on cesarean deliveries was limited by the absence of data on the timing of the rupture of membranes, the duration of labor, maternal virologic and immunologic characteristics, or maternal adherence to antiretroviral treatments. Data on the duration of breastfeeding were not collected. Because the practice of breastfeeding is discouraged among HIV-infected mothers in the United States, it is likely that the duration was short and therefore did not contribute to perinatal HIV transmission.

Missed Opportunities and Failures of Perinatal HIV Prevention

There were also missed opportunities for perinatal HIV prevention. In 1997 to 2003, 14% of the births had at least 1 missed opportunity and 17% of the infants born to mothers with missed opportunities were HIV infected. The first missed opportunity was lack of prenatal care. Women with a history of illicit drug use were about 6 times as

TABLE 3—Factors Associated With Perinatal HIV Transmission Among HIV-Exposed Singleton Births (n = 2059) With Prenatal Care: New York City, 1997–2003

	AOR (95% CI)	*P*
Year of birth		
1997	3.93 (1.30, 11.93)	.02
1998	3.26 (1.06, 10.03)	.04
1999	3.33 (1.11, 9.94)	.03
2000	2.06 (0.64, 6.58)	NS
2001	2.93 (0.95, 8.99)	NS
2002	2.42 (0.75, 7.78)	NS
2003 (Ref)	1.00	
Birthweight, g		
< 2500	2.24 (1.50, 3.35)	< .001
≥ 2500 (Ref)	1.00	
Infant's race/ethnicity		
Black (Ref)	1.00	
White	2.72 (1.10, 6.76)	.03
Hispanic	1.26 (0.84, 1.88)	NS
Infant's medical insurance		
Public (Ref)	1.00	
Private	0.84 (0.37, 1.91)	NS
None	0.47 (0.11, 1.99)	NS
Prenatal interventions		
No prenatal HIV testing and no antiretrovirals (Ref)	1.00	
Prenatal HIV testing and no antiretrovirals	0.77 (0.29, 2.05)	NS
Prenatal HIV testing and 1- or 2-arm antiretroviral regimens	0.18 (0.10, 0.33)	< .001
Prenatal HIV testing and 3-arm zidovudine	0.10 (0.06, 0.19)	< .001
Prenatal HIV testing and 3-arm combination zidovudine[a]	0.05 (0.03, 0.11)	< .001
Delivery type		
Vaginal (Ref)	1.00	
Caesarian section	1.10 (0.73, 1.64)	NS
Maternal illicit drug use		
No report or mention (Ref)	1.00	
Yes	1.83 (1.18, 2.82)	.007

Note. AOR = adjusted odds ratio; CI = confidence interval; NS = not significant.
[a]Prenatal zidovudine with other antiretrovirals along with intrapartum and neonatal zidovudine.

likely to lack prenatal care as women who had no report or mention of illicit drug use. We could not evaluate potential barriers to receiving prenatal care (e.g., language barriers among non–English-speaking immigrants and undocumented immigrant status). We used source of pediatric medical insurance as a proxy for maternal source of medical insurance. Lack of medical insurance was a significant factor associated with lack of prenatal care, and we may have underestimated the proportion of mothers who lacked insurance by using pediatric source as a proxy for maternal source of medical insurance, such as might be the case with illegal immigrants.

The second missed opportunity was lack of HIV testing before delivery. Although the percentage of HIV-infected women who were tested for HIV before delivery was high, those who were not tested contributed substantially to perinatal HIV transmission. Our data support the US Public Health Service guidelines that recommend universal HIV testing during pregnancy.[33,34] The contribution of the third missed opportunity—i.e., lack of prenatal antiretrovirals among women in prenatal care who were diagnosed before delivery—was small. Although most of the pediatric medical records contained information on the mothers' prenatal events, review of only pediatric records introduced a limitation on the interpretation of the data.

