

C H A P T E R

# 19

*Mother-  
to-Child  
Transmission of  
HIV Through  
Breastfeeding:  
Strategies for  
Prevention*

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## *Mother-to-Child Transmission of HIV Through Breastfeeding: Strategies for Prevention*

### **INTRODUCTION**

The rapid expansion of the AIDS epidemic in resource-constrained settings, greater understanding of HIV transmission through breastmilk and increasing child mortality have forced the problem of mother-to-child transmission (MTCT) to the top of the international health policy agenda. MTCT can take place during pregnancy, during delivery and in the postnatal period through breastfeeding. Although fewer than half the babies born to HIV-infected women acquire HIV, increasing HIV prevalence among pregnant women has resulted in a very rapid increase in the number of HIV-infected children.

Breastfeeding can offer many benefits. For infants, breastfeeding provides adequate nutrition and protective anti-infective agents during the first six months of life. For mothers, breastfeeding facilitates uterine contraction, protects against excessive blood loss and delays the return of normal menstruation—the last conserves iron and contributes to child spacing. This chapter focuses on breastfeeding practices and alternatives, and examines some of the socioeconomic factors that determine whether mothers choose to breastfeed.

### **MAGNITUDE OF BREASTMILK TRANSMISSION OF HIV**

Breastmilk transmission of HIV has been documented among infants of newly infected women and among women with established infections. According to the best available estimate, one out of seven children breastfed by an HIV-infected mother will become infected through breastfeeding.

Infants of HIV-infected women are at risk as long as they breastfeed. While there are limited data on the correlates of breastmilk transmission of HIV, prematurity, age at weaning and infant immune responses are believed to modify risk.

## **WEIGHING RISKS AND BENEFITS OF PREVENTION OF BREASTMILK TRANSMISSION OF HIV**

Replacement feeding prevents breastmilk transmission of HIV. However, in resource-constrained settings the infant-feeding decision should be based on the balance between the risk of HIV transmission if the mother does breastfeed and the risk of death due to artificial feeding if she does not. Not breastfeeding can result in social stigmatization, economic hardship and early return of fertility. Women must be aware of all risks in order to make an informed decision.

## **PREVENTION OF BREASTMILK TRANSMISSION OF HIV**

The most effective way of preventing breastmilk transmission of HIV while ensuring that babies enjoy the benefits of breastfeeding is to protect women of child-bearing age from HIV infection. HIV-infected women should be assisted with counseling and accessible family planning services to limit fertility and interventions to prevent breastmilk transmission of HIV through breastfeeding. These interventions include strategies to replace or shorten the duration of breastfeeding and reduce the infant's vulnerability to infection.

Prevention of breastmilk transmission of HIV can be achieved through the implementation of a seven-step program. Each step is outlined with accompanying practice points.

- Step 1: Good nutrition during pregnancy and the postnatal period
- Step 2: Good breastfeeding technique instruction
- Step 3: Reduction of infant's vulnerability to infection
- Step 4: Voluntary Counseling and Testing (VCT)
- Step 5a: Risk-reduction counseling for HIV-negative women
- Step 5b: Counseling for HIV-positive women
- Step 6: Antiretroviral Therapy (ART) to reduce MTCT
- Step 7: Infant-feeding options for HIV-positive women

Topics covered under Step 7, which was adapted from UNICEF/UNAIDS/WHO, include:

- Breastmilk substitutes
- Modifications of breastfeeding
- Safer breastfeeding
- Micronutrient supplementation
- Avoidance of dehydration

- Unsuitable replacement feeds
- Complementary feeding and weaning
- Family planning services
- Ethical considerations
- Spillover

**PREPARING THE HEALTH CARE SYSTEM  
FOR PREVENTION STRATEGIES**

Health care systems must be prepared before implementing a program to prevent HIV transmission through breastfeeding. Health workers should be skilled in HIV counseling and testing, prevention of MTCT, lactation management and promotion of good breastfeeding techniques, standard midwifery procedures, management of antiretroviral therapy (ART) interventions, replacement feeding, nutrition counseling and family planning for HIV-infected couples. The health care system should also be strengthened to provide a continuum of care to manage the mother-infant pair.

