

# HIV Transmission Through Breastfeeding

Ellen Israel, CNM, MPH, Senior Reproductive Health Advisor, in collaboration with Douglas Huber, MD, MSc, Medical Director, Pathfinder International

## SUMMARY

*Approximately 1.2 to 1.8 million children have become HIV-infected through breastfeeding, roughly one-third to one-half of the 3.6 million children infected through mother-to-child transmission (MTCT). HIV-positive women need to know about HIV transmission through breastmilk and options to protect their children. Some options are complicated, raising new dilemmas.*

*The World Health Organization (WHO) recommends that women who either do not know their HIV status or who are HIV-negative be encouraged to breastfeed. This guidance applies to over 90 percent of women in developing countries. For a woman who feels she is at risk of being HIV-positive, accessible voluntary counseling and testing (VCT) is vital for her to make an informed decision about breastfeeding.*

*For women who are HIV-positive, WHO guidelines give four options: 1. give suitable replacements for breastmilk, provided these are affordable for six months and can be prepared accurately and hygienically—risk of HIV infection by breastmilk is thereby eliminated; 2. where suitable replacement feeding is not possible, exclusively breastfeed for 3 to 6 months, followed by cessation—risk of HIV transmission is reduced but not completely; 3. manually express and heat-treat breastmilk, or use a breastmilk bank; and 4. use a wet-nurse who is documented HIV-negative and accepts the small risk of possibly being infected by the baby. Options 1 and 2 are generally more feasible in low-resource settings. The guidelines will probably change again, and providers need to keep current.*

*Counseling HIV-positive women on their options and making VCT widely available are two urgent challenges. Voluntary contraceptive services must be made readily available to HIV-positive women to protect their health and to help them prevent MTCT.*

*Some encouraging news includes: 1. a recent study that reinforces the safety of exclusive breastfeeding for 3 months followed by early cessation, but verification is needed; and 2. Nevirapine, a new low-cost drug, substantially lowers the risk of MTCT during delivery and is being tested for breastfeeding mothers.*

---

### Acknowledgments

Special thanks to reviewers Betty Farrell, independent consultant; Rosemary Kamunya, Pathfinder Africa Regional Office; Monica Nolan, Centers for Disease Control; Jay Ross, Linkages; and Cathy Solter, Pathfinder International; and others who offered comments: Mary Kroeger, Linkages; Miriam Labbok, USAID; and Ronnie Lovich, Save the Children.

Suggested citation: Israel, E. and Huber, D. *HIV Transmission Through Breastfeeding*. Pathfinder International Technical Guidance Series, No. 1. Watertown, Massachusetts, Pathfinder International, December 1999.



## THE PROBLEM

Breastfeeding is the norm in most of the world, and for good reasons. It is the best nutrition for babies, it protects against deadly childhood diseases, it delays return to fertility, it costs nothing, and it promotes bonding and social/emotional development in babies. The rise in HIV/AIDS cases, especially in Africa, puts new focus on breastfeeding as a route of transmission from mother to child.

The estimated added risk of HIV infection from breastmilk is, on average, 15 percent for infants whose mothers have established HIV infections. This is the additional risk of HIV transmission above that during pregnancy and delivery. The risk may be higher than 15 percent among infants who are breastfed for prolonged periods. Of the close to four million children who have been infected with HIV (9 out of 10 are in Africa), vertical transmission or MTCT is responsible for 90 percent, or 3.6 million children. Of those, most data indicate about one-third to one-half are infected through breastfeeding, 1.2-1.8 million. The other one-half to two-thirds are infected during labor and delivery (the majority of cases) or during pregnancy (minimal transmission) (5,21).

Estimates of total MTCT of HIV range from 5 percent in industrialized countries to as high as 45 percent in developing countries (5,20). Most estimates of total MTCT for developing countries are in the 25-35 percent range (5). The lower rates in industrialized countries are presumed to be due to the availability of certain interventions, such as anti-viral therapy before and during birth, Caesarian section before rupture of membranes and labor, and safe alternative feeding methods.