During 1997 to 2003, HIV infection occurred in approximately 3% of HIV-exposed infants despite apparent recommended perinatal HIV prevention measures. Maternal illicit drug use was highly associated with these failure cases. Illicit drug use is likely to interfere with adherence to treatment regimens. Poor compliance may create a potential for the development of drug resistance and transmission of a drug-resistant virus.[35]

Public Health Efforts in Perinatal HIV Prevention

In New York State, 2 key interventions have been contributing to the early identification of perinatally HIV-exposed newborns: In 1997, universal screening of all newborns for HIV exposure went into effect, and in 1999, New York State initiated mandatory expedited HIV testing of the mother at delivery or of the newborn at birth in cases where the prenatal HIV diagnosis is not known. The key to maximizing perinatal HIV prevention is to provide prenatal care, to diagnose HIV infection before delivery, and to offer the most-effective medical interventions. The US Public Health Service first issued guidelines for universal counseling and offering of voluntary HIV testing of pregnant women in 1995 and, subsequently, in 2001, revised the guidelines to recommend universal HIV testing of pregnant women.[33,36] Since 1996, universal prenatal HIV counseling is required by regulation in licensed settings in New York State. In 2003, the CDC restated its goal of universal HIV testing of all pregnant women[37] and, to achieve this goal, recommended the "opt-out approach" in which a pregnant woman is notified that an HIV test will be included in the standard battery of prenatal tests unless she declines testing. The CDC recommends routine rapid testing at labor for women whose HIV status is unknown. The American College of Obstetricians and Gynecologists and CDC recommend a routine second HIV test during the third trimester for women with HIV risk factors who tested negative on the first test.[34,38]

Ongoing perinatal HIV surveillance allows for monitoring the implementation of guidelines to prevent mother-to-child transmission of HIV and determining factors that may contribute to perinatal HIV transmission (e.g., inadequate access to care for pregnant women, no receipt of antiretrovirals or suboptimal regimens, barriers to compliance with care, and maternal illicit drug use). Surveillance data can reveal areas that need further effort, especially for hard-to-reach populations. Such areas include outreach to at-risk pregnant women (e.g., women who use illicit drugs) and case management to ensure access to and compliance with prenatal care, as well as early identification of HIV infection and access to the newest interventions available to prevent perinatal HIV transmission. ■

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This article was accepted July 6, 2007.

Contributions

V.B. Peters originated the study and led the drafting of the article, and supervised all aspects of the analyses. K.L. Liu completed the analyses and assisted with interpretation and writing. L.G. Robinson assisted with acquisition of the data and with critical review of the article. K.L. Dominguez and P.A. Thomas assisted with the study origination and design, analysis and interpretation of data, and critical review of the article. E.J. Abrams assisted with critical review of the article. B.S. Gill provided statistical expertise and assisted with analysis and interpretation of data.

Acknowledgments

This work was supported in part by the Centers for Disease Control and Prevention (cooperative agreement U64/CCU206818).

We thank the New York City Health Department and Mental Hygiene Project Staff for performing data collection and data management for this study: Catrice Abner, Myrna Beckles, Janine Brewton, Annette Brooks, Sharon Browne-Isles, Patricia Diggs, Stephanie Manning, Chere Mapson, Carol McFarlane, Karla McFarlane, Samuel Sawyerr, James Swanzy-Parker, and Rosamond Walker.

We thank the physicians of the collaborating hospitals for their cooperation in conducting this study: Albert Einstein Hospital: Arye Rubinstein; Bronx Lebanon Hospital: Saroj Bakshi; University Hospital of Brooklyn: Edward Handelsman; Harlem Hospital Center: Elaine Abrams; Incarnation Children's Center: Cathy Painter; Jacobi Medical Center: Andrew Wiznia; Kings County Hospital Center: Ninad Desai; Montefiore Hospital: Nathan Litman; New York Presbyterian Hospital at New York Weill Cornell Center: Joseph Stavola (posthumously); North Central Bronx Hospital: Jacob Abadi; Beth Israel Medical Center: Joanna Dobroszycki; Brookdale Hospital: Mahmoud Hassanein; Lincoln Hospital: Hermann Mendez; Long Island College Hospital: John Belko; Long Island Jewish Medical Center: Vincent Bonagura; Metropolitan Hospital Center: Marukh Bamji; Mount Sinai Medical Center: Roberto Posada; New York Presbyterian Hospital at Columbia Presbyterian Center: Marc Foca; Queens Hospital Center: Paul Zam; St Luke's–Roosevelt Hospital: Stephen Arpadi; St Vincent's Hospital: Mona Rigaud; and Woodhull Medical and Mental Health Center: Lubin Augustine.

Human Participant Protection

This study involved medical chart review only and was approved by the New York City Department of Health.

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