



HHS Public Access

Author manuscript

J Acquir Immune Defic Syndr. Author manuscript; available in PMC 2018 December 15.

Published in final edited form as:

J Acquir Immune Defic Syndr. 2017 December 15; 76(5): 461–464. doi:10.1097/QAI.0000000000001552.

Estimated Incidence of Perinatally Acquired HIV Infection in the United States, 1978–2013

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Abstract

Background: An incidence of perinatally acquired HIV infection less than 1:100,000 live births is one of the Centers for Disease Control and Prevention (CDC) goals of the United States. Such an estimate has only been possible in recent years because regular nationwide data were lacking.

Method: Using previously published CDC estimates of the number of infants born with HIV infection in the United States (interpolating for years for which there was no published estimate), and census data on the annual number of live-born infants, estimated incidence was calculated for 1978–2013. Exact 95% confidence intervals (CIs) were calculated using the Poisson distribution.

Results: Estimated incidence of perinatally acquired HIV infection peaked at 43.1 (95% CI: 41.1 to 45.1) in 1992 and declined rapidly after the use of zidovudine prophylaxis was recommended in 1994. In 2013, estimated incidence of perinatally acquired HIV infection in the United States was 1.8 (95% CI: 1.4 to 2.2), a 96% decline since the peak.

Conclusion: Estimated incidence of perinatally acquired HIV infection in the United States in 2013 was 1.8/100,000 live births.

Keywords

HIV; incidence; infants; United States

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The findings and conclusions in this article are those of the authors and do not necessarily represent the views of the CDC. The use of trade names and commercial sources is for identification only and does not imply endorsement by the CDC.

All the authors are employees or contractors of the US government. The authors have no funding or conflicts of interest to disclose.

From the beginning of the HIV epidemic, for many years, data were insufficient to answer the question: how many infants with HIV infection are born annually in the United States? Until recently, therefore, it has been necessary to estimate that number by modeling or other means.

Since the mid-1980s, AIDS reporting was mandatory in nearly all jurisdictions, whereas name-based reporting of cases of HIV infection was conducted in a subset of states. Not until 2008 had all states implemented name-based reporting, and only when the systems in all jurisdictions had “matured” sufficiently, in 2012, were the data made available for all the United States. Specifically, since 2008, it has been possible to determine the number of infants born with HIV infection in the United States. With these numbers, it has become possible to calculate the incidence of perinatally acquired HIV, thus addressing one of the goals of the Centers for Disease Control and Prevention for the elimination of perinatally acquired HIV,¹ namely, an incidence less than 1 per 100,000 live births.

Before 2008, there were several estimates of the number of infants born with HIV infection in all 50 states.^{2–5} For the earliest years of the epidemic (1978–1993), the number was “back calculated,”² beginning with the number of infants and children with diagnoses of AIDS. In more recent years, the number of infants born with HIV infection in the United States was determined by Taylor et al⁶ for the years 2006–2009, accounting for 2 types of delay—birth to diagnosis and diagnosis to report—but had to extrapolate from the states with name-based reporting to the rest of the states; this number is considered “estimated” because it incorporates those 2 weights. These estimated numbers^{2–6} were used to construct a curve representing the estimated annual number of infants with HIV infection born during 1978–2010⁷; in that report, for years in which no estimate had been made, the numbers of infants with HIV infection were interpolated. A subsequent report⁸ estimated the numbers of infants with HIV infection for 2002–2013; this report accounted for delays from birth to diagnosis and from diagnosis to report as had been done earlier⁶ but did not require extrapolation from states which did not have name-based reporting—an improvement over the former method.

To calculate estimated incidence rates of perinatally acquired HIV infection for 1978–2013 (ie, the number of infants per 100,000 live births), the numbers of infants with perinatal HIV infection estimated for 1978–1993,² 1995–1996,³ 2000,⁴ and 2002–2013⁸ and the interpolated numbers between those years were divided by the respective annual number of live-born infants in the United States.⁹ Table 1 shows the annual numbers of live-born infants in the United States, the estimated annual number of infants with perinatal HIV born in the United States, and the incidence of perinatal HIV per 100,000 live births with exact 95% confidence intervals (CIs) calculated using the Poisson distribution. The incidence per 100,000 live births is depicted graphically in Figure 1 and fit with a cubic smoothing spline.

From Figure 1, several observations are possible. Peak estimated incidence occurred in 1992, with 43.1 per 100,000 live births (95% CI: 41.1 to 45.1). Overall, since the implementation of antiretroviral prophylaxis to prevent mother-to-child HIV transmission,¹⁰ that is, during 1994–2013, the incidence of perinatally acquired HIV in the United States has decreased approximately 94%. There is an approximately 96% decrease from the peak, which was reached in 1992 several years before the 1994 recommendation to use zidovudine

prophylaxis for pregnant women with HIV infection and their newborn infants.¹⁰ The incidence of HIV infection in infants declined rapidly in a brief period once zidovudine prophylaxis became standard, a 71% decrease by 1996. That is, a large proportion of the overall decrease occurred in the period when most, if not all, perinatal prophylaxis regimens used a single drug, zidovudine.