## BREASTFEEDING— SPECIAL RISK FACTORS FOR HIV TRANSMISSION

There are several factors that are thought to increase the risk of transmission through breastfeeding:

- The mother contracting HIV during pregnancy and especially in the postnatal period because of the high viral load around the time of transmission. (There

is a 29 percent transmission rate if the mother seroconverts while breastfeeding.)

- The longer the period of breastfeeding, the more likely transmission will occur, especially after the first 3 to 6 months. There is evidence for a gradual and continued increase in transmission risk as long as the child is breastfed (1).
- Nutritional deficiencies in the mother such as anemia make the mother less receptive to anti-viral therapy. Vitamin A deficiency was thought to make transmission to the baby more likely (19). However, this was not supported by findings from the new Durban study (see page 7), among others, that found no effect of vitamin A supplementation on the risk of HIV-1 infection by 3 months, although it helped prevent premature birth (1).
- Mastitis, cracked nipples, especially with Vitamin A deficiency and poor breastfeeding technique, or sores/breaks in the infant's oral mucosa (21).
- A woman with AIDS is more likely to transmit the infection to her infant than a woman with no signs of disease because of her increased viral load.

## THE LATEST WHO GUIDANCE ON HIV AND BREASTFEEDING

The primary strategy for dealing with the HIV/AIDS epidemic is always prevention—the only sure way of protecting men and women, as well as their infants and children, from AIDS.

### Mothers Whose HIV Status is Negative or Unknown Should Breastfeed

For women with unknown status, WHO's recommendation is to encourage exclusive breastfeeding and to offer the same counseling as for HIV-negative women, including the benefits of breastfeeding and how to do it effectively: feeding on demand, correct positioning, and avoiding all artificial feeding, bottles, and pacifiers. Exclusive breastfeeding, as opposed to mixed feeding, is giving only breastmilk to the infant in the first 3 to 6 months, avoiding all



supplements, including formula, juices, water, teas, cereals, and other foods, that might contaminate and injure the immature gastrointestinal tract, making transmission of HIV more likely (1). Other counseling points are the risks and cost of using formula and other replacement feeding and the need for safer sex to avoid HIV infection or reinfection. If a woman becomes infected while breastfeeding, the risk of transmission to the baby is significantly higher because of the heavy viral load present at the onset of HIV infection (20).

It is vital that women who feel they are at risk have access to voluntary counseling and testing (VCT), so they can make informed decisions about breastfeeding. Women also need wide access to VCT so they can make informed decisions about whether to become pregnant or to use family planning.

### **Choices for Mothers Who Are HIV-positive**

For known HIV-positive women, suitable replacements for breastmilk (such as commercial infant formula or home-prepared formula from modified animal milks) can eliminate HIV transmission through breastfeeding. However, the danger of using breastmilk substitutes in developing countries is well known and must be considered, along with the specific circumstances of the woman and her family.

#### **1. Infant Replacement Feeding Options**

The safest method of giving replacement feeding of any kind is with a clean cup. Contaminated bottles and nipples are culprits in bacterial infections and dental disease, and cups can be kept clean more easily.

- **Commercially prepared formula** is an option where it is available and the family can afford adequate supplies. Formula is the closest to mother's milk, but still lacks the long-chain fatty acids needed for brain development. Commercial infant formula may be considered as an option by HIV-positive women when:

- The family has reliable access to sufficient formula for at least six months; and
- The family has the resources—water, fuel, utensils, skills, and time—to prepare it accurately and hygienically (21).
- **Home-prepared formula** can be made from fresh animal milks (cow, goat, camel, sheep, and buffalo), dried milk powder, or evaporated milk. All of these lack different micronutrients that are important to infant development, especially the long-chain fatty acids. (UNICEF produces micronutrient supplements in sachet form to add to replacement milks.) Careful counseling must go along with teaching home-prepared formulas. The animal milks should be diluted with water and sugar added. Cow, goat, and camel milks are very similar: per 100 ml milk add 50 ml boiled water and 10g (2 teaspoons) sugar. Sheep and buffalo milks have more fat, energy, and protein (50 ml each, milk and water, plus 5 g sugar) (20). Appropriate complimentary foods are even more important when not breastfeeding, starting at 4 to 6 months. Skimmed and sweetened condensed milks are not recommended, nor are fruit juices, sugar-water or dilute cereal gruels before six months of age.

