# Prevention of HIV Mother to Child Transmission: A review

*Musoke Philippa M.* and Miiro F.A.+*

*Department of Pediatrics* and Obstetrics and Gynaecology+, Makerere University, Kampala, Uganda*

**Abstract**

**Major advances have been made in the prevention of HIV mother to child transmission (MTCT) including shorter, less expensive, antiretroviral (ARV) regimens for the developing world. In 1994, ACTG 076 using long course AZT during pregnancy reduced MTCT by 68%. Subsequently oral AZT regimens starting at 35-36 weeks gestations have also reduced transmission by 50% in non-breast feeding populations and 30% in breast feeding cohorts. Combination therapy is more effective than monotherapy and pregnant women on HAART with an undetectable viral load have vertical transmission rates less than two percent. Elective caesarian section reduces vertical transmission rates independent of ARV therapy. However the risk of surgery in HIV-infected pregnant women must be weighed against the benefit of caesarian section. Vaginal antiseptic cleansing and nutritional interventions have not been shown to reduce MTCT, but are reported to reduce maternal and neonatal morbidity and mortality. Single dose NVP at the onset of labor and a single dose to the infant (HIVNET 012) led to a 42% reduction in transmission, providing the developing world with a simple and cheap regimen. However, most developing countries are not able to implement prevention programs on a large scale because of inadequate infrastructure, limited access to voluntary couhseling and testing (VCCT), insufficient community involvement and lack of infant feeding options. Exclusive breast-feeding may provide protection against acquisition of HIV through breast milk in these populations. Despite these advances in prevention of perinatal transmission there is still a need for further research, including operational research to improve implementation of successful interventions.**

**Key words**

**HIV. Mother. Child. Vertical transmission. Prevention**

## Introduction

Mother to child transmission remains the main mode of acquisition of HIV infection in children. The number of children living with HIV infection is estimated at 1.3 million with 3.8 million deaths since the epidemic began[1]. Each year approximately 2.4 million infected women give birth and 1800 infants acquire HIV infection every day. Vertical transmission (VT) can occur *in utero, intra partum,* or *post partum* through breast feeding but the majority (60-70%) occurs around the time of delivery. Significant advances have been made since the first major breakthrough in 1994, using long course zidovudine (AZT) to prevent mother to child transmission (MTCT)[2]. Subsequently effective therapy for the

***Correspondence to:***
Philippa Musoke
Department of Paediatrics,
Makerere
University, Medical School, P.O. Box 7072
Kampala, Uganda

treatment of HIV infection, highly active antiretoviral therapy (HAART) was developed, enabling many HIV-infected pregnant women to have access to them[3]. The overall improvement in maternal health, increased access to perinatal counselling, reduction in maternal viral load and use of infant replacement feeding has led to significant reduction in prenatal transmission of HIV in developed regions[4-6]. Multiple studies, carried out in developing countries have looked at shorter, less expensive, and easier to administer regimens for the prevention of perinatal transmission of HIV. These regimens have been effective in reducing MTCT, albeit lower in breast feeding populations[7-10]. Despite these advances most HIV-infected pregnant women in developing countries do not have access to these basic therapies. This article will review the prevention strategies developed and implemented for the prevention of MTCT as well as discuss some of the issues delaying implementation in developing countries.