**COST-EFFECTIVENESS OF STRATEGIES TO  
PREVENT BREASTMILK TRANSMISSION OF HIV IN  
RESOURCE-CONSTRAINED SETTINGS**

The high cost of infant-feeding options other than breastfeeding can be a major difficulty in resource-constrained communities. Any evaluation of cost-effectiveness must involve the definition of “effectiveness” and how it is measured. Although replacement feeding may not pay for itself in health care savings and may not compare favorably with other child survival strategies in cost-effectiveness analysis, there is a strong moral and ethical obligation to use all known strategies to prevent MTCT through breastfeeding.

**POLICY CONSIDERATIONS**

The International Code of Marketing of Breastmilk Substitutes and subsequent related World Health Assembly resolutions (which place restrictions on the ways in which the formula industry can market breastmilk substitutes) have helped reduce the impact of commercial marketing on breastfeeding. Although violations of the code continue, the WHA code and resolutions remain more relevant than ever in the context of HIV/AIDS, where there is a clear medical need for breastmilk substitutes.

## LESSONS LEARNED AND FUTURE DIRECTIONS

Careful monitoring of programs to prevent MTCT in resource-constrained settings provides an opportunity to answer a number of important programmatic questions:

- How can health care workers best provide the information that HIV-positive mothers need to make infant-feeding decisions and best support these women in carrying out their decisions?
- How can such infant-feeding counseling and services be provided while minimizing their potential negative impacts?
- What is the risk of HIV transmission through breastfeeding under different conditions?
- What factors modify this risk?
- What is the risk of death due to artificial feeding under the same conditions?

## CONCLUSION

The risk of MTCT through breastfeeding presents a huge challenge for HIV-infected women who must decide how to feed their infants, for the health care workers who counsel them and for the decision makers who must provide appropriate policy guidelines and resources. Research and pilot studies are planned or currently underway to provide better understanding and more effective solutions.

## CASE STUDIES

Two case studies provide examples of interventions to prevent MTCT in resource-constrained settings.

### THAI PROGRAM TO AVOID BREASTFEEDING IN HIV-INFECTED WOMEN

Thailand recently implemented several large regional programs of short-course ziduvodine (ZDV) treatment and avoidance of breastfeeding. With monitoring, these programs may provide more specific information about the acceptability and risks of HIV-infected women avoiding breastfeeding in a variety of settings.

### THE ZAMBIAN NDOLA DEMONSTRATION PROJECT

A demonstration project is being implemented to introduce VCT and improved infant-feeding counseling into antenatal care and community services in a low-income area. The project aims to reduce MTCT by encouraging pregnant women and their partners to be tested for HIV and providing counseling on HIV prevention, improved care and nutrition during pregnancy and delivery and infant-feeding options for HIV-positive and uninfected mothers.

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**T**he rapid expansion of the AIDS epidemic in resource-constrained settings, greater understanding of the magnitude of breastmilk transmission of HIV and increasing child mortality have forced the problem of mother-to-child transmission (MTCT) of HIV\* to the top of the international health policy agenda. MTCT can take place during pregnancy or delivery and in the postnatal period

## **I N T R O D U C T I O N**

through breastfeeding.<sup>1</sup>

Although fewer than half the babies born to HIV-infected women acquire HIV, increasing HIV prevalence among pregnant women has resulted in a very rapid increase in the number of HIV-infected children. The Joint United Nations Programme on HIV/AIDS (UNAIDS) estimates that about 600,000 children under age 15 were newly infected with HIV in the year 2000. Ninety percent of them acquired infection from their mothers – and 90 percent of these infected children live in sub-Saharan Africa.<sup>2</sup>

