

Benefits and costs of expanding access to family planning programs to women living with HIV

Daniel T. Halperin^a, John Stover^b and Heidi W. Reynolds^c

Objective: This analysis models the potential benefits and costs of adding family planning to national strategies for achieving universal access to programs to prevent mother-to-child HIV transmission.

Methods: We assume a service delivery perspective and estimate the cost-effectiveness of programs to reduce the number of HIV-infected children through using antiretroviral prophylaxis to prevent perinatal transmission, and of family planning programs to avert additional infant infections not already averted by antiretroviral prophylaxis, as well as of family planning to reduce the number of total unintended births to women living with HIV. Data are presented from the 139 countries included in the 2008 Annual United Nations Joint Programme on HIV/AIDS Report, although the main results are for the 14 countries with the largest number of HIV-infected pregnant women.

Results: Programs to prevent perinatal HIV transmission would, if accessed by all women in need with the most efficacious antiretroviral regimen available, prevent over 240 000 infant HIV infections in the top 14 countries (over 300 000 globally) at an estimated cost of over \$131 million (\$208 million globally). However, almost 72 000 infant HIV infections would still occur in the 14 countries (over 90 000 globally) that could have been averted by preventing unintended pregnancies at a cost of only about \$26 million (over \$33 million globally). If all unintended births (whether or not resulting in HIV-infected children) to HIV-positive women were prevented with family planning, the cost per birth averted would be \$61 in the 14 countries (\$63 globally).

Conclusion: This analysis suggests that national strategies should adopt a comprehensive approach to preventing mother-to-child transmission and thus focus on preventing perinatal HIV transmission as well as unintended pregnancies. Family planning is cost-effective for preventing HIV transmission and unintended pregnancies and will also reduce infant and maternal mortality and result in fewer orphans.

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Background

In low and middle-income countries, an estimated 1.5 million children are born annually to women with HIV infection [1]. In the absence of prevention interventions, 15–45% of these infants would become infected during pregnancy (5–10%), labor and delivery (10–20%), or through breastfeeding (5–20%) [2]. Some of those children who do not become infected may face

the prospect of being orphaned in the near-to-medium future, as care and treatment services for women are still not fully available or widely accessed.

The United Nations agencies have developed a comprehensive four-element strategy to prevent HIV transmission from mothers to their infants [3]. This strategy includes preventing primary HIV infection in women, preventing unintended pregnancies among

^aHarvard University School of Public Health, Boston, Massachusetts, ^bFutures Institute, Glastonbury, Connecticut, and ^cMEASURE Evaluation Project, Carolina Population Center, University of North Carolina, Chapel Hill, North Carolina, USA.

Correspondence to Heidi W. Reynolds, PhD, MPH, Carolina Population Center, University of North Carolina, 206 W. Franklin St., 2nd Floor, CB 8120, Chapel Hill, NC 27516, USA.

Tel: +1 919 843 3757; fax: +1 919 966 2391; e-mail: Heidi_reynolds@unc.edu

HIV-infected women, preventing perinatal HIV infection, and care and support for HIV-positive mothers, their children and families. It has been estimated that even moderate decreases in the number of pregnancies to HIV-infected women (the second element) – ranging from 6 to 35% depending on the country – could result in numbers of averted HIV-positive births equivalent to those averted by antiretroviral (ARV) drugs (the third element) [4]. Despite an official comprehensive strategy and compelling evidence for the potential contribution of other elements, most attention and resources have continued to be targeted to preventing perinatal HIV transmission [5].

Comprehensive programs to prevent perinatal HIV transmission can significantly reduce infant infections by providing a package of interventions during pregnancy, delivery and the postnatal period. These services include HIV testing and counseling for pregnant women seeking antenatal care (ANC); promotion of behavior change for women and their partners (i.e., partner reduction and consistent condom use); ARV therapy for those who are clinically eligible or else ARV prophylaxis; safer delivery practices; ARV prophylaxis for the newborn; and counseling and support for exclusive breastfeeding for the first 6 months or replacement feeding where it is 'acceptable, feasible, affordable and sustainable' [6].