## Antiretroviral therapies

Multiple studies have compared different antiretroviral regimens to reduce MTCT of HIV (Tables 1 and 2). Since 1994 evidence has shown that AZT given orally during pregnancy starting between 14 to 34 weeks gestation, intravenously during labor and delivery and postnatally for six weeks to the infant does reduce vertical transmission of HIV by 68%[2]. Besides demonstrating that AZT during pregnancy can prevent MTCT this study highlighted the significance of maternal viral load in vertical transmission and the role of infant dosing in providing post exposure prophylaxis. This regimen was implemented in antenatal clinics in developed countries with a reduction in VT rates to less than 5%[11,12]. However, ACTG 076 was complex and expensive for the majority of the developing world. Therefore cheaper, less complex and easier to administer regimens were developed for resource poor countries. In 1997 the results from the Bangkok, Thailand trial demonstrated that oral AZT starting at 36 weeks gestation, during labor and delivery was able to reduce vertical transmission by 50% in a non-breast feeding population[5]. This randomized double-blind placebo-controlled study of 397 women was the first to show that a shorter oral AZT regimen given only to the mother was effective. The vertical transmission rates at six months were 18.9% (95% CI 13.2-24.2%) in the placebo arm and 9.4% (95% CI 5.2 -13.5%) in the treatment arm. Two similar trials were conducted in West Africa with reduced efficacy in these breast feeding populations[7,8]. The Cote d'Ivoire trial (RETROCI) which was identical to the Bangkok/CDC trial showed a 37% reduction and the DITRAME study (Cote d'Ivoire & Burkina Faso) which had an additional 1 week postnatal dose to the mother had a 38% reduction at three months. The latter study showed no benefit from the additional one week postnatal dosing for the mother in this breastfeeding cohort. The later perinatal HIV prevention trial (PHPT) in Thailand examined various lengths of AZT treatments for the mother and her infant to determine the shortest and most effective regimen. This study demonstrated that when maternal AZT dosing was started early in the third trimester, 28 weeks and the infant received drug for three days or six weeks, the vertical transmission rates were equivalent at 6.7 and 5.7% respectively. The arm with the short maternal dosing (36 weeks gestation) and short infant dosing (3 days) was inferior to the other arms[12]. The AIDS Institute of New York State Department of Health reviewed information on perinatal AZT treatment received and outcome on 939 infants. The treatment with AZT had been received at various stages of pregnancy and neonatal life. AZT was effective even in regimens initiated during labor or during the first 48 hours of life, emphasizing the benefit of only infant prophylaxis[13].

A multi-center trial (PETRA) coordinated by UNAIDS was conducted in Uganda, Tanzania and South Africa. This randomised double blind placebo controlled trial of 1400 women used a combination of AZT and lamivudine (3TC) in predominantly breast feeding populations. The long arm starting at 36 weeks gestation, *intra partum* and *post partum* for one week to both mother and infant was the most effective with a reduction of 50% as compared to placebo[14]. The *intra partum* alone arm was not effective but the *intra partum* and one week postnatal arm reduced transmission by 37%. The postnatal dose to the mother and infant did provide benefit when the mother's treatment started during the *intrapartum*. However, the 18 months follow-up was disappointing because the benefit obtained from the perinatal treatment was lost probably due to breast feeding[15]. This is in contrast to the short course AZT studies also carried out in breastfeeding populations where the benefit of perinatal treatment was maintained beyond 18 months.

In 1999, HIVNET 012 demonstrated that a single 200 mg tablet of Nevirapine (NVP) at the onset of labor and a single 2 mg/kg dose of NVP syrup to the infant within 72 hours after delivery was able to reduce transmission by 47% at 14 weeks[10]. The transmission rate at 12 months was 24.1% of 294 children in the AZT arm as compared to the 15.7% of 300 children in the NVP arm with a 42% reduction in transmission[16]. So far, this NVP regimen is the simplest, least expensive and most feasible prevention therapy for resource poor countries. The SAINT study in South Africa confirmed the benefit of NVP in an equivalence study using NVP (HIVNET 012) compared to intrapartum and 1 week postnatal AZT and 3TC (PETRA)[17]. Besides AZT, other antiretrovirals like didanosine (DDI), stavudine (d4T) have been used alone or in combination. The AI455-094 trial conducted in a non-breast feeding population of South Africa demonstrated that AZT, DDI and d4T alone or in combination reduced vertical transmission of HIV from mother to infant to < 6% in all arms measured at the 6 week time point[18]. The risk of transmission may reach less than 1% in women with plasma viral load < 400 HIV RNA copies/mL on antiretroviral treatment, which is lower than the risks associated with the current perinatal regimens[19-21]. In countries where HIV-infected women have ac-

**Table 1.** *Non-Breast Feeding Populations - Trials Evaluating the Efficacy of Antiretrovirals in Prevention of Mother to Child Transmission*