Breastfeeding can offer many benefits to both mother and infant. Exclusive breastfeeding (no other fluids and foods) provides infants with adequate nutrition for the first six months of life. Giving babies any other food during this early stage displaces breastmilk without increasing calorie intake and exposes the infants to pathogens that may cause diarrhea and other illnesses. Breastmilk has many protective anti-infective agents including macrophages, different types of lymphocytes, immunoglobulins, lipids and a variety of soluble factors such as lactoferrin.<sup>3-5</sup> Breastfed babies have fewer and less severe episodes of diarrhea, pneumonia or other infections. In the developing world, where the leading causes of infant morbidity and mortality are infectious diseases, breastfeeding provides significant

protection to the young infant.<sup>6-10</sup> Breastfeeding also helps babies and their mothers develop a close and loving relationship, enhancing mental and emotional development.<sup>4</sup>

Breastfeeding is also beneficial to the mother. In the immediate post-delivery period, the hormone oxytocin, which is produced as a result of stimulation of the nipples during suckling, facilitates uterine contraction and thus protects the mother from excessive blood loss. Exclusive breastfeeding delays the return of normal menstruation after delivery, which conserves iron and contributes to child spacing—thus reducing reproductive stress, maternal depletion and maternal mortality.

This chapter focuses on breastfeeding practices and alternatives, and examines some of the socioeconomic factors that may determine whether mothers choose to breastfeed. A seven-step program to prevent breastmilk transmission of HIV is provided.

*\* In this chapter « HIV » is used to mean HIV-1.*

## **MAGNITUDE OF BREASTMILK TRANSMISSION OF HIV**

### **BREASTMILK TRANSMISSION OF HIV IN NEWLY INFECTED WOMEN**

Breastmilk transmission of HIV has been documented among infants of newly infected women,<sup>11-15</sup> who carry very high viral loads before they develop HIV-specific immune responses. These women have an especially high risk of HIV transmission through breastfeeding: A meta-analysis based on four published studies estimated this risk to be 29 percent (95 percent confidence interval [CI]: 16 to 42 percent).<sup>16</sup>

### **BREASTMILK TRANSMISSION OF HIV AMONG WOMEN WITH ESTABLISHED INFECTION**

Women with established HIV infections also transmit HIV through breastfeeding.<sup>17-19</sup> The best available estimate of the risk of breastmilk transmission is based on an analysis of the results of six studies. This meta-analysis estimated the additional risk of breastmilk transmission of HIV to be 14 percent (95 percent CI: 7 to 22 percent).<sup>18</sup> That is, one out of seven children breastfed by an HIV-infected mother will become infected through breastfeeding. In a more recent study from Kenya,<sup>20</sup> the transmission rate among infants randomly assigned to be breastfed was 37 percent versus 21 percent among infants assigned to be formula-fed, a risk difference of 16 percent. The investigators considered that this difference underestimated the risk, because 30 percent of infants in the formula-fed group actually received some breastmilk and may therefore have been infected through breastfeeding. Although the estimates remain imprecise, experts conclude that one-quarter to one-half of all MTCT among breastfed infants may be attributed to breastfeeding.<sup>21</sup>

A common problem in interpreting these data has been a lack of precise definition of the breastfeeding pattern. Experts have long suggested that truly exclusive breastfeeding (no other fluids or foods) may be safer than the usual pattern of non-exclusive breastfeeding or “mixed feeding.” They speculate that the addition of other foods and fluids to the breastmilk diet increases the risk of gut infections or physical trauma, thus increasing vulnerability to transmission. Previous studies that compared transmission among

“mixed fed” and “exclusively breastfed” babies used different definitions of these terms, and did not produce statistically significant results.<sup>18,22</sup> In Brazil, transmission was higher among breastfed infants whose mothers reported early mixed feeding, but this trend was not statistically significant.<sup>23</sup> But in a more recent South African study,<sup>24</sup> infants exclusively breastfed for at least three months had significantly lower rates of infection at age three months (19.4 percent) than breastfed infants who had also received other foods or fluids (26.1 percent). In fact, the transmission risk among exclusively breastfed infants was not statistically different from that among formula-fed infants (19.4 percent). These results offer hope that promotion of exclusive breastfeeding among mothers who choose to breastfeed may be a feasible and effective option for reducing the risk of MTCT.

