Epidemiologic Modeling to Evaluate Prevention of Mother–Infant HIV Transmission in Ontario

Robert S. Remis, MD, CM, MPH, Susan M. King, MD, MSc, FRCPC, Lee Vernich, MSc, Carol Major, BSc, MLT, and Elaine Whittingham, MSc

Objectives: To evaluate the impact of the Ontario HIV screening program to reduce mother–infant HIV transmission, this study estimated the proportion of preventable transmissions that were prevented.

Methods: Using an iterative spreadsheet model, incidences of HIV infection, AIDS, and AIDS mortality in Ontario women were estimated by exposure category. The number of HIV-infected infants born to HIV-infected mothers was then estimated from conception and abortion rates of HIV-infected women of childbearing age and surveillance data. Finally, the proportion of HIV-infected mothers who received antiretroviral prophylaxis (ARP) was assessed.

Results: HIV prevalence in 2001 among women of childbearing age was 1.05 per 1000. From 1984–2001, 764 infants were born to HIV-infected mothers and 180 were infected. From mid-1994–2001, 214 (39%) of the estimated 544 HIV-infected mothers were diagnosed; almost all received ARP. Of 118 preventable infections among infants born in this period, 39 (33%) were prevented. In 2001, only 46% of preventable infections were prevented and 11 preventable transmissions occurred.

Conclusions: HIV prevalence among women in Ontario increased >4-fold from 1990 to 2001. Fewer than half of HIV-infected mothers received ARP and preventable HIV infections continue to occur. Measures to further increase uptake of prenatal HIV screening must be instituted.

Key Words: HIV, transmission, perinatal, testing, Ontario

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In 1997, we carried out a preliminary analysis of the epidemiology of HIV infection in the province of Ontario, Canada and estimated HIV prevalence among women of childbearing age was 0.63 per 1000, almost 3 times the rate of 0.23 per 1000 observed in 1989–1992.[1] In the light of the Pediatric AIDS Clinical Trial Group (PACTG) 076 study in 1994 indicating that antiretroviral prophylaxis (ARP) reduced mother–infant HIV transmission from 25 to 8.3%,[2] we wished to further examine HIV infection among pregnant women and transmission to their infants in Ontario (in this report, we refer to antiretroviral regimens used to reduce mother–infant transmission as *prophylaxis*; this is not meant to minimize the importance of antiretroviral *treatment* for the pregnant woman). Since then, additional studies demonstrated that HIV transmission with combination antiretroviral regimens may be as low as 1%.[3]

Our initial results suggested that a minority of HIV-infected pregnant women were diagnosed and offered ARP.[4] In December 1998, the Ontario Ministry of Health announced a program to encourage physicians to offer HIV testing to all pregnant women. In the present study, we modeled mother–infant HIV transmission and examined the diagnosis of HIV infection and uptake of ARP since the PACTG 076 results were released and evaluated the impact of the new screening policy.

METHODS

We carried out the study in 4 stages: We estimated the number of HIV-infected women of childbearing age in Ontario for each year from 1978–2001; characterized infants born in Ontario to HIV-infected mothers from 1984–2001 reported to an active surveillance network (Canadian Pediatric AIDS Research Group [CPARG]) by year of birth, exposure category of mother, and region where care was received; estimated the number of HIV-infected women delivering and the number of HIV-infected infants born each year from 1978–2001; and for the period July 1, 1994–December 31, 2001, quantified the impact of ARP on mother–infant HIV transmission under 3 scenarios: no intervention, actual, and "ideal."

Stage 1: HIV Infections Among Women in Ontario

The model estimated for each of 4 exposure categories the annual incidence, cumulative incidence and prevalence of HIV infection, first-time HIV diagnoses, AIDS, and HIV-related deaths from 1978–2001. The exposure categories were women born in an HIV-endemic region ("HIV-endemic" re-

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From the Department of Public Health Sciences, University of Toronto (Dr Remis, Ms Vernich, and Ms Whittingham); Hospital for Sick Children (Dr King); and Laboratories Branch, Ontario Ministry of Health and Long-Term Care, Toronto, Ontario, Canada (Ms Major).