Provision of ARV prophylaxis has been the central focus of efforts to prevent perinatal transmission. In 1999, the results of a study [7] demonstrating the effectiveness of a simple, single-dose nevirapine (sdNVP) regimen, and a subsequent cost-effectiveness analysis [8] motivated the rapid expansion of services providing access to this HIV prevention medication. Increasingly encouraged to also address the mother's health, to avoid potential NVP resistance and to work toward the elimination of perinatal HIV transmission, HIV treatment for women and more efficacious ARV prophylactic regimens are now becoming more widely available.

Efforts to reduce perinatal HIV transmission have resulted in an estimated 33% of HIV-infected women accessing ARVs during pregnancy in 2007, up from only 10% in 2004, and access is expected to continue increasing [9]. The Declaration of Commitment of the United Nations General Assembly Special Session on HIV/AIDS called for expansion of preventing mother-to-child transmission (PMTCT) services in order to reach 80% of pregnant women accessing ANC by 2010 [10].

The second part of the United Nations strategy – prevention of unintended pregnancies among women who are infected with HIV – has not been awarded nearly the same level of attention as other approaches such as ARV prophylaxis or infant-feeding counseling [11]. Family planning is rarely included in policies or guidelines

addressing prevention of perinatal HIV transmission [12]. Yet, there is mounting evidence of both the need to prevent unintended pregnancies among women with HIV as well as the potential effectiveness and cost-effectiveness of this strategy.

Millions of women in low and middle-income countries are exposed to the risk of unintended pregnancies because they are sexually active, fecund, do not want to get pregnant soon or ever, and yet they are not currently using a method to prevent pregnancy. The proportion of women with unmet need ranges regionally from 10% in North Africa and West Asia to 24% in sub-Saharan Africa [13]. Studies [14–16] have documented similar or even higher levels of unmet need among women living with HIV. There is also evidence that substantial numbers of HIV-positive women have had unintended pregnancies. For example, between 51% and 92% of HIV-positive women in Rwanda, Kenya, Cote d'Ivoire, Malawi and Uganda had an unintended pregnancy [15–19].

Some recent studies have estimated the impact that contraceptive use has had on averting infant HIV infections. Current levels of contraceptive use in sub-Saharan Africa may already be preventing 22% (or 173 000) of HIV-positive births annually [20], and a more recent analysis of solely the 15 US President's Emergency Plan for AIDS Relief 'focus countries' suggests that this number may be an underestimate [21].

Another study [22] compared the relative cost-effectiveness of increasing access to HIV counselling and testing during pregnancy combined with NVP prophylaxis with increasing access to family planning for all women. For the same level of expenditure, increasing contraceptive use among current nonusers who do not want to become pregnant, through use of traditional family planning services and outreach, would avert almost 30% more HIV-positive births than would HIV counseling and testing during pregnancy coupled with NVP prophylaxis [22].

In response to the previous preoccupation of most perinatal HIV transmission programs with strictly preventing the infant from becoming infected, prior analyses of the contribution of family planning to preventing vertical HIV transmission adopted a similar focus. However, as the global public health community increasingly shifts to a more women's and family-focused orientation to HIV prevention and treatment, analyses of the potential contribution of family planning to the HIV epidemic need to be broadened accordingly. Hence, in its traditional context, family planning has long been recognized for providing extensive benefits beyond only the prevention of unintended pregnancies. These benefits include a reduction in maternal and infant deaths from delaying first births and spacing births further apart, and the greater educational and economic opportunities for

women who have fewer pregnancies and births [23]. Family planning can offer women living with HIV the same advantages, as well as allowing them time to seek out the resources and support they may need if and when they do wish to become pregnant.

This study aims to add to the evidence base through exploring whether programs to prevent perinatal HIV transmission and unintended pregnancies could be synergistic and, in combination, could substantially increase both the number of infant HIV infections prevented and unintended births averted to women with HIV. Thus, our analysis models the impact of national strategies which would be dedicated to the implementation of both elements, that is, prevention of perinatal HIV transmission as well as of unintended pregnancies. We assume a service delivery perspective and thereby estimate the cost-effectiveness of programs to reduce the number of infected children through ARV prophylaxis to prevent perinatal transmission and family planning to reduce the number of births to women living with HIV. We also estimate the cost-effectiveness of family planning in preventing any unintended births to women living with HIV, including those children who would not have become infected with HIV.