In the years immediately after the initial large decrease, 2 major interventions were introduced. The first was the use of 3-drug antiretroviral regimens (known then as “highly active antiretroviral therapy,” or HAART, known for a while as “combination antiretroviral therapy” or cART; now simply known as antiretroviral therapy, ART).¹¹ Although the recommendations did not specify whether such therapy should continue after pregnancy, by 1998, nearly half of women who began ART during pregnancy continued post-partum,^{12,13} with higher percentages in the years immediately after.^{14,15} The second major intervention was the introduction of scheduled cesarean delivery for pregnant women with HIV infection whose plasma levels of HIV (“viral load”) were not well controlled.^{16–18}

During 2002–2007, although there was still no specific recommendation to continue ART postpartum, it seems that the practice was becoming more common.¹⁵ In the subsequent period, new antiretroviral drugs were introduced and became components of preferred or alternative regimens for HIV-infected pregnant women. Tenofovir and darunavir were recommended for alternative regimens in 2012,¹⁹ which also included raltegravir for special circumstances. “Preferred” regimens recommended in 2014²⁰ and 2016,²¹ respectively, included tenofovir and raltegravir, reflecting increased use of such regimens in the years immediately preceding. In addition, in 2012 (March 27), treatment guidelines for adults recommended unequivocally that ART should be started for all HIV-infected persons and should not be discontinued.²² Concurrent with this change in practice, between 2007 and 2013, there was a 64% decline in the incidence of perinatally acquired HIV infections in the United States. During this period, the proportion of pregnant women with HIV infection receiving an integrase strand inhibitor as part of their regimen appears to have increased dramatically; in 2015, 43% of pregnant women enrolled in the Perinatal HIV/AIDS Cohort Study were receiving an integrase strand inhibitor as a component of their ART (20% dolutegravir, 20% elvitegravir, and 3% raltegravir).²³ The lowest estimated incidence of perinatally acquired HIV was in 2013, with 1.8 per 100,000 live births (95% CI: 53.7 to 87.3), still lower than CDC’s incidence goal.

Perinatal HIV transmission continues to occur in the United States, for well-recognized reasons: late maternal diagnosis and incomplete uptake of ART.⁸ Despite these factors, we describe here a continued—albeit protracted—decline in the incidence curve of perinatally acquired HIV infection. The degree that this curve is affected by the numbers of women of childbearing age is undetermined, but it is interesting that the number of women of childbearing age (13–44 years) living with HIV declined approximately 10% during 2008–2014,²⁴ and the number of new diagnoses of women in this age range declined approximately 30%.²⁵ There is reason to believe that the number of births to women living with HIV has declined significantly in recent years.²⁶ The relative impact of these declines, the apparently increasing birth rate among women living with HIV,²⁷ and the dramatic increase in the use of more potent antiretroviral therapy with integrase inhibitors—with their

improved tolerability and ability to rapidly reduce HIV viral load—have yet to be determined.

Acknowledgments

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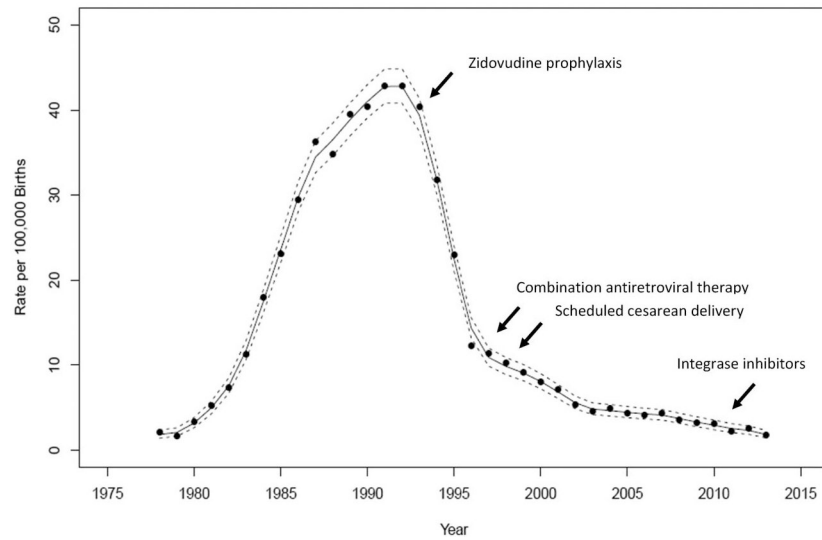


FIGURE 1.