Reprints: Robert S. Remis, Department of Public Health Sciences, University of Toronto, 12 Queen's Park Crescent West, Toronto, Ontario, Canada M5S 1A8 (e-mail: rs.remis@utoronto.ca).

fers to countries where HIV prevalence is high and most transmission is heterosexual), other women infected through heterosexual contact, injection drug users (IDUs), and other (receipt of blood transfusion or clotting factors or not known).

Initial values of the incidence of HIV infection, HIV diagnoses, AIDS, and AIDS-associated deaths were entered into spreadsheet software (Lotus 1-2-3, Version 4.01, Lotus Development Corp., IBM). For HIV infection, HIV diagnoses, AIDS, and AIDS-related deaths, cumulative incidence at the end of the year was the sum of annual incidences to that year and prevalence at year-end of HIV infection, HIV diagnoses, and AIDS was derived by subtracting cumulative deaths from cumulative incidence.

The parameter values were derived as follows.

HIV Diagnoses

Data for first-time HIV diagnoses among women of childbearing age were obtained from the HIV Laboratory, Ontario Ministry of Health.[5] Essentially all HIV serodiagnostic testing in Ontario is carried out at this laboratory; other health care institutions, including laboratories and hospitals, are not licensed to perform HIV testing. Information including name, age, sex, and risk factors for HIV acquisition is requested on the test requisition but is not required. The numbers of first-time positive tests were adjusted for duplicates using data from a laboratory-based study to enhance HIV surveillance.[6,7]

AIDS Incidence

AIDS incidence was obtained from the Ontario AIDS Surveillance Program and adjusted for reporting delays and underreporting.[5]

HIV-Related Deaths

HIV-related mortality data were available for 1987–1997 and were adjusted for a 15% underascertainment.[5] Mortality was also modeled from AIDS incidence using survival data from published studies to validate vital statistics data and to estimate mortality before and after death data were available.

HIV Incidence

HIV incidence was the only parameter for which no data were available. Therefore, the estimates of annual HIV incidence were refined iteratively using available data on HIV infection among women in Ontario. In this way, independent data sources were used to refine and validate initially crude estimates of HIV incidence. The following approaches were used: results from the anonymous, unlinked seroprevalence study*:* HIV prevalence among women of childbearing age was adjusted to be consistent with the results of a time-limited study by Coates et al.[1] among newborns carried out from 1989–1992; a simplified progression matrix was constructed to ensure that the number and pattern of HIV infection were consistent with the yearly and cumulative adjusted AIDS to 1988 (when the effect of antiretroviral therapy would have been minimal); and the proportion of HIV-infected women diagnosed (both cumulatively and, especially, among those living in the mid- to late-1990s) was plausible based on clinical experience and other studies, both in Ontario and elsewhere.

Stage 2: Reports of HIV-Infected Women Delivering in Ontario

We analyzed data on HIV-infected women delivering in Ontario identified through CPARG (King S, Personal communication, May 2001). In particular, we examined the distribution and trends over time of institutions providing care and the mother's exposure category. For the trend analysis, individual years were aggregated into periods within which the proportions were relatively homogeneous.

Stage 3: HIV Transmission From Mothers to Infants 1978–2001

The analysis was carried out among women of childbearing age, a subset of the HIV-infected women estimated in stage 1 above. Based on the age distribution of women at first HIV diagnosis in Ontario, 85% of HIV-infected women in Ontario were of childbearing age, though this varied by exposure category. To estimate the number of HIV-infected women, the mother–infant transmission model was carried out separately for each exposure category and summed to obtain the estimates for Ontario.

The rate of mother–infant HIV transmission was varied over the range of 5–40%[8] such that the modeled number of HIV-infected infants matched the number for each year, except for the most recent years. This allowed the calculation of the number of HIV transmissions from these women to their newborn infants in each year from 1984–2001 from the estimated number of HIV-infected women giving birth each year during this same period.