| Trials | Countries | Drugs | Doses and Treatment Timing | | | | Risk of Transmission | | p value | RRR | Infant age |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *Pre partum* | *Intra partum* | *Post partum* Maternal | *Post partum* Infant | Placebo | Treatment | | | |
| ACTG 076/ANRS 024[2] | France, USA | AZT | 14 wks, 100 mg 5x a day | IV 2 mg/kg load, then 1 mg/kg/h | None | Infant 2 mg/kg Q6h for 6 wks | 25,5% | 8.3% | 0.00006 | 67,5% | 18 mo |
| Bangkok/CDC[7] | Thailand | AZT | 36wks, 300 mg Q12h | PO 300 mg Q3h | None | None | 18,9% | 9.4% | 0.006 | 50% | 6 mo |
| PHPT[12] | Thailand | AZT | Long 28 wks: 300 mg Q12h | PO 300 mg Q3h | None | Long 6 wks, 2 mg/kg Q6h | None L/L | 6.7% | most effective | | 6 mo |
| | | | Short 35 wks | PO 300 mg Q3h | None | Short 3 days | S/S | 10.6% | Inferior to L/L | | |
| | | | | | | | L/S | 5.7% | Equiv. to L/L | | |
| | | | | | | | S/L | 8.4% | Borderline | | |
| AI455-094[18] | S. Africa | AZT | all start 34 wks, 300 mg Q12h | 300 mg Q3h | None | 2 mg/kg Q12 h for 6 wks | None | 6.3% | 6 wks | | |
| | | ddI | 200 mg Q12h | 200 mg Q12h | None | 120 mg/m$^2$ Q12 h for 6 wks | None | 1.9% | | | |
| | | d4T | 40 mg Q12h | 40 mg Q12h | None | 1 mg/kg Q12 h for 6 weeks | None | 4.2% | | | |
| | | d4T + ddI | 40 mg Q12h + 200 mg Q12h | 40 mg Q12h + 200 mg Q12h | None | combine ddI & d4T | None | 2.0% | | | |

AZT-zidovudine, 3TC-lamivudine, ddI-didanosine, d4T-stavudine. Q12h dosing every 12 hours. RRR - Relative risk reduction.

**Table 2.** *Breast Feeding Populations - Trials Evaluating the Efficacy of Antiretrovirals in Prevention of Mother to Child Transmission*

| Trials | Countries | Drugs | Doses and Treatment Timing | | | | Risk of Transmission | | p value | RRR | Infant age |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *Pre partum* | *Intra partum* | *Post partum* Maternal | *Post partum* Infant | Placebo | Treatment | | | |
| RETROCI & DITRAME[8,9] | Cote d'Ivoire, Burkina Faso, France | AZT | 36 wks, 300 mg Q12h | 300 mg Q3h | Yes/None | None | 30.1% | 22.1 | <0.5 | 27% | 24 mo |
| PETRA[14,15] | S. Africa, Tanzania, Uganda | AZT + 3TC | 36 wks; AZT 300 mg Q12h + 3TC 150 mg Q12h | AZT 600 mg load, 300 mg Q3h + 3TC Q12h | AZT 300 mg Q12h + 3TC 150 mg Q12h | AZT 4 mg/kg Q12 h + 3TC 2 mg/kg Q12h | 26.6% | 20.7% | 0.07 (NS) | 22% | 18 mo |
| | | IP + PP | None | Yes | Yes | Yes | 26.6% | 24.4% | 0.51 (NS) | 8% | 18 mo |
| | | IP alone | None | Yes | None | None | 26.6% | 25.7% | 0.8 (NS) | 3% | 18 mo |
| HIVNET012[10] | Uganda | NVP | None | 200 mg at onset of labor x 1 | None | 2 mg/kg within 72 h of life x 1 | Dropped | 15.7% | 0.006 | 42% | 12 mo |
| | | AZT | None | AZT 600 mg load, 300 mg Q3 h | None | 4 mg/kg Q12 h for 1 wk | | 24.1% | | | |
| SAINT[17] | S. Africa | NVP | None | 200 mg at onset of labor, repeated 48h later | None | 2 mg/kg within 72 h of life x 1 | None | 14% | Study Ongoing, no statistical difference between NVP and AZT + 3TC at 8 wks. | | |
| | | AZT + 3TC | None | AZT 600 mg load, 300 mg Q3 h + 3TC Q12 h | AZT 300 mg Q12h + 3TC 150 mg Q12 h | AZT 4 mg/kg Q12 h + 3TC 2 mg/kg Q12h | None | 10.8% | | | 8 wks |

AZT-zidovudine, 3TC-lamivudine, ddI-didanosine, d4T-stavudine. Q12h dosing every 12 hours. RRR - Relative risk reduction.

cess to HAART for treatment of their HIV infection, these perinatal regimens are an interim measure because treatment should not only reduce MTCT, but preserve the health of the mother as well.