When adequate replacement feeding is not possible, mothers may choose among the three following strategies to reduce breastmilk transmission, the first of the three being the most practical in many settings; the second and third have limited applicability in resource-poor areas.

#### **2. Exclusive Breastfeeding With Early Cessation**

**Exclusive breastfeeding followed by early cessation** by 6 months reduces exposure and hence the risk of transmission through breastmilk, while not eliminating the risk entirely. WHO recommends this strategy because the risk of infection and death from early childhood diseases due to replacement feeding, as well as the

protective effects of breastfeeding, are highest in the early months. The importance of avoiding all supplemental fluids and foods must be conveyed to individuals, communities, and to health workers who counsel women—not an easy task where traditional infant feeding usually includes supplementing. Many studies have shown a correlation between duration of breastfeeding and increased transmission but none have established an optimum time for weaning. This option maximizes the protective effects of breastfeeding in areas where formula feeding is not an option due to lack of ability to buy or safely prepare and give formula or other animal milks.

#### 1. Heat-treating Expressed Milk

**Manually expressing and heat-treating breastmilk with cup feeding may be a viable option in some settings. The literature and research is still scant regarding this method and the logistics are complicated, similar to formula feeding in the need for fuel/heat source, a breast pump, sufficient time, and skill in both avoiding contamination and using the breast pump. There is some mention of scalding breastmilk, but the Holder pasteurization method of heating the milk to 62.5C for 30 minutes, and cooling is a viable method of killing the virus (10). Cup feeding is strongly recommended over bottles and nipples. There are specific guidelines on successfully cup feeding an infant, including premature infants as young as 30 weeks' gestation (7,20).**

**Breastmilk banks** are usually established for feeding premature or ill newborns for a

limited time period and should have clearly defined standard procedures and safety precautions. They should also screen all donors for HIV and pasteurize the milk. It is difficult to maintain milk banks at all in many settings, especially with the necessary standards. Also, it is difficult for a woman to access the bank for several feedings per day.

#### 4. Wet-nursing by an HIV-negative Woman

**Wet nurses** are another possibility. In many communities a woman other than the mother nursing the baby is a common practice. WHO stresses that the wet nurse should:

- be a family member to avoid money being exchanged
- be tested and confirmed to be HIV-negative and know how to stay that way, and
- be informed of her possible risk of being infected with HIV by the baby.

The quantification of risk to the wet nurse was not stated, only that her risk might increase if she has sore or cracked nipples, or infections of the breast. Since testing is not available in most places, both the infant and the wet nurse would be vulnerable to becoming infected, especially considering the lack of data on the risk for the wet nurse. Older women in the family may be suitable wet nurses (20).