The model estimated the number of HIV-infected women in 3 categories. Group 1 was women diagnosed before conception; group 2a was women undiagnosed at conception but diagnosed during pregnancy; and group 2b was women undiagnosed at conception who remained undiagnosed throughout the pregnancy. Rates of pregnancy, spontaneous abortion, ectopic pregnancy, and therapeutic abortion were obtained from published studies,[9–14] including one from Canada with data from women from Ontario.[10] The number of pregnant HIV-infected women previously diagnosed and those diagnosed in the course of pregnancy in 1999 through 2001 was known from a separate ongoing study in Ontario[15] and was used to adjust the reproductive parameters to achieve model fit. Figure 1 shows the conceptual model on which the model of mother–infant HIV transmission was based.

To help validate our results, we estimated subsequent AIDS incidence for each annual cohort of estimated HIV-infected infants per year who progressed to AIDS using pro-

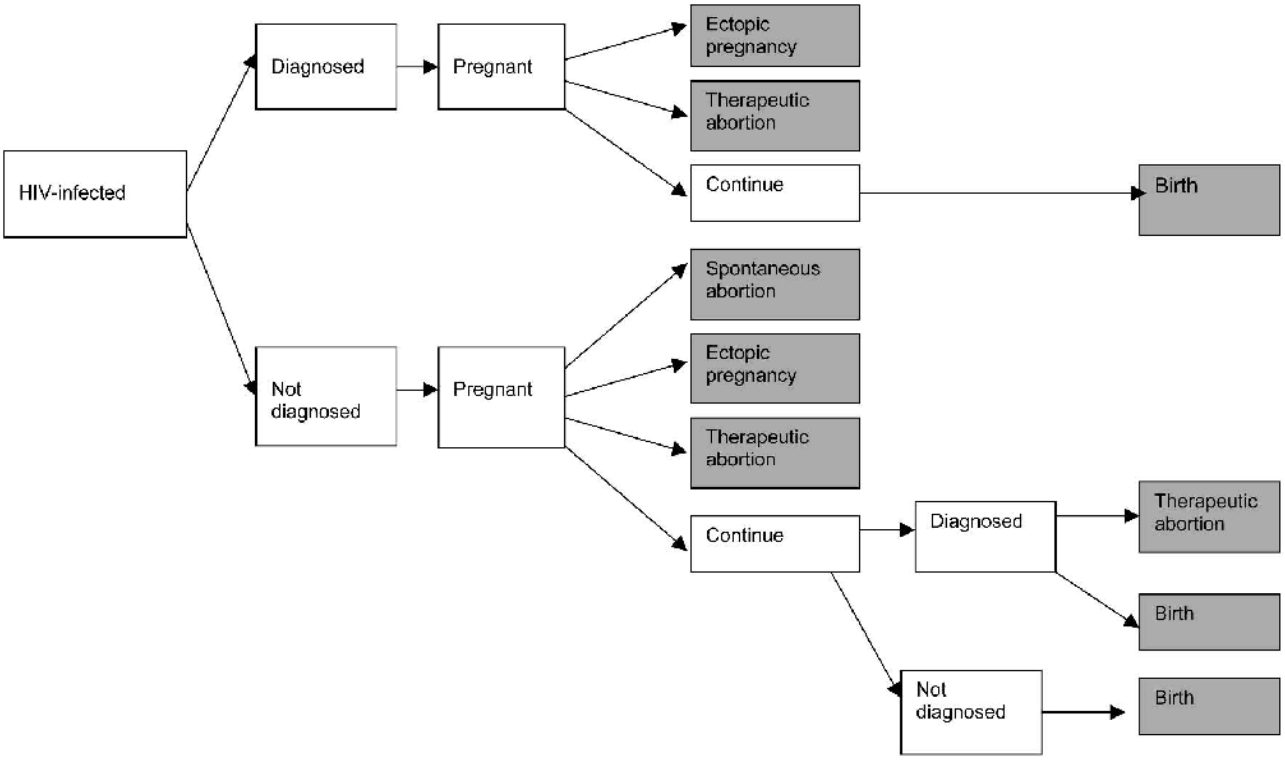

FIGURE 1. Mother–infant HIV transmission model.

gression probabilities of 35% for HIV-infected infants in the 1st year and 10% for each subsequent year among infants still uninfected at the beginning of the year.[16–19] We compared AIDS incidence modeled in this way to that reported to CPARG, especially for recent years.