Estimated incidence of perinatal HIV infection per 100,000 live births, United States 1978–2013. The estimated incidence of perinatal HIV infections per 100,000 live births (points) with a smoothed curve (solid line) and 95% confidence bands (dashed lines). The timing of important advances in recommendations for prevention of maternal-to-child transmission of HIV is noted on the figure. The arrows indicate the year in which the interventions (eg, “Zidovudine prophylaxis”) occurred.

TABLE 1. Annual Number of Live-Born Infants and Estimated Number and Incidence of Perinatal HIV Infection, United States, 1978–2013

Year	No. of Live-Born Infants		No. of HIV-Infected Infants		Incidence per 100,000 Live Births	
	n	95% CI	n	95% CI	n	95% CI
1978	3,333,279	54.6 to 88.4	70	54.6 to 88.4	2.1	1.6 to 2.7
1979	3,494,398	45.8 to 77.2	60	45.8 to 77.2	1.7	1.3 to 2.2
1980	3,612,258	99.5 to 143.5	120	99.5 to 143.5	3.3	2.8 to 4.0
1981	3,629,238	163.9 to 219.0	190	163.9 to 219.0	5.2	4.5 to 6.0
1982	3,680,537	238.8 to 304.2	270	238.8 to 304.2	7.3	6.5 to 8.3
1983	3,638,933	371.3 to 451.7	410	371.3 to 451.7	11.3	10.2 to 12.4
1984	3,669,141	610.6 to 712.3	660	610.6 to 712.3	18.0	16.6 to 19.4
1985	3,760,561	813.1 to 929.8	870	813.1 to 929.8	23.1	21.6 to 24.7
1986	3,756,547	1035.9 to 1167.0	1100	1035.9 to 1167.0	29.3	27.6 to 31.1
1987	3,809,394	1317.9 to 1465.0	1390	1317.9 to 1465.0	36.5	34.6 to 38.5
1988	3,909,510	1288.7 to 1434.2	1360	1288.7 to 1434.2	34.8	33.0 to 36.7
1989	4,040,958	1512.8 to 1670.1	1590	1512.8 to 1670.1	39.3	37.4 to 41.3
1990	4,158,212	1610.4 to 1772.5	1690	1610.4 to 1772.5	40.6	38.7 to 42.6
1991	4,110,907	1678.7 to 1844.2	1760	1678.7 to 1844.2	42.8	40.8 to 44.9
1992	4,065,014	1669.0 to 1834.0	1750	1669.0 to 1834.0	43.1	41.1 to 45.1
1993	4,000,240	1551.8 to 1711.1	1630	1551.8 to 1711.1	40.7	38.8 to 42.8
1994	3,952,767	1194.3 to 1334.6	1263	1194.3 to 1334.6	32.0	30.2 to 33.8
1995	3,899,589	837.3 to 955.6	895	837.3 to 955.6	23.0	21.5 to 24.5
1996	3,891,494	438.0 to 524.9	480	438.0 to 524.9	12.3	11.3 to 13.5
1997	3,880,894	400.8 to 484.1	441	400.8 to 484.1	11.4	10.3 to 12.5
1998	3,941,553	364.6 to 444.3	403	364.6 to 444.3	10.2	9.3 to 11.3
1999	3,959,417	327.6 to 403.4	364	327.6 to 403.4	9.2	8.3 to 10.2
2000	4,058,814	290.6 to 362.3	325	290.6 to 362.3	8.0	7.2 to 8.9
2001	4,025,933	253.8 to 321.1	286	253.8 to 321.1	7.1	6.3 to 8.0
2002	4,021,726	188.2 to 246.8	216	188.2 to 246.8	5.4	4.7 to 6.1
2003	4,089,950	163.0 to 218.0	189	163.0 to 218.0	4.6	4.0 to 5.3
2004	4,112,052	176.0 to 232.9	203	176.0 to 232.9	4.9	4.3 to 5.7

Year	No. of Live-Born Infants		No. of HIV-Infected Infants		Incidence per 100,000 Live Births	
	n	95% CI	n	95% CI	n	95% CI
2005	4,138,349		182	156.5 to 210.4	4.4	3.8 to 5.1
2006	4,265,555		175	150.0 to 202.9	4.1	3.5 to 4.8
2007	4,316,233		190	163.9 to 219.0	4.4	3.8 to 5.1
2008	4,247,694		153	129.7 to 179.3	3.6	3.1 to 4.2
2009	4,130,665		135	113.2 to 159.8	3.3	2.7 to 3.9
2010	3,399,386		105	85.9 to 127.1	3.1	2.5 to 3.7
2011	3,953,590		90	72.4 to 110.6	2.3	1.8 to 2.8
2012	3,952,841		103	84.1 to 124.9	2.6	2.1 to 3.2

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