### Dilemmas

1. In many societies where there is still a strong stigma attached to and discrimination, and even violence, against a person with HIV/AIDS, a woman choosing to not breastfeed would send a signal to her community that she is HIV-positive. Or there may just be a strong ethic that breastfeeding is what is best for the baby and the woman would be looked down upon for not breastfeeding. IEC campaigns are needed in every community, along with development of support services for HIV-positive people (medical, psychological, social and community based), to bring the disease out in the open where it can be understood and halted. Stigma should not be the basis on which at-risk or positive women and couples make choices about VCT, pregnancy, and infant feeding method.
2. Making formula available could bring back the nightmare of increased death from childhood diseases as occurred when formula company campaigns convinced whole countries that formula was better than breastmilk. (Breastmilk protects—and formula is ineffective—against diarrhea, pneumonia, neonatal sepsis and acute otitis media.) Undermining the years of work to promote exclusive breastfeeding in developing countries could result. In a given situation, it is necessary to weigh the risk of death from childhood diseases against the risk of death by AIDS in advising women on their choice of feeding method. Formula should be prescription-controlled in areas where this does not prevent access to HIV-positive mothers, and the International Code of Marketing of Breastmilk Substitutes should be observed (19).
3. There is evidence that a limited period of exclusive breastfeeding might maximize nutritional and immunologic benefits while minimizing HIV risk, but the risk of transmission is still there. The immunologic, anti-bacterial, and anti-viral properties of breastmilk in HIV-positive women who do not yet have AIDS are similar to those of HIV-negative women (1).

### COUNSELING HIV-POSITIVE WOMEN ON INFANT FEEDING

Health systems must develop programs to help HIV-positive women feed their babies in the safest possible way and find the money and the will to do this effectively. Counseling guidelines for health workers and policy makers are needed to help women with HIV in decision-making about infant feeding choices. Investing in preventing transmission to babies (providing testing, infant feeding counseling and education, formula, fuel and heat source, breast pumps, health services, etc.) will avoid the enormous costs of caring for sick babies later, as well as preventing the loss of human lives.

The primary strategy for dealing with the HIV/AIDS epidemic is prevention. Second

to prevention is universally accessible voluntary counseling and testing (VCT) for HIV. Presently less than 5 percent of HIV-infected individuals have access to reliable HIV testing (4). Expanding VCT is vitally important for decreasing vertical transmission right now. Choices can be made based on real risk, women can be connected to health services through the counseling process, and measures can be taken to reduce the chances of infecting the baby as well as preventing the deterioration of the mother's health. There are significant benefits of VCT for women who test negative as well. They have a real incentive to protect themselves from infection and can breastfeed without worry.

VCT should especially be offered as early in the prenatal period as possible. Perhaps





testing has to become more within people's grasp through social marketing of VCT using the rapid test, and clinics must not insist on the follow-up or confirmatory testing before informing people of their positive status on the rapid test, since the Western Blot Test is available to only a small minority of people. Two consecutive rapid tests have similar accuracy to the Elisa/Western Blot sequence. It has been estimated that 100,000 people in the USA have not returned after testing for their results. In developing countries the numbers not returning must be even larger due to the more difficult logistics. Increasing the availability of testing must go hand-in-hand with real choices for action once test results are given.

The human rights of HIV-positive people must be respected, including the right to make decisions about infant feeding based on full information, as wide a choice as possible, and support for her choice. Choosing may be a very complicated process involving questions of:

- Cost—The cost of formula, plus fuel, water, medical care for the baby and hours of work lost can exceed a family's annual income.
- Community—She may face devastating discrimination if she doesn't breastfeed.
- Skill, support, logistics—Her situation may make it impossible to perform complicated, time consuming measures to prepare alternative milk for her baby, especially where there is an unsafe water supply.
- She may not be able to face the possibility of transmitting her disease to her child.
- If her status is unknown, she could avoid unsafe sex to decrease the possibility of postnatal transmission and the high viral load of early infection. If she is high risk or she is known to be HIV-positive, she could breastfeed for a limited time (three months to avoid the deadly childhood diseases during this vulnerable time) followed by appropriate replacement feeding and complimentary foods. Also, it appears that HIV-positive children who

are not breastfed have faster progression to AIDS.

- Availability of health services for the baby—If she chooses not to breastfeed, her baby may be at higher risk for serious childhood diseases such as diarrhea and acute respiratory infection, the two leading killers of infants in the developing world.