Stage 4: Impact of ARP on HIV transmission, 1994–2001

A decision tree was developed whereby subpopulations of HIV-infected mothers were stratified as to whether the HIV infection was diagnosed, whether ARP was administered, and whether the infant became infected. We used an initial reduction of 76% for the impact of ARP in diminishing the probability of HIV transmission to the infant, that is, from 25% with no therapy to 6.0% with zidovudine. The latter figure was derived from an intermediate between the results of the PACTG 076 trial (transmission of 8.3% with zidovudine) and experience in Canada. Studies in Ontario (n = 39),[20] Quebec (n = 55),[21] and British Columbia (n = 20)[22] observed HIV transmission rates of 2.6, 3.6, and 5.0%, respectively, with a pooled rate of 3.5%. We incorporated the impact of using combination therapies beginning in 1997, estimating the proportion of pregnant women on ARP on each of 3 regimen categories—monotherapy (zidovudine), dual therapy (usually zidovudine/lamivudine), and combination therapy using ≥3 drugs, i.e., highly active antiretroviral therapy—and the expected efficacy of each regimen (efficacy of 75, 85, and 93%, with HIV transmission rates of 6.3, 3.8, and 1.8%, respectively).

The analyses were carried out for infants born from July 1, 1994–December 31, 2001 under 3 scenarios of ARP utilization: none, actual, and ideal. The objective was to estimate the proportion of HIV-infected mothers diagnosed and the proportion of preventable HIV infections prevented by ARP.

RESULTS

Stage 1: Number of HIV-Infected Women in Ontario

An estimated 3641 women have been infected with HIV in Ontario from 1978–2001 (Table 1), with 3207 living as of December 2001, of whom 59.3% have been diagnosed.

We calculated HIV prevalence rates by exposure category from our model for 2001. Of 110,000 women of childbearing age from HIV-endemic countries, 628 were HIV infected and 38 carried a pregnancy to term. For IDUs, the numbers were 10,000, 447, and 8, respectively, and for other women infected heterosexually, 2,600,000, 1,201, and 23, respectively. HIV prevalence was 0.57% among women from HIV-endemic countries compared with 0.046% in the heterosexual category and 4.5% among IDUs.

Stage 2: Analysis of the CPARG Database

From 1984–2001, 375 HIV-infected Ontario women who delivered an infant in Canada were identified by CPARG. Of these, 105 infants, or 28%, were known to have been infected. (This proportion does not reflect the HIV transmission rate since some of the mother–infant pairs were identified only when the infant developed HIV disease). A further 202 infants (62%) were not infected. For 39 infants (10%), the HIV infection status was pending or unknown; 16 of these were born in 2001.

Of the 105 HIV-infected infants, the exposure category of the mother (and proportion of those known) was as follows: born in HIV-endemic countries, 55 (56%); IDUs, 9 (9%); others infected through heterosexual contact, 32 (32%); and transfusion, 3 (3%). Six were born to women for whom the exposure category was not identified. The proportion infected was higher among women from HIV-endemic countries, 55% compared with 24% for all other infants of mothers with known exposure category ($P = 0.047$). This is probably a reflection of HIV testing patterns (i.e., whether the mother was diagnosed prospectively, before her infection was recognized because her child developed symptoms of HIV infection). We observed fluctuations in the proportion of HIV-infected infants born to mothers from HIV-endemic countries; this proportion was highest in 1996–1997. Sixty-seven percent were treated in Toronto and 23% in Ottawa. The distribution of exposure category by region did not differ significantly by institution of care nor did the proportion treated in each region change significantly over time.

Of the 55 HIV-infected infants born to mothers from HIV-endemic countries, 39 (71%) were from Africa and 16 (29%) the Caribbean. In Africa, the countries of Central and Eastern Africa accounted for 23 (82%) of the 28 infants for whom the country of birth was known.