Methods

The analysis includes data from the 139 countries included in the 2008 Joint United Nations Programme on HIV/AIDS (UNAIDS) Report on the Global AIDS Epidemic [24].

Cost per infection averted by programs to prevent perinatal HIV transmission

We begin by estimating the cost per infection averted by current programs to prevent perinatal HIV transmission. Programs are rapidly shifting from only offering sdNVP to offering a more efficacious ARV prophylaxis regimen composed of azidothymidine (AZT) from 28 weeks of pregnancy, AZT and lamivudine (3TC) along with sdNVP at delivery, and AZT and 3TC for 7 days for women, and sdNVP and AZT for 1 week for infants, as per the current international guidelines [25].

The estimated number of women requiring access to these programs (i.e., the number of HIV-positive pregnant women) on an annual basis comes from the WHO [9]. In the absence of prophylaxis, we follow the UNAIDS assumptions that the overall rate of vertical HIV transmission to be 35% (assuming 20% perinatal transmission and 15% from breastfeeding) [26], and the rate with ARV prophylaxis to be 17% [9]. Although the perinatal transmission rate with ARV prophylaxis is only 2%, the risk of transmission during breastfeeding is assumed to remain at 15%. Few HIV-infected women in

developing countries (except in the small country of Botswana) have access to programs providing safe replacement feeding. Although exclusive breastfeeding during the first 6 months postpartum carries lower HIV transmission risk than mixed feeding (4–19 vs. 10–26%) [27], unfortunately most women (of any HIV status) continue to practice mixed feeding and the median duration of breastfeeding in Africa is considerably longer than 6 months [9]. The number of HIV-positive pregnant women multiplied by the difference in the risk of transmission (18%, i.e., 35% minus 17%) yields the potential number of infections averted by ARV prophylaxis.

The cost of programs to prevent perinatal HIV transmission is derived from the estimates contained in a recent UNAIDS report [28] on the resources required to provide universal access to HIV care and treatment (reported unit costs of services to prevent perinatal HIV transmission range from \$5 to over \$4100 with a median of \$100). Where costs for specific countries are unavailable, we used the regional averages (\$64 in sub-Saharan Africa, \$115 in East Asia, \$121 in South and South-east Asia, and \$1400 in Latin America).

Additional infections averted by services to prevent unintended pregnancies

To estimate the cost per additional infection averted by preventing unintended pregnancies with family planning services, we first estimated the level of unmet need based on the Demographic and Health Surveys (DHS) of women of reproductive age (irrespective of HIV status; <http://www.measuredhs.com/aboutsurveys/dhs/start.cfm>). For countries that have not yet conducted a DHS, unmet need was estimated using the regional average. Then, we calculated a rate of reduction in total births, if unmet need were to be fully met. The reduction is based on the ratio of the contraceptive index, C_c , in the proximate determinants of fertility framework [29], which is defined as $1 - 1.08 \times \text{CPR} \times \text{eff.}$, where CPR is the reported contraceptive prevalence rate and eff. is the average effectiveness of contraception. (The 1.08 factor accounts for contraceptive use by infecund couples). The reduction in the number of births caused by expanding family planning services is estimated as C_c'/C_c , where C_c is the contraceptive index calculated using the current CPR and C_c' is the index calculated using current contraception and unmet need. We then applied this rate of 'reduction in births if unmet need is met' to the estimated number of HIV-positive births still occurring in the presence of full ARV prophylaxis availability.

Total births averted by services to prevent unintended pregnancies

In addition, we estimate the number of all births (whether or not those children would end up becoming HIV positive) averted to women living with HIV, if unmet need is met. This is the product of the rate of 'reduction in

births if unmet need is met' and the annual number of births to women living with HIV.

Cost of averting infant infections or unintended births with family planning

We estimated the cost of programs to meet the unmet need for family planning by multiplying the average cost per family planning user by the number of HIV-positive women. The average cost per family planning user is estimated to be about US\$20 and is derived from data on the cost per user for each method and according to typical method mixes [30]. The annual full service delivery cost per user ranges from \$6 to \$24 for temporary methods (pills, injectables and condoms), from \$9 to \$60 per acceptor of long-term methods (intrauterine device and implants), and from \$30 to \$100 per female sterilization. These estimated costs are based on studies of family planning service and user fee costs [30].