Other issues in considering alternative feeding methods include:

- Nutritional requirements—The only perfect food for the first six months is breastmilk. Care has to be taken to provide all the infant nutritional needs if using replacement feeding.
- Bacterial infection—Not having the mother's protective antibodies against infection and also not having the ability to hygienically prepare breastmilk substitutes—clean water, fuel/heat source, sufficient time, refrigeration, or access to health services for childhood diseases.
- The contraceptive benefit of breastfeeding is lost, which is an important issue especially for HIV-positive women. Effective family planning services need to be made available and accessible.

Before pregnancy, family planning outreach and counseling should be available for HIV-positive women/couples, or those at high risk, to prevent unwanted pregnancy or, at least, to minimize the double problem of an unwanted pregnancy and the risk of transmitting HIV to the baby. If they are high-risk and of unknown status but the woman/couple still decide to get pregnant, they should be counseled about minimizing the risk of transmission by using condoms except during fertile times, never having sex when there are signs of an STD or non-STD vaginitis, being treated for STDs early, and screened for asymptomatic STDs where possible. Counseling for an HIV-positive woman should include the possibility of miscarriage, fevers, infection, and deteriorating health of the mother, and inability to care for a child, serious

postpartum infections, and an infected and/or premature baby.

Health care workers have an important role to play in assisting HIV-positive mothers to stay as healthy as possible for their own quality of life as well as their children's survival, and to assist the HIV-negative mothers to stay that way in the face of, often, the lack of power to make decisions that can protect her. Attention should be paid to their counseling needs as well as prophylaxis and treatment for opportunistic infections.



## OTHER STRATEGIES FOR DECREASING MOTHER-TO-CHILD TRANSMISSION OF HIV

Other strategies for decreasing MTCT look promising, including prenatal strategies such as:

- VCT available early in pregnancy
- paying careful attention to the nutrition of pregnant women
- diagnosing and treating STDs in pregnancy

Most MTCT occurs during labor and birth. The mechanisms are presumed to be: 1. transfusion of the mother's blood to the fetus during contractions of labor; 2. ascending infection after rupture of the bag of waters; and 3. direct contact of the baby with infected secretions and blood in the genital tract (13). Possible intrapartum strategies include:

- having HIV rapid tests available in labor.
- providing anti-viral medications to women, especially around labor and birth, and to newborns in the early postpartum period. Antivirals, mostly Zidovudine (AZT), have been used with some success, but are largely unavailable and have been prohibitively expensive outside of the industrialized world, even for the short course given during labor and delivery. This has precluded any program of providing AZT to breastfeeding women on the theory that it may decrease transmission to the baby.

- in high prevalence areas, one might give Nevirapine to all women in labor and all babies within 72 hours of birth (see next section), although this should not replace VCT and its benefits to HIV-positive and negative women (2).
- decreasing invasive interventions in labor such as artificially breaking the bag of waters and episiotomy incisions.
- washing out the vagina shortly before birth with microbicides (e.g. chlorhexadine) to decrease secretions and the amount of virus the baby comes in contact with.
- Caesarian sections where they are safe for the mother and hospital personnel because they can significantly reduce MTCT. An elective caesarian section before the bag of water breaks and before labor begins cuts the risk of transmission to the baby in half. An emergency caesarian section after labor has begun, however, has no effect on the rate of transmission (9).

Several studies have reported that HIV is inactivated when milk is left to stand at room temperature for half an hour (8,10). In addition, recent research indicates that human milk has properties that protect it from bacterial contamination. Thus, new suggested guidelines on how long breastmilk can stay at room temperature without spoiling are: colostrum for the first 6 days postpartum, 12 hours at 27-32°C; mature milk 24 hours at 15.6°C, 10 hours at 18.9-22.2°C, and 6 hours at 26.1°C (7). These observations may together become the basis for a simple method of cup feeding milk instead of using the Holder method, but more evidence is needed.

## SOME GOOD NEWS

There are two recent studies, which, if they can be replicated, could profoundly change the outlook for HIV-positive mothers and their children.