Stage 3: Modeled HIV Transmission From Infected Mothers to Infants

Table 2 shows the number of women of childbearing age, the number of HIV-infected women delivering each year, and the estimated number of HIV-infected infants born in Ontario each year from 1987–2001. Overall, we estimate that 180 infants were infected by HIV, of whom 105 have been identified to December 2001. According to the model, 88 HIV-infected women carried an infant to term in Ontario in 2001. The comparison of the modeled versus the reported HIV-infected infants for all exposure categories is shown in Figure 2.

Stage 4: Modeled Impact of ARP on HIV Transmission

Tables 3 illustrates the situation in Ontario from July 1, 1994–December 31, 2001 with respect to the subgroups of HIV infected who were diagnosed, those who received ARP, and the predicted number of HIV infections occurring in each of the subgroups according to whether the mother was diagnosed and received ARP. We estimate that 548 infants were born to HIV-infected mothers during this 7.5-year period. Of these, 214 HIV-infected mothers were diagnosed before the infant's birth and 182 received ARP.

Table 3 also shows the number of mother–infant transmissions that would have occurred without any program, the number of cases that could have been prevented by a universally offered and accepted screening program, and the number who were diagnosed and received ARP. We concluded that, during this period, there would have been 137 HIV mother–infant transmissions in the absence of any intervention. Of these, 19 were not preventable and 118 were preventable. During the 7.5-year study period, according to our model, 98 HIV infections were transmitted from mother to infant. Of the 118 preventable infections, only 39, or 33%, were in fact prevented. In 2001, 11 preventable HIV transmissions occurred; the 9 HIV infections prevented represented 46% of the 20 preventable infections. For women from HIV-endemic countries, 53% of preventable HIV transmissions were prevented and, for other women infected heterosexually, 27% were prevented.

DISCUSSION

In a model of mother–infant HIV transmission in Ontario by exposure category using multiple data sources, we estimated that 180 HIV-infected were born from 1987–2001. Of these, 105 have been identified through active surveillance. From July 1994–December 2001, only 39 (33%) of 118 preventable HIV transmissions were prevented. In 2001 alone, an estimated 11 preventable HIV transmissions occurred. Our results also suggest that prevalence of HIV infection among women of childbearing age in Ontario in 2001 was 1.05 per 1000, >4-fold higher than that observed in a seroepidemiologic study in 1989–1992 and higher than previously thought.

The results of our study are subject to uncertainty. The CPARG surveillance database may not capture all diagnosed HIV-infected infants in Ontario. A preliminary review of AIDS cases revealed modest underascertainment of HIV-infected infants born outside the major centers. Nevertheless, HIV-infected children generally require specialized care and it is unlikely that the pediatricians participating in the CPARG network, representing all pediatric infectious disease specialists in Ontario, would not have treated almost all diagnosed cases, especially if the infant were HIV infected. A review of laboratory data in 2001 indicated that, though some HIV-infected mothers were not reported, reporting was relatively complete, especially in recent years. In any case, the distributions of modeled and observed HIV-infected infants fit extremely well until 1996. In addition, our estimate of HIV prevalence among women in the period 1989–1992 was very similar to that observed among pregnant women during that period. A recent study from Toronto reported 6 HIV-infected infants born in

TABLE 1. Modeled Estimates of Incidence and Prevalence of HIV Infection, AIDS and AIDS-Associated Mortality Among Women 15+ Years of Age in Ontario, 1978–2001

Period/Year	Annual HIV Incidence	HIV Cumulative Incidence	HIV Prevalence	Annual HIV+ Women Diagnosed	Cumulative HIV+ Women Diagnosed	Proportion HIV+ Women Diagnosed
1978–84	186	186	185	5	5	0.0%
1985–89	434	620	557	236	240	29.7%
1990	149	769	675	154	394	38.7%
1991	160	928	795	162	556	59.9%
1992	222	1,151	985	156	712	61.9%
1993	264	1,415	1,206	151	863	61.0%
1994	314	1,728	1,471	188	1,051	60.8%
1995	295	2,024	1,727	190	1,241	61.3%
1996	251	2,274	1,948	167	1,408	61.9%
1997	253	2,527	2,177	177	1,584	62.7%
1998	273	2,800	2,415	169	1,753	62.6%
1999	287	3,087	2,683	163	1,916	62.1%
2000	266	3,353	2,933	184	2,100	62.6%
2001	288	3,641	3,207	225	2,325	63.9%