The cost per infant infection or birth averted by perinatal HIV transmission or family planning programs was derived by dividing the total number of infections or births prevented by the total cost of preventing vertical transmission or unintended pregnancies. It is important to note that there are other benefits associated with the use of family planning, such as reduced infant and maternal mortality, which are not estimated here.

Results are presented specifically for the 14 countries containing the largest number of HIV-infected pregnant women, as these shoulder the greatest public health burden regarding the issue under consideration. The

cutoff point of 14 countries was based mainly on the steep drop-off in the number of HIV-positive pregnant women after the top 14 countries. The global totals for all 139 countries are also presented here, but space limitations do not allow for including details for those countries beyond the top 14.

Results

The 14 countries for which we present detailed results contain four-fifths of all the HIV-positive pregnant women living in the 139 countries (Table 1 [9,24,28,31]). The number of pregnant women becoming infected with HIV annually is currently over 1.3 million in the 14 countries (over 1.65 million globally) (Table 1). Access to the most efficacious ARV prophylaxis regimens would avert 241 000 new HIV infections in the top 14 countries (302 000 globally). The annual cost would be at least \$131 million in the 14 countries (\$208 million globally). This represents a cost per infant infection averted, in this scenario, of \$543 in the 14 countries (\$609 globally) (Table 2).

High levels of unmet need for contraception (i.e., women who wish to delay or limit their childbearing) are evident across most of the 14 countries (Table 3). The average level of unmet need is 23% in the 14 countries and 17% globally. Even with 100% access to efficacious ARV regimens, almost 72 000 infant HIV infections would continue to occur in the 14 countries (over 90 000 globally) that

Table 1. Potential number of HIV infections averted by antiretroviral prophylaxis and perinatal HIV transmission programs and total costs in the top 14 countries and global totals.

Country	A HIV prevalence, 15–49 years	B Number needing perinatal HIV transmission prevention	C Potential infections averted by efficacious ARV prophylaxis (B × 18%)	D Perinatal HIV transmission program unit cost (US\$)	E Perinatal HIV transmission program total cost (US\$) (B × D)
South Africa	20.82	214 857	38 674	330	70 810 343
Nigeria	3.67	202 521	36 454	64	12 935 721
Mozambique	14.47	113 613	20 450	64	7 256 842
Democratic Republic of the Congo	3.51	112 630	20 273	64	7 194 033
Uganda	5.96	101 551	18 279	36	3 655 836
United Republic of Tanzania	6.53	92 453	16 642	53	4 900 003
Kenya	5.96	87 394	15 731	54	4 681 701
Zambia	16.61	81 011	14 582	64	5 174 420
Ethiopia	2.33	75 923	13 666	32	2 408 262
Malawi	12.75	73 770	13 279	64	4 711 962
Zimbabwe	19.16	73 497	13 229	64	4 694 491
India	0.19	49 776	8 960	5	248 880
Cameroon	6.05	33 922	6 106	64	2 166 680
Cote d'Ivoire	4.35	29 281	5 271	10	292 807
Subtotal 14 countries		1 342 199	241 596		131 131 979
Global total		1 679 322	302 278		208 621 455

A, women HIV prevalence, UNAIDS, [24]; B, number needing perinatal HIV prevention program [9], HIV prevalence multiplied by total births from United Nations Population Division [31]; C, potential infections averted, number needing perinatal HIV prevention program (B) multiplied by 18% (the potential reduction in HIV transmission with perinatal HIV prevention program); D, perinatal HIV prevention services unit costs, UNAIDS [28]; E, perinatal HIV prevention program cost, number needing perinatal HIV prevention program (B) multiplied by perinatal HIV prevention program unit costs (D). ARV, antiretroviral.

Table 2. Cost per outcome averted by strategy.