Firstly, a recent vitamin A intervention trial in Durban, South Africa looked at the effects of infant feeding patterns on vertical transmission as well. Using the new

methods of RNA-PCA testing of infants, the researchers found that babies of HIV-positive mothers who were exclusively breastfed for at least the first 3 months had overall acquisition of HIV at a slightly lower rate (14.6 percent) than that of formula fed babies (18.8 percent) (the difference was not statistically significant), but at three months of age, at significantly lower rates than babies receiving mixed feedings (24.1 percent). None of the mothers had received anti-viral medication. At 15 months, 21.8 percent of the babies exclusively breastfed in the first 3 months were HIV-positive compared to 28.2 percent of babies who received mixed feedings in their first 3 months. This suggests continuing protection of early exclusive breastfeeding (11).

The researchers' explanations were that: 1. anti-viral properties of breastmilk are protective and, although breastfeeding causes some post-natal transmission of HIV, a roughly similar number of babies are protected through breastmilk due to HIV antibodies and other immunologic agents; and 2. mixed feeding negates the immunologic advantages of breastmilk, and allergic reaction to foods or contamination causes injury to the immature gut making transmission easier (3). Supplemental feedings are traditionally entrenched in many regions and it would take effective community-wide efforts to make exclusive breastfeeding viable for women.

WHO has not changed its recommendations on infant feeding based on this one study, but is watching for replication and validation of the findings.

Secondly, a study in Uganda on the effect of Nevirapine, an anti-AIDS drug, on reducing MTCT is promising. Giving one dose of Nevirapine to the mother in labor and one dose to the baby within 72 hours of birth has been shown to be 47 percent more effective up to 14-16 weeks of age than the equivalent AZT regimen in preventing MTCT at a tiny fraction of the cost (around \$4). (The current AZT regimen can cost from \$700 to more than \$1000 in the U.S. and \$50 to \$80 in Africa and Asia per mother-child pair.) Nevirapine is well tolerated and

has no appreciable short-term side effects, it stays in the body longer than AZT, and it crosses the placenta and gets into the breastmilk. The regimen does not require antenatal contact. All of the babies in the study were breastfed for at least 2 weeks. More than 95 percent were breastfed for more than 3 months (2). Centers for Disease Control (CDC) trials are underway to test postpartum regimens of Nevirapine for infants up to six months who are being breastfed.

Thirdly, a recent study in Malawi suggests that mastitis, or infection of the breast and nipple, may increase the transmission rate through breastfeeding. Breast infections can be avoided by proper breastfeeding techniques, especially positioning, or prompt treatment to avoid increasing the possibility of transmission to the baby.

Combining these three strategies (exclusive breastfeeding, Nevirapine for mother and baby during labor and early postpartum, and avoiding and prompt treatment of breast infections) in low-resource areas could potentially significantly reduce the amount of MTCT, but these studies must be reviewed further and replicated before any program or policy changes are made.

These are some of the current issues around breastfeeding for HIV-positive women and their babies, and for those responsible for their health care. The findings of the Durban study plus the increased availability of a low-cost anti-viral medication may make the choice to breastfeed a much easier one. The information is changing all the time and may result in new recommendations in the near future. Alternatives need to be seriously developed, and soon, to support the HIV-positive mother and protect her baby.

## RECOMMENDATIONS

1. Strengthen prevention efforts to protect women, especially adolescents, from being infected with HIV and thereby avoid the possibility of MTCT altogether.
2. Make sure that VCT is available for everyone, and investigate ways to remove barriers to testing, such as



reducing stigma, improving provider attitudes, ensuring confidentiality, and promoting and providing benefits to both HIV-positive and HIV-negative women.