### **TIMING OF BREASTMILK TRANSMISSION OF HIV**

Infants of HIV-infected women are at risk of breastmilk transmission as long as they are breastfed. Some studies have used time to the first positive polymerase chain reaction (PCR) to determine when, during the postnatal period, breastmilk transmission of HIV takes place. But it is not possible to differentiate transmission during late pregnancy, delivery and the early postnatal period. These studies therefore only reported rates of late postnatal transmission, defined in different ways by each study.

Late postnatal transmission of HIV refers to babies who initially are found to be uninfected, but who become infected following exposure to breastmilk. There is considerable variation in the published literature in the rate of late postnatal transmission. This is not surprising, as different periods of observation, definitions and laboratory methods were used to ascertain infection status. In a pooled analysis of data from 2,807 children from four cohorts in industrialized and

non-industrialized countries, the overall rate of late postnatal transmission (first positive PCR after 2.5 months) was estimated to be five percent, with an estimated risk of 3.2 infections per 100 child-years of breastfeeding follow-up (95 percent CI: 3.1 to 3.8 percent).<sup>25</sup> Malawi reported transmission rates of 0.7 percent per person-month during age one month to five months, 0.6 percent from age six months to 11 months, 0.3 percent from age 12 months to 17 months and 0.2 percent from age 18 months to 23 months.<sup>26</sup> These rates suggest declining risk with age. But such age-related variations in transmission are difficult to ascribe solely to the age of the infant, as feeding practices typically also change over this period. Beginning very early in infancy, other liquids and foods are introduced in ever-increasing amounts, which may reduce the amount of breastmilk consumed, thus reducing exposure, or may contribute to disruption of the integrity of the gut, thus increasing vulnerability to infection. As these studies did not measure such feeding mode effects, it is difficult to distinguish the real cause of any observed age-related variation in transmission rates. In Kenya, although risk of transmission of HIV per day of breastfeeding was about twice as great in the first four months as later in infancy (0.00042/d before versus 0.00026/d after four months), the risk of HIV transmission per liter of breast milk consumed did not vary with age. Rather, as children grew, they consumed less breastmilk and therefore the risk of breastfeeding transmission was reduced.<sup>27</sup>

### **CORRELATES OF BREASTMILK TRANSMISSION OF HIV**

There are limited data on the correlates of breastmilk transmission of HIV. A number of factors are thought to be involved, and the relationships are complex. Cell-associated and cell-free HIV virus is found in as much as 70 percent of breastmilk samples from infected women.<sup>28-30</sup> One study that compared the

prevalence and concentration of HIV in mature milk and colostrum found more virus in mature milk.<sup>29</sup> But the presence of HIV in breastmilk does not automatically result in breastmilk transmission; there is a complex interaction with anti-infective factors in breastmilk.<sup>31-34</sup> One study in Rwanda suggested that the presence of HIV-specific immunoglobulin M (IgM), an antibody found in breastmilk, may protect against infection.<sup>28</sup> Cracked nipples and mastitis are also risk factors for breastmilk transmission of HIV.<sup>35,36</sup> A baby's age and immune status are also important in this relationship, and there are ongoing studies to determine how prematurity, age at weaning and infant immune responses modify the risk.

### **WEIGHING RISKS AND BENEFITS OF PREVENTION OF BREASTMILK TRANSMISSION OF HIV**

Replacement feeding prevents breastmilk transmission of HIV. But in resource-constrained settings the infant-feeding decision must include consideration of the risk of HIV transmission if the mother does breastfeed and the risk of death due to artificial feeding if she does not. A number of published studies use simulation models to weigh these risks,<sup>37-43</sup> the features and results of which have been reviewed recently.<sup>44</sup> The models all reach the same conclusion: Where there is a high level of infectious disease mortality in childhood, breastfeeding is safer for infants of HIV-positive mothers than artificial feeding, despite the risk of transmission through breastfeeding. Where the baseline infant mortality is less than about 80 per 1,000 live births and the risk of death due to artificial feeding is less than 2.5 times the risk of death of exclusively breastfed infants, infants of HIV-positive mothers are generally safer when fed artificially. When the mother's status is not known and she is living under conditions of poverty and poor hygiene, breastfeeding is virtually always favored.