Period/Year	Living HIV+ Women Diagnosed	Proportion Living HIV+ Women Diagnosed	Annual AIDS Incidence	AIDS Cumulative Incidence	Annual AIDS Deaths	AIDS Cumulative Deaths
1978–84	0	0.0%	1	1	2	2
1985–89	188	24.2%	76	77	59	62
1990	310	32.8%	37	115	29	90
1991	432	54.3%	46	161	34	124
1992	556	56.5%	42	203	31	156
1993	665	55.1%	44	247	43	198
1994	806	54.8%	44	291	47	245
1995	958	55.5%	48	339	38	283
1996	1,095	56.2%	53	391	30	313
1997	1,245	57.2%	37	428	27	339
1998	1,394	57.7%	46	474	20	359
1999	1,529	57.0%	32	506	28	387
2000	1,693	57.7%	20	526	20	407
2001	1,901	59.3%	59	585	17	424

Note: HIV prevalence is at end year and cumulative incidence is from beginning of epidemic to end year.

Ontario from mid-1999 to mid-2001.[23] Taking into account the progression of HIV infection in infants, this observation is consistent with our model results. Thus, we believe our estimates of the number of HIV-infected women and infants are plausible.

According to our model, from July 1984–December 2001, only 39% of HIV-infected mothers were diagnosed in time to be offered ARP; in the absence of ARP, 137 HIV mother–infant HIV transmissions would have occurred, of which 118 would be preventable. Of these, according to our model, only 39 (or 33%) were prevented. An estimated 11 preventable HIV transmissions occurred in 2001. The lifetime cost of treating an HIV-infected infant is estimated at from $US 161,000[24] to $US 393,500.[25] The annual costs of the program to implement and evaluate expanded HIV testing of the 140,000 pregnant women in Ontario were <$US 700,000. Though a detailed cost-effectiveness analysis is beyond the scope of this study, it appears that such a program is highly cost effective, with savings in direct medical costs alone being substantially greater than program costs.[26]

TABLE 2A. Modeled HIV Transmission From Mother to Infant in Ontario, 1987–2001

		Group 1 (Diagnosed Before Conception)				
Year	Number of Births	Modelled HIV Prevalence (/1,000)	Modeled HIV-Infected Women CBA	HIV+ Women CBA+ Diagnosed	Pregnancies	SA/EP
1987	135,283	0.13	291	34	3	0
1988	138,232	0.16	365	82	6	0
1989	145,448	0.19	451	148	11	1
1990	150,357	0.24	561	259	18	1
1991	151,346	0.28	673	372	25	2
1992	150,402	0.35	847	480	32	2
1993	147,943	0.42	1,047	576	39	2
1994	147,190	0.51	1,286	700	44	10
1995	145,159	0.59	1,514	834	49	12
1996	139,710	0.67	1,711	956	56	14
1997	134,536	0.74	1,916	1,091	64	16
1998	132,275	0.81	2,128	1,207	72	18
1999	131,356	0.89	2,367	1,335	74	20
2000	130,045	0.97	2,588	1,483	82	22
2001	128,334	1.05	2,830	1,668	97	25
Total					674	146

	Group 2						
Year	TAB1	Carried to Term	HIV+ Women Not Diagnosed	Pregnancies	SA/EP	TAB1	Prenatal Visit
1987	2	1	257	43	8	20	14
1988	4	2	283	48	9	22	16
1989	7	4	302	52	10	24	18
1990	12	5	302	52	9	24	18
1991	18	6	301	52	9	24	19
1992	23	7	367	64	11	29	23
1993	28	9	471	83	14	37	31
1994	15	18	585	103	18	46	39
1995	17	20	680	119	21	53	46
1996	19	22	755	132	23	58	52
1997	31	17	825	145	25	62	58
1998	34	20	921	162	28	69	66
1999	38	16	1,031	182	31	76	75
2000	42	18	1,105	195	33	82	80
2001	47	26	1,162	205	35	85	85
Total	337	190		1,747	308	767	672

CBA, childbearing age; SA/EP, spontaneous abortion/ectopic pregnancy; TAB1, therapeutic abortion, first stage; Total, from 1978–2001.
Note: HIV prevalence is at end year.