	Cost per infant infection averted by perinatal prevention (US\$)	Additional cost per infant infection averted by unintended pregnancy prevention (US\$)	Cost per each unintended pregnancy prevented to women with HIV (US\$)
14 countries	543	359	61
All countries	690	371	63

could have been averted by preventing unintended pregnancies. The annual cost of providing family planning to all HIV-infected women who wish to prevent unintended births is almost \$26 million (over \$33 million globally). The estimated cost per additional infant infection averted, through preventing unintended pregnancies with expanded family planning programs, is \$359 in the top 14 countries (\$371 globally).

Finally, if all the unmet need for family planning were satisfied for women living with HIV, at least 423 000 births in the 14 countries (530 000 globally) could be prevented. The cost per birth averted would be \$61 in the 14 countries (\$63 globally).

Discussion

Our analysis suggests that national strategies that focus on preventing both perinatal HIV transmission and unintended pregnancies would be beneficial, and that family planning is cost-effective for HIV prevention as well as for preventing unintended pregnancies to women living with

HIV, which provides various other health and social benefits from preventing unintended pregnancies, including reducing the number of potential orphans. This analysis is the fifth one to date that we know of, which demonstrates that investments in programs for preventing unintended pregnancies to HIV-positive women would considerably reduce the total number of newly infected infants as well as contribute cost savings to programs for preventing perinatal HIV transmission [4,20–22]. The present analysis builds on previous studies by also demonstrating the relatively low cost of family planning services per unintended birth averted to HIV-infected women. This study also goes one step further to estimate the cost-effectiveness of family planning programs for the prevention of all unintended pregnancies to HIV-positive women, whether or not those infants would become HIV infected. In addition, and importantly, reducing unintended pregnancies among women living with HIV would also reduce maternal mortality and morbidities and increase social and economic opportunities for these women.

The estimated cost per infection averted in this study is on the lower end of that found in some other studies.

Table 3. Additional infant infections averted and total births averted to women with HIV if unmet need for family planning is met and family planning costs.

Country	F Unmet need for family planning	G Reduction in births if unmet need is met ^a	H Additional infant HIV infections averted by increased family planning use ^b	I Total births averted to HIV-positive women by increased family planning use ^c	J Family planning cost (US\$), all HIV-positive women (with unmet need) ^d
South Africa	15	0.32	11 762	69 189	3 346 158
Nigeria	17	0.19	6445	37 911	3 640 521
Mozambique	18	0.24	4593	27 016	2 061 227
Democratic Republic of the Congo	24	0.30	5678	33 400	1 802 384
Uganda	41	0.51	8852	52 070	2 296 627
United Republic of Tanzania	22	0.28	4375	25 738	1 801 042
Kenya	25	0.39	5725	33 676	1 713 488
Zambia	27	0.40	5494	32 319	1 548 977
Ethiopia	34	0.38	4947	29 101	2 068 411
Malawi	28	0.39	4918	28 929	1 704 185
Zimbabwe	13	0.30	3747	22 042	1 096 146
India	13	0.27	2325	13 678	1 168 812
Cameroon	20	0.26	1515	8913	859 648
Cote d'Ivoire	28	0.32	1569	9229	738 655
Subtotal 14 countries			71 945	423 211	25 846 281
Global total			90 177	530 453	33 423 326

^a $1 - (1 - 1.08 \times [(CPR + \text{unmet need})/100] \times 0.9)/(1 - 1.08 \times CPR/100 \times 0.9)$, where 0.9 is assumed to be the average effectiveness of contraception and 1.08 accounts for contraceptive use by infertile couples.

^bColumn G multiplied by the number of HIV-positive births if there were no prophylaxis minus the number of infant infections averted with prophylaxis.

^cColumn G multiplied by number needing perinatal HIV transmission prevention (column B, Table 1).

^d $\$20 \times \text{column F} \times \text{number of married women of reproductive age} \times 1000 \times A/100$.

Programs in sub-Saharan Africa that offer NVP to prevent perinatal transmission have reported estimates ranging from \$298 to \$9258 per infant infection averted [4,32–34]. It is also lower than the cost per infant infection averted by family planning services, as estimated by a previous study (\$663) [22].