These analyses generally compare risks during an entire infancy. But the decision to initiate breastfeeding may be made on the basis of a risk assessment covering just the first few weeks or months. The additional risk of death due to artificial feeding is reduced as the infant ages, whereas the risk of transmission is

assumed to be relatively constant as long as the infant is breastfed. This situation is illustrated in Figure 1. As the infant matures and the risk of death due to artificial feeding is reduced, the balance of risks may shift to favor an alternative diet. The optimal time to stop breastfeeding would vary with the situation, depending on the shape and location of the replacement diet risk curve, which are unknown.

It is tempting to conclude from the risk analysis that mothers in resource-constrained settings should be advised to breastfeed despite the risk of transmission. This was the basis of earlier infant feeding guidelines.<sup>45</sup> The rapid expansion of the epidemic in resource-constrained settings, greater understanding of the magnitude of breastmilk transmission and increasing child mortality have challenged the old policy that provides prescriptive advice based on access to resources. In 1997, a new policy on infant feeding was formulated that promotes and supports breastfeeding for infants of women without HIV infection or of unknown status, and the right of a woman infected with HIV who is informed of her serostatus to choose an infant-feeding strategy based on full information about the risks and benefits of each alternative.<sup>46</sup> This principle of informed choice presents practical difficulties for health workers, who must tailor the information they provide to mothers based on the risks and benefits of each available infant-feeding option. In most cases this information is specific to the community and the household. It therefore requires some assessment of the mother's particular situation (hygiene and sanitation in the home, reliability of supply of ingredients for breast-

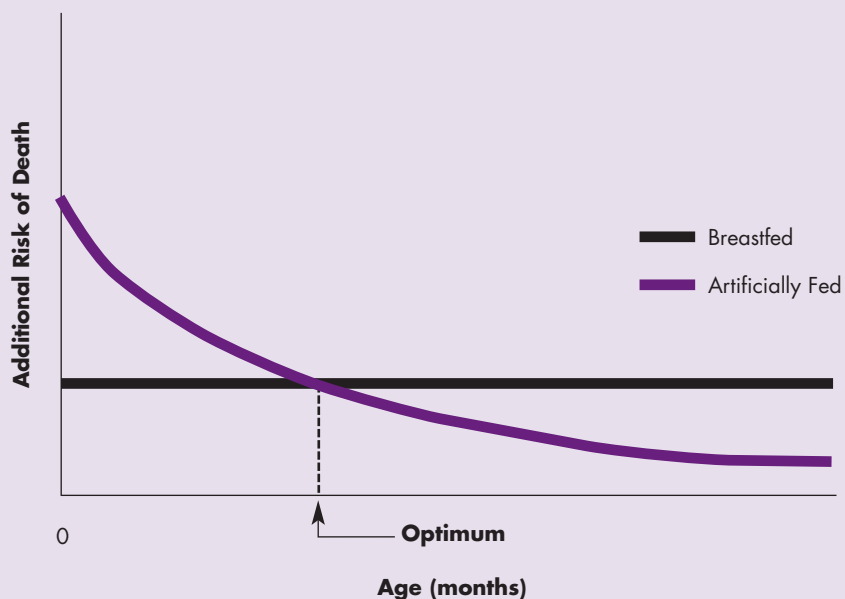
milk substitutes, reliability of income, etc.).<sup>47</sup> A rapid method for assessing infant feeding options at the community level is described in the case study from Zambia.

In addition to the health risks to the infant, there are other dangers that the mother must consider. Preliminary evidence from Kenya suggests that breastfeeding may jeopardize the infected mother's own health.<sup>48</sup> Not breastfeeding can result in social stigmatization, economic hardship and early return of fertility. Women should be aware of all known risks in order to make an informed decision.