## Resistance

Selection of genotypic resistance has been documented in women on AZT therapy during pregnancy[22-24]. Twenty eight percent genotypic resistance to AZT was reported in transmitting women in the PACTG 185 and was associated with increased transmission[24]. Selection of NVP resistance in 23% of the transmitting mothers in the HIVNET 012 trial was also reported. The clinical relevance of this finding is still uncertain since in HIVNET 012 none of the resistant strains were transmitted to their infants and all maternal resistant virus had reverted back to wild type by 12-18 months[25]. Monotherapy in HIV-infected pregnant women, with development of resistant virus raises concerns about the potential risk of transmitting resistant virus to the infant and the ability to use the same drug for therapy at subsequent pregnancies. The development of resistance has not prevented implementation of ACTG 076 and should not prevent the continued use of NVP for the prevention of MTCT[26]. Lamivudine and other NNRTI may have a higher rate of genotypic resistance in women who have been on previous antiretroviral therapy[27]. Further investigation is still needed to ascertain the importance of genotypic resistance in perinatal transmission of HIV.

## Toxicity

Animals studies have not demonstrated serious adverse effects of AZT on their reproductive capacity. However, there are reports of AZT teratogenicity in experimental mice models and vaginal tumors in rodents exposed to high doses[28,29]. To date no teratogenicity or fetal toxicity has been reported in pregnant women using AZT[30]. Data on other antiretrovirals especially protease inhibitors is still limited. In ACTG 076 the infants in the treatment arm had a signficantly lower Hb at birth but by 12 weeks the two groups were similar. Five years into the follow up of these infants has reported no malignancies and no significant differences in immunological, neuro-developmental, and growth variables between the zidovudine and placebo groups[31]. Possible mitochondrial dysfunction was reported from France in 8 uninfected children, who were exposed to AZT and or 3TC[32]. However, further review of large cohorts of infants exposed to both drugs in the USA and Europe have not found similar abnormalities[33,34]. Recently, severe congenital anomalies were identified in 3 of 13 infant monkeys born to mothers who had received Efavirenz, during pregnancy (*DuPont-Merck 1998*). The doses used in the study were those anticipated to produce plasma concentrations similar to those achieved in humans on standard doses. Therefore, although there are no anomalies reported in humans, women on Efavirenz are advised not to become pregnant. ACTG 219 enrolls infants exposed to antiretroviral therapy in utero or during infancy to evaluate the potential long term sequelae. This is critical since the long term safety of most drugs used in the prevention of MTCT is not documented and yet all drugs that cross the placenta do have the potential for foetal toxicity.

## Mode of delivery

Multiple studies, however not all, have documented the benefit of elective cesarean section (C/S) in reducing vertical transmission[35-39]. The meta-analysis of 15 prospective cohort studies suggested that elective C/S reduces the risk of transmission of HIV from mother to child independent of the effects of treatment with zidovudine[40]. The 8533 mother infant pairs were analysed after adjustments for receipt of antiretroviral therapy, maternal stage of disease, and infant birth weight. Vertical transmission rates were decreased by 50% with elective C/S as compared to other modes of delivery. The combined benefit of C/S and antiretroviral therapy yielded an 87% reduction in MTCT. However, the benefit of C/S must be weighed against the risk of surgery in HIV-infected women. Women already on HAART with undetectable viral load have such low risk of VT that C/S may not provide additional benefit. In most developing countries the risk of surgery and its complications make the use of C/S for the reduction of MTCT unfeasible.

## Immune therapy

The role of passive antibodies in protecting the infant is not completely clear since there are reports of mothers with high anti-gp160 antibody who have enhanced transmission of the virus to their infants[41]. However, the lack of HIV autologous neutralising antibody has been associated with an increased risk of HIV MTCT[42,43]. Furthermore, data from Rhesus macaques demonstrated protection from an oral challenge of simian immunodeficiency virus after passive immunisation[44]. In a phase I/II study in Uganda, HIV immune globulin was safe and well tolerated by 31 mothers and their infants[45]. A larger phase III study is planned to evaluate the efficacy of HIVIG in preventing vertical transmission. In the US study ACTG 185, in which all the women received AZT and were randomized to received either HIVIG or IVIG, transmission rates in both arms were 5%. It was difficult to demonstrate any benefit from HIVIG as compared to IVIG because of the low rate of transmission in both arms[46]. Vaccine trials to prevent vertical transmission of HIV are still in the early stages, planned (HIVNET 027) and phase I/II studies[47]. The development of an effective vaccine given in the prenatal or neonatal period would make a significant contribution to prevention of MTCT. The hope is to develop a model similar to the Hepatitis B perinatal prevention strategy where active immunisation would be combined with passive immunisation at birth to reduce vertical transmission especially during breastfeeding.