According to our results, 11 HIV-infected infants were born in Ontario in 2001 who would not have been infected had their mothers been diagnosed and received ARP. Thus, uptake of HIV testing in Ontario during the study period was less than ideal. Nevertheless, a recent analysis of the uptake of HIV testing[15] indicated that test uptake improved since the prenatal testing program was begun. HIV test uptake was 40% in the first quarter of 1999, increased to 58% by early 2001, and was 74% by early 2002. The increase appeared to be largely due to a memo sent to physicians with prenatal specimens for which

TABLE 2B. Modeled HIV Transmission From Mother to Infant in Ontario, 1987–2001

Year	Group 2a: Diagnosed in Pregnancy	TAB2	Carried to Term	Group 2b: Still Undiagnosed in Pregnancy	Groups 1 + 2a: Total Diagnosed Carried to Term	Total Carried to Term
1987	1	1	0	14	1	14
1988	1	1	0	16	2	18
1989	1	0	1	17	4	22
1990	3	2	1	16	6	21
1991	3	2	1	16	6	22
1992	3	2	1	20	8	28
1993	4	3	2	27	10	37
1994	8	4	3	31	21	52
1995	9	5	4	36	23	60
1996	10	6	4	41	27	68
1997	12	7	5	46	22	68
1998	22	13	10	43	30	73
1999	25	14	11	49	27	77
2000	27	16	12	53	30	83
2001	39	22	17	46	43	88
Total	169	98	71	503	261	764

Year	Modelled HIV-Infected Infants-no ARP	Proportion Taking ARP (%)	Modelled Annual HIV-Infected Infants	Diagnosed HIV-Infected Infants	Diagnosed HIV-Infected Mothers
1987	4	0%	4	4	7
1988	5	0%	5	5	9
1989	6	0%	6	10	13
1990	6	0%	6	5	17
1991	7	4%	7	7	14
1992	8	7%	8	11	18
1993	11	5%	11	10	27
1994	15	17%	13	9	32
1995	17	32%	13	9	35
1996	20	31%	15	8	33
1997	20	13%	19	0	12
1998	22	40%	14	7	38
1999	24	34%	17	7	35
2000	26	34%	18	2	30
2001	28	46%	15	4	36
Total	226		180	105	375

CBA, childbearing age; SA/EP, spontaneous abortion/ectopic pregnancy; TAB1, therapeutic abortion, first stage; Total, from 1978–2001; ARP, autoretroviral prophylaxis; TAB2, therapeutic abortion, second stage.

HIV was not ordered, beginning in September 2001. A recent survey in Ontario[27] observed that many physicians are not aware of the provincial recommendation to offer HIV testing to all pregnant women; this may explain in part the suboptimal testing rates.

There are several reasons why women are not tested. The physician, voluntarily or through oversight, may not offer the test and a woman may refuse an offer to be tested. The test may not be done for logistical reasons even when ordered. Finally, the test result may be lost or the woman may not return to