Figure 1

### SCHEMATIC ILLUSTRATION OF THE CHANGING BALANCE OF ADDITIONAL RISK OF DEATH DUE TO ARTIFICIAL FEEDING VS. THE RISK OF MTCT OF HIV THROUGH BREASTFEEDING

The age at which the risk of death due to artificial feeding falls below the risk of transmission would be the optimal age to stop breastfeeding.



## PREVENTION OF BREASTMILK TRANSMISSION OF HIV

The most effective way of preventing breastmilk transmission of HIV while ensuring that babies enjoy the benefits of breastfeeding is to protect women of child-bearing age from HIV infection. HIV-infected women should be assisted with counseling and friendly and accessible family planning services to limit fertility. Interventions to prevent breastmilk transmission of HIV through breastfeeding should be available to infected mothers. These interventions include strategies to replace or shorten the duration of breastfeeding and, at the same time, reduce the infant's vulnerability to infection.

Prevention of breastmilk transmission of HIV can be achieved through the implementation of a seven-step program. The first four steps are general interventions that can be implemented in all health facilities and will improve the well-being of all women and their children. The last three steps are specific interventions for the HIV-infected woman.

### STEP 1: ENSURE GOOD NUTRITION DURING PREGNANCY AND THE POSTNATAL PERIOD

Vitamin A deficiency and anemia are common in HIV-infected women. Both these deficiencies are associated with MTCT.<sup>40, 50</sup> Iron deficiency is also associated with low birth weight and prematurity, both of which are risk factors for infant HIV infection.<sup>51-54</sup> Vitamin A deficiency in immunosuppressed women is associated with a significant increase in breastmilk HIV<sup>29</sup> and with increased mortality in HIV-infected adults.<sup>55, 56</sup> This may be because serum Vitamin A levels are reduced as HIV progresses. Vitamin A supplementation resulted in a 63 percent reduction in mortality among HIV-infected children over 24 months of follow-up.<sup>57</sup> It has not, however, resulted in reduced MTCT.<sup>58</sup>

Use of multiple micronutrient supplements in pregnancy reduces prematurity and low birth-weight and ensures adequate stores of iron in babies. In one randomized clinical trial in Malawi, giving multiple micronutrients (but not vitamin A alone) to HIV-infected pregnant women resulted in a 44 percent reduction in low birth-weight, a 39 percent reduction in prematurity and improved maternal hemoglobin and CD4 counts after delivery.<sup>59</sup> The role of micronutrient supplementation in prevention of MTCT has not yet been fully evaluated. Maternal iron status and hemoglobin concentration may also be improved through prevention and control of malaria during pregnancy.

### *Practice points*

- Women should be counseled to consume a nutritious diet throughout pregnancy and lactation. The advice should be based on locally available foods.
- All pregnant women's diets should be supplemented with iron, folic acid, zinc and other micronutrients. Protocols for supplementation should follow national policy and availability.
- Malaria should be prevented through chemoprophylaxis and other avoidance and control measures.
- Women should be given high-dose vitamin A following delivery.

### STEP 2: INSTRUCT ON GOOD BREASTFEEDING TECHNIQUE

Cracked nipples, mastitis and breast abscess significantly increase the risk of breastmilk transmission of HIV.<sup>35, 36</sup> Cracked nipples can be caused by poor suckling technique, particularly latching onto the nipple rather than the areola. Candida infection and use of abrasive creams and soaps on the breasts may also cause cracked nipples. It is very painful to suckle an infant on cracked nipples, which puts a woman at risk of breast engorgement because of inadequate emptying of the breasts from infrequent feeding or avoidance of feeding. If poorly treated, breast engorgement may progress to mastitis.<sup>9</sup>

### *Practice points*

- Instruct all women in good breastfeeding technique.
- Mothers in high HIV prevalence areas who do not know their HIV status should avoid breastfeeding from breasts with cracked nipples, mastitis or an abscess.
- If both breasts are affected, the woman should be encouraged to express breastmilk and pasteurize or boil it.
- If one breast is affected, express and discard breastmilk from the affected breast to avoid engorgement while continuing to feed from the unaffected breast.
- Treat the underlying condition appropriately.