3. Promote rapid testing, without confirmatory testing before informing the client of her status, and social marketing of VCT.
4. Establish guidelines for health workers and trained counselors in every facility for counseling HIV-positive pregnant women about decreasing the chances of MTCT through infant feeding options. Always observe their human rights and support their choices in all aspects of HIV-positive women's own health and that of their babies.
5. Guarantee that family planning and health and counseling services are universally available to maximize the HIV-positive woman's chances of preventing pregnancy or avoiding transmitting the virus to her baby, to support her in her choice of feeding method materially and emotionally, and to provide care to a baby who may not have the protective benefits of breastfeeding.
6. Provide the highest attainable level of care to infected women, including, at a minimum, basic opportunistic infection management, both for their own health and well being and for the optimal health of their children.
7. Take steps for HIV-negative women and women of unknown status to make sure that successful breastfeeding practices are promoted and supported to decrease infant and child morbidity and mortality. For the vast majority of women breastfeeding should not be undermined by fears of MTCT.
8. Be aware of new information and strategies for confronting this problem. Our understanding is changing rapidly and new recommendations may appear soon



## References and additional readings

1. COUTSODIS, A., PILLAY, K., SPOONER, E., KUHN, L. and COOVADIA, H. Influence of infant-feeding patterns on early mother-to-child transmission of HIV-1 in Durban, South Africa: a prospective cohort study. *The Lancet* 354.9177 (1999): 12 p. Online. Available: <http://www.thelancet.com/newlancet/sub/issues/vol354np9177/body.early471.html>, 8/30/99.
2. GUAY, L., MUSOKE, P., FLEMING, T., BAGENDA, D., ALLEN, M., NAKABIITO, C., SHERMAN, J., BAKAKI, P., DUCAR, C., DESEYVE, M., EMEL, L., MIROCHNICK, M., FOWLER, M., MOFENSON, L., MIOTTI, P., DRANSFIELD, K., BRAY, D., MMIRO, F., and JACKSON, J. Intrapartum and neonatal single-dose nevirapine compared with zidovudine for prevention of mother-to-child transmission of HIV-1 in Kampala, Uganda: HIVNET 012 randomised trial. *The Lancet* 354.9181 (1999): 15 p. Online. Available: <http://www.thelancet.com/newlancet/sub/issues/vol354no9181/body.article795.html>, 9/8/99
3. INTERNATIONAL AIDS SOCIETY. IAS Position Paper on Prevention of HIV 1 mother-to-child transmission. *AIDS* 13 (11): p. 5-9. 7/30/99.
4. LINKAGES PROJECT. FAQ sheet 1. Frequently asked questions on: breastfeeding and HIV/AIDS. Washington DC, Academy for Educational Development, October 1998. 6 p.
5. MACNEIL, J. Preventing mother-to-child transmission of HIV. *Family Health International Impact Project. Impact on HIV* 1(1): p. 37-39. October 1998.
6. MARSEILLE, E., KAHN, J., MMIRO, F., GUAY, L., MUSOKE, P., FOWLER, M., and JACKSON, J. Cost effectiveness of single-dose nevirapine regimen for mothers and babies to decrease vertical HIV-1 transmission in sub-Saharan Africa. *The Lancet* 354.9181 (1999): 15 p. Online. Available: <http://www.thelancet.com/newlancet/sub/issues/vol354no9181/body.article803.html>, 9/8/99.
7. MOHRBACHER, N. and STOCK, J. *The breastfeeding answer book*. Schaumburg, Illinois, La Leche League International, January 1997. 586 p.
8. NEWBURG, D., VISCIDI, R., RUFF, A., and YOLKEN, R. A human milk factor inhibits binding of human immunodeficiency virus to the CD4 Receptor. *Pediatrics Research* 31(1): p. 22-28. January 1992.
9. NEWELL, M. How can we prevent mother-to-child transmission of HIV infection? *IPPF Medical Bulletin* 33(3): p. 1-3. June 1999.
10. ORLOFF, S., WALLINGFORD, J., and MCDOUGAL, J. Inactivation of human immunodeficiency virus type I in human milk: effects of intrinsic factors in human milk and of pasteurization. *Journal of Human Lactation* 9(1): p. 13-17. March 1993.
11. PIWOZ, E., and ROSS, J. Highlights from the 2<sup>nd</sup> conference on global strategies for the prevention of HIV transmission from mothers to infants. Montreal, Canada, September 1999.
12. PREBLE, E., and PIWOZ, E. HIV and infant feeding: a chronology of research and policy advances and their implications for programs. Washington, DC, Academy for Educational Development, 1998. 27 p.
13. REPRODUCTIVE HEALTH OUTLOOK. Reducing maternal-fetal HIV transmission. p. 3. Online. Available: [http://www.rho.org/html/hiv\\_aids\\_restopics.htm](http://www.rho.org/html/hiv_aids_restopics.htm), 9/17/99.
14. SEMBA, R., KUMWENDA, N., HOOVER, D., TAHA, T., QUINN, T., MTIMAVALYE, L., BIGGAR, R., BROADHEAD, R., MIOTTI, P., SOKOLL, L., VAN DER HOEVEN, L., and CHIPHANGWI, J. Human immunodeficiency virus load in breastmilk, mastitis, and mother-to-child transmission of human immunodeficiency virus type 1. *The Journal of Infectious Diseases* 180:p.93-98. 1999.
15. UNAIDS (Joint United Nations Programme on HIV/AIDS). Counseling and voluntary HIV testing for pregnant women in high HIV prevalence countries: guidance for service