One possible limitation in this study is that we only included the service delivery costs of family planning services to meet the unmet need for contraception. The availability of family planning services is not the only barrier to increased use, thus, there is no guarantee that spending this additional amount on family planning services would result in the levels of increased use that are assumed here. It is unrealistic to assume that all current unmet need for family planning can be met. Programs may also be needed to help motivate couples to plan their family sizes and for activities to remove other barriers such as inadequate logistic systems, lack of training and provider biases. Thus, the full costs of expanding family planning services are likely to be somewhat higher, especially in countries where contraceptive prevalence is currently quite low. There are a number of promising strategies that have been tested such as expanding education, communication and services through community outreach programs that could be implemented on a large scale to increase both demand and supply for family planning and to reduce unmet need [35–37].

Similarly, the full costs of extending programs to prevent perinatal HIV transmission for all women requiring them might also be considerably higher. For example, problems of stigma and discrimination must be tackled so that women can disclose their status without fear of social isolation or worse. Compliance with an ARV prophylactic regimen is positively associated with partner notification and partner willingness to take an HIV test [38], and negatively associated with HIV fear, stigma and reluctance to notify one's partner [39–41]. In fact, it is unrealistic to expect 100% access to either programs that prevent perinatal HIV transmission or unintended pregnancies. However, even at lower levels of coverage the relative cost-effectiveness indicated by this analysis is unlikely to change substantially. HIV-positive women in the later stages of infection tend to have lower fertility than women who are not infected [42]. We have not adjusted for this relationship, thus, the number of HIV-positive women needing PMTCT services may be somewhat overstated.

It is noteworthy that expanding access to family planning services for HIV-positive women would also have important 'spillover' benefits, such as helping more women generally, regardless of HIV status, to access contraceptive methods. This would provide various other health and societal benefits as well. It has been estimated that current family planning use in developing countries is preventing 60 million unplanned births, 2.7 million

infant deaths and 136 000 pregnancy-related deaths (not related to abortion) among other benefits [43]. Assuming the same level of benefits from preventing the 530 453 unplanned births globally to HIV-positive women, which was estimated by our study, this would translate into an additional 23 870 infant deaths and 1180 pregnancy-related maternal deaths (not related to abortion) being prevented.

The influence of an HIV-positive diagnosis on women's pregnancy and childbearing desires and decisions has been a cause of much debate. A recent longitudinal study [19] found that, upon learning their status, HIV-positive women were less likely to want children and more likely to use contraceptives, and the effect persisted through the 1-year study follow-up period. In addition to all the usual reasons that people require family planning services, women who learn they are HIV-positive often have a special additional need for such services, so that they can make informed reproductive decisions, given their present and future health status.

As most women do not know their HIV status the most effective approach for reaching the largest number of HIV-positive women is to expand family planning services for all women. This is particularly true in the regions with the worst epidemics, where HIV prevalence among pregnant women can be as high as 25–50%. A major opportunity to reach HIV-positive women is to provide family planning counseling and services to postpartum women found to be HIV-positive during pregnancy. An additional opportunity may arise as testing programs expand beyond diagnostic testing and voluntary counseling and testing to new ways to reach people who are not sick, including household testing and approaches to offer testing during most contacts with the health system. As these programs expand they will identify more women who are HIV-positive but not yet sick. Appropriate referral to or provision of family planning counseling and services to men and women found to be HIV-positive would allow couples to make better-informed decisions.

Conclusion

High levels of HIV prevalence among women of childbearing age in some parts of the world, especially in the most severely affected regions of sub-Saharan Africa, carry a triple tragedy. Not only do HIV-positive women face the prospect of discrimination, illness and possibly early death, but they may also transmit HIV infection to their children, leave their children behind as orphans if they die young, or both. Eliminating mother-to-child HIV transmission is not possible with the current limited focus on only providing ARV prophylaxis (and information on infant feeding) for preventing perinatal

HIV transmission. A strategy that could approach elimination would be one that broadens the emphasis on ARV provision to a more holistic approach including prevention of unintended pregnancies, as well as a renewed evidence-based focus on primary HIV prevention [44]. Expanding access to family planning programs would substantially benefit HIV prevention efforts and also provide other health and social benefits to women living with HIV as well as to the wider population.

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