## VCCT Counselling

Voluntary Counselling and testing is an integral part of MTCT prevention. With the opportunity of using AZT to prevent MTCT there was an increased need and incentive for counselling and testing during pregnancy[48,49]. Subsequently VT rates significantly reduced as the services became more widely available in the USA and Europe[5,6]. In contrast, most women in developing countries do not have access to voluntary counseling and testing. The antenatal clinic is one of the few places where health services have routine interactions with pregnant young women. This provides an important opportunity for women to receive health promotion information, including access to HIV testing and how to prevent themselves from becoming infected. Counseling and testing in labor has been done but its feasibility and wide scale applicability remain to be proved[50]. Counselling and testing without access to appropriate therapies for the HIV-infected woman is seen as a death sentence and makes acceptance rates in developing countries low[51]. The advances made in prevention of MTCT using simple, less expensive therapies has the potential to reduce the number of children infected with HIV in the developing world. However the translation of research into implementation requires more than the availability of the drugs. Successful implementation of prevention strategies requires: accessible and affordable counselling and testing, early involvement of the partner, family and community and ongoing support for the HIV-infected woman[52-54]. We believe that when these conditions are met the women would be more likely to agree to HIV testing, to return for the results of the test and to be compliant with the prevention therapy. Many women do not accept testing, or agree to testing but refuse to return for results for fear of knowing their status and possible violence in the home if her positive status is disclosed. Further research is still needed to find avenues to support these women as they make choices about HIV testing, receiving of results and partner notification. The early involvement of male partners in the counselling, HIV testing, and ongoing support may increase acceptance of testing and compliance with perinatal treatment.

## Breast Feeding and HIV infection

Vertical transmission rates in Africa (25-40%) are much higher than those in North America and Europe (15-25%) even before the use of antiretroviral therapy during pregnancy. Breast feeding may account for the major differences in transmission rates. The risk of transmission through breastmilk is well documented, but varies among the multiple studies[55-57]. From a meta-analysis the attributable risk of breast milk transmission was 14% (CI 7-22%) from mothers who were seropositive at the time of delivery and 29% (95%CI 16-42%) from mothers who had primary infection during the *post partum* period[58]. Multiple factors may contribute to increased transmission through breastfeeding including high breast milk viral load, breastmilk factors, mastitis, Vitamin A deficiency and prolonged breast feeding[59-64]. A randomized trial in Nairobi, Kenya demonstrated a 44% reduction in vertical transmission in the formula fed group as compared to the breast fed group. Two thirds of the breast milk transmission occurred by six weeks and three quarters by six months. However low level transmission continued throughout the breast feeding period[65]. Similar findings were reported from Malawi where the highest risk of breast milk transmission occurred within the first five months[57]. The benefit of perinatal ARV treatment is diminished in breast fed infants as demonstrated by the reduced efficacy of the same short course AZT regimen used in Thailand and West Africa[7,8]. Perinatal treatment in the setting of breastfeeding may serve largely to shift part of the risk of infection from the peripartum period to several months later. In developed countries, infant formula is recommended for the HIV-infected woman. In contrast, the majority of HIV-infected women, found mainly in sub-Saharan Africa, breast feed their babies and infant formula is not a feasible alternative. The increased risk of diarhoeal diseases, malnutrition and pneumonia when infants are not breast fed in resource poor countries makes it difficult to make a standard recommendation of formula feeding for these populations[66-68]. This emphasizes the need to find avenues to continue protecting the breast feeding child who may have escaped from perinatal HIV transmission. Studies are planned to give antiretrovirals, like NVP, to the infant during the breast feeding period in an effort to reduce transmission through breast milk (HIVNET 023). Exclusive breast feeding may have a protective role in reducing HIV transmission through breast milk[69,70]. In the Durban Vitamin A study the infants who were exclusively breast fed had a transmission rate of 14% compared to the mixed fed group of 24.1% at 3 months of life[69]. Further research is still needed to confirm the benefit of exclusive breast feeding, identify problems associated with early weaning, and to monitor possible spill over to HIV-negative women.