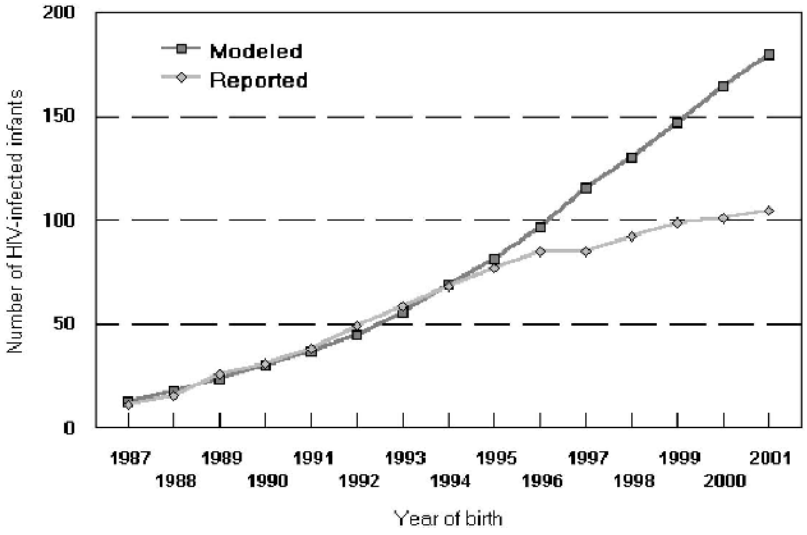

FIGURE 2. Cumulative number of HIV-infected infants in Ontario, modeled versus reported, 1987–2001.

receive her test result. HIV transmission may occur despite confirmation of the woman's positive serostatus if she refuses or incompletely follows ARP regimens or if ARP fails.

No system can ensure that all HIV-infected pregnant women are diagnosed prior to delivery. However, universal offering of HIV screening to pregnant women can ensure that ≥80% are tested. Such results have been achieved in British Columbia.[28] In Alberta and Newfoundland, where HIV screening in pregnancy is now routine, >95% uptake has been achieved.[29,30] In Quebec, the proportion of pregnant women being tested for HIV from 1998–2000 was about 60%.[31] Uptake of HIV testing in pregnant women in the US is also less than ideal.[32] However, the most specific indicator to evaluate the success of HIV screening programs is the proportion of preventable HIV infections prevented. In 2001, we estimate that in Ontario we prevented only 9 (46%) of the 20 preventable infections. Investigators in the United Kingdom recently observed similar results; based on their data, we estimate that approximately 40 (46%) of the 88 preventable infections were prevented.[33] Our model may be useful for others evaluating their own perinatal HIV prevention programs. We also found that the proportion of preventable HIV transmissions was lowest in women infected heterosexually; this insight may be helpful in better targeting prevention activities.

In early 1995, the Ontario Ministry of Health recommended that physicians offer HIV testing only to women at high risk based on a risk assessment. This policy was based on data available at the time but appeared not to have worked. Following an initial evaluation of maternal HIV infection and based on experience elsewhere, a policy of offering HIV testing to all pregnant women was adopted in Ontario in January 1999. Despite improvements, the results of the present study and from analysis of HIV testing uptake in pregnant women[15] suggest that the impact may still be less than optimal. The current policy in Ontario should be reviewed to determine how the situation can be improved. In fact, a communications campaign aimed to improve test uptake was recently implemented. A reminder notice sent with prenatal test results when an HIV

TABLE 3. Modeled Impact of HIV Diagnosis and Antiretroviral Prophylaxis on HIV Transmission and Progression to AIDS, Ontario, July 1, 1994 to December 31, 2001

HIV-Infected Mothers	Mother Diagnosed?		Received ARP?		Infant Infected?	
					No	Yes
548	Yes	214	Yes	182	176	6
			No	32	24	8
	No	334	No	334	250	83
		548		548	450	98
Total transmissions, no therapy				137		
Estimated HIV-infected infants				98		
Nonpreventable infections				19		
Preventable infections				118		
Prevented infections				39	33%	
Preventable, not prevented				79	67%	
2001 only						
Total transmissions, no therapy				22		
Estimated HIV-infected infants				13		
Nonpreventable infections				2		
Preventable infections				20		
Prevented infections				9	46%	
Preventable, not prevented				11	54%	

ARP, antiretroviral prophylaxis.

test was not ordered should probably be reinstated. If these prove not to be effective, adoption of an "opt-out" approach where testing is carried out unless the woman specifically refuses should be seriously considered.[35,36] This approach appears to be more effective.[32,36] Such a decision requires careful review of the benefits and risks, including legal and ethical considerations. Recommendations on prenatal HIV testing were recently updated by the US Centers for Disease Control[37] but are subject to considerable controversy.[38] Nevertheless, with HIV transmission rates of 1–2% now,[39,40] the need to diagnose as many HIV-infected pregnant women as possible is imperative.

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