- providers. May 1999. 18 p. Online. Available: <http://www.unaids.org/unaids/document/mother%2Dto%2Dchild/pisani.html>, 6/11/99.
16. UNAIDS (Joint United Nations Programme on HIV/AIDS). Prevention of HIV transmission from mother to child: strategic options. May 1999. 14 p. Online. Available: <http://www.unaids.org/unaids/document/mother%2Dto%2Dchild/strat0599.html>, 6/11/99.
  17. UNAIDS (Joint United Nations Programme on HIV/AIDS). Vertical transmission of HIV—rapid assessment guide. 9 p. Online. Available: <http://www.unaids.org/unaids/document/mother%2Dto%2Dchild/sitanag.html>, 11 June 1999.
  18. WITKOR, S., EKPINI, E., KARON, J., NKENGASONG, J., MAURICE, C., SEVERIN, S., ROELS, T., KOUASSI, M., LACKRITZ, E., COULIBALY, I., and GREENBERG, A. Short-course oral zidovudine for prevention of mother-to-child transmission of HIV-1 in Abidjan, Côte d'Ivoire: a randomised trial. *The Lancet* 353: p. 781-785. 3/6/99.
  19. WORLD HEALTH ORGANIZATION (WHO). JOINT UNITED NATIONS PROGRAMME ON HIV/AIDS (UNAIDS). HIV and infant feeding: guidelines for decision-makers. 36 p. Geneva, WHO, June 1998.
  20. WORLD HEALTH ORGANIZATION (WHO). JOINT UNITED NATIONS PROGRAMME ON HIV/AIDS (UNAIDS). HIV and infant feeding: a guide for health care managers and supervisors. Geneva, WHO, June 1998.
  21. WORLD HEALTH ORGANIZATION (WHO). JOINT UNITED NATIONS PROGRAMME ON HIV/AIDS (UNAIDS). HIV and infant feeding: a review of HIV transmission through breastfeeding. Geneva, WHO, December 1998.

*For more information, see WHO's three manuals on HIV and infant feeding (nos. 20-22 above). These publications can be accessed through the UNAIDS website (<http://www.unaids.org/publications/documents/mtct/index.html>) or obtained by writing to: WHO, Distribution and Sales, CH-1211, Geneva 27, Switzerland. Alternatively, contact Ellen Israel ([eisrael@pathfind.org](mailto:eisrael@pathfind.org)) or Yasmeen Khan ([ykhan@pathfind.org](mailto:ykhan@pathfind.org)) for photocopies. Refer also to other materials in the bibliography.*

*Funds for the Technical Guidance Series are provided in part by the Agency for International Development. The views expressed are those of Pathfinder International and do not necessarily reflect those of USAID.*