## Non-antiretroviral interventions

Non-antiretroviral interventions if successful would be the most appropriate prevention strategy for the developing world. However, none of the current therapies have been successful in reducing HIV vertical transmission. Vitamin A deficiency has been associated with an increased rate of vertical transmission but Vitamin A and multivitamin supplementation during pregnancy have not been shown to reduce MTCT. Multivitamins, but not Vitamin A were shown to decrease adverse pregnancy outcomes[71,72]. The use of 0.25% chlorohexidine vaginal washes during labor was not associated with a reduction in vertical transmission, unless the membranes were ruptured for greater than four hours. However, overall maternal morbidity and neonatal morbidity and mortality were significantly decreased[73]. Chorioamnionitis has been shown to be a risk factor for vertical transmission in developed and

developing countries[74,75]. In an effort to reduce this risk and hopefully reduce transmission, the use of prophylactic antibiotics during pregnancy and labor is planned as a phase III intervention trial (HIVNET 024). Mastitis has been associated with a higher viral load in breast milk and increased transmission[76]. Whether prevention and treatment of mastitis would reduce vertical transmission through breast milk requires further study. The results of non-antiretroviral interventions have been disappointing in not demonstrating reduction in HIV transmission. However, most of these interventions would be beneficial in reducing adverse pregnancy outcomes of women in developing countries regardless of HIV status. Furthermore implementation of these strategies would not require counselling, testing or disclosure of HIV status.

## Implementation of antiretroviral therapy

Since 1994 when the results of ACTG 076 were released and thereafter implemented there has been a significant decline in vertical transmission rates in USA and other developed countries[3,37,41]. Since the advent of HAART most of the HIV-infected pregnant women in developed countries are on triple antiretroviral therapy with very low or undetectable viral loads[77]. Vertical transmission rates in the USA and Europe are currently less than 5% and the incidence of AIDS in children under five has also decreased significantly in the USA[5]. In contrast, the vertical transmission rates in developing countries are unchanged and over 90% of the children living with HIV are found in sub-Saharan Africa[1]. Despite the advances in the prevention of HIV MTCT including simple, cheap, easy to administer regimens like single dose NVP (HIVNET 012), the developing world is still struggling to implement them[78,79]. Pilot projects for the prevention MTCT under the auspices of UNICEF/UNAIDS are being implemented in various developing countries[80]. Monitoring and evaluation indicators are being developed and are at various stages in the different countries. These pilot projects and other implementation programs have highlighted the problems of the reproductive health services in these countries[81-83]. The inadequate infrastructure for reproductive health services, limited access to counselling and testing in the antenatal clinic, lack of community involvement, absence of alternatives to breast milk as well as poor treatment options in developing countries have prevented full scale national implementation. Exclusive breast feeding, rapid weaning and early cessation may prove to be an acceptable option for the HIV-infected women from resource poor countries. The role of universal NVP in pregnant women is still controversial but hypothetical, with cost-benefit analysis models demonstrating its cost effectiveness in high prevalence areas as a public health measure[84]. However, it is not a solution for the larger problem where HIV-infected women need to be identified so as to encourage them to live positively and prevent further pregnancies. The HIV-negative women who are the majority need to be assisted in developing strategies to remain negative. Operational research is still required to answer issues regarding acceptance of HIV testing and reception of results, infant feeding options, innovative ways to improve counselling and community involvement in implementation. The commitment of individual government's in the developing countries is essential to national implementation programs. Less developed countries are in different categories, with some able to implement programs with minimal assistance while others need significant support of the reproductive health services infrastructure.

## Conclusion

Significant progress has been achieved in prevention of HIV MTCT in developed countries. Despite this success there are still unanswered questions, including short and long term antiretroviral toxicity especially using protease inhibitors, effect of drug resistance on efficacy, and whether there are more effective strategies. In developed countries where vertical transmission rates are very low, efforts at identifying populations that do not access HIV testing and prophylaxis must be maintained. In developing countries operational research needs to go hand in hand with implementation in order to improve the current strategies. If these prevention strategies were widely implemented, there would be a significant impact on the morbidity and mortality of children.

Implementation programs have met obstacles, including shortage of staff and facilities in an already overwhelmed health system, limited access to counseling and testing in the antenatal clinic, and lack of support for the women by their partners and communities. Many resource poor countries are unable to implement even the simplest regimens because of multiple logistical problems. Efforts have to be made by individual countries, United Nations Agencies, pharmaceuticals, non government organisations and donors to make implementation a priority for the present and the future. There is an urgent need to increase and improve access of HIV prevention strategies for the many women in developing countries and by so doing improve the overall reproductive health services. However, primary prevention of HIV infection in women of reproductive age remains the most effective method to reduce HIV infection in children. Research into effective vaginal microbicides to prevent sexual transmission of HIV would empower women with a prevention strategy within their control. Strategies to improve primary prevention through education, condom use, behaviour change models, peer counseling, and community mobilisation are still a priority.

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