### **STEP 3: REDUCE AN INFANT'S VULNERABILITY TO INFECTION**

The infant risk factors for HIV transmission are less well-evaluated. But it is generally accepted that the following factors affect an infant's vulnerability to breastmilk transmission of HIV:

- Integrity of the infant gut epithelium: This can be compromised by vigorous suction at birth, poor nutritional status or oral lesions caused by candida infection.
- Duration of breastfeeding: Longer exposure is associated with a higher risk of infection.
- Colostrum versus mature milk: HIV is found in both the cell-free and cellular components of breastmilk. There is no evidence that colostrum is more infectious than mature milk.
- Mixed feeding versus exclusive breastfeeding: The lower rate of infection among infants exclusively breastfed for at least three months compared with infants who also received other liquids or food by this time suggests that exclusive breastfeeding is protective.<sup>24</sup>

### *Practice points (for mothers who are HIV-negative or of unknown status)*

- Exclusively breastfeed infants for the first six months, then gradually introduce and increase the quantity of nutritious complementary foods while maintaining frequent breastfeeding.
- Do not deny infants colostrum.
- Avoid mixed feeding in the first six months because it puts an infant at risk of enteric infections, which could increase vulnerability to HIV infection when exposed to breastmilk from an infected mother.
- Treat both mother and infant for candida infection as soon as it appears in either of them.

### **STEP 4: VOLUNTARY COUNSELING AND TESTING (VCT)**

All pregnant women should be counseled about HIV/AIDS, MTCT and the benefits of knowing one's HIV status, after which confidential and voluntary testing should be available.

### *Practice points*

- Counsel all women about HIV/AIDS and MTCT.
- Promote and provide voluntary and confidential HIV testing.

### **STEP 5A: RISK REDUCTION COUNSELING FOR HIV-NEGATIVE WOMEN**

HIV negative women should be counseled on risk reduction. A number of studies have documented a high incidence of HIV seroconversion in the year after delivery.<sup>60, 61</sup> Seroconversion during pregnancy and the postnatal period is associated with a high risk of MTCT.

- HIV-negative women should be counseled on ways to reduce their risks of infection, especially during pregnancy and lactation.
- HIV-negative women and women of unknown HIV status should be counseled to exclusively breastfeed their infants for the first six months (see Step 3).

## STEP 5B: COUNSELING HIV-POSITIVE WOMEN

- Counsel and support women to accept their HIV status.
- Review different modes of HIV transmission (sexual, blood-borne and MTCT) and how to prevent them.
- Review the risks of MTCT with the woman, particularly transmission through breastfeeding.
- Counsel women on ART options for their own health and to prevent MTCT (see Step 6).
- Counsel HIV-infected women on options for preventing breastmilk transmission of HIV and associated costs and risks (see Step 7).

## STEP 6: ANTIRETROVIRAL THERAPY (ART) TO REDUCE MTCT

A number of ART regimens of varying cost, complexity and efficacy have been shown to reduce the risk of MTCT for non-breastfed infants. To date, five clinical trials have tested ART regimens in breastfed infants. Since these regimens provide ART only during the perinatal period, it is not surprising that, with continued breastfeeding, efficacy is reduced over time. Still, for the four trials that have reported long-term (12-month to 24-month) efficacy, ART reduced MTCT by 21 percent to 35 percent.<sup>62</sup>

Despite efforts to reduce costs and simplify ART regimens, most remain unaffordable to public health services in poor countries. An exception is nevirapine (NVP).<sup>63</sup> A single dose given to the mother during labor and to the infant during the first 72 hours after delivery costs only US\$4 per treatment and reduces MTCT among breastfed infants by 35 percent by 12 months; results are comparable to an equivalent treatment with zidovudine (ZDV).<sup>64</sup> In comparison with a

placebo and with longer-term postpartum treatment, NVP would likely be even more effective. Although concerns about the development of drug resistance to NVP have so far limited its use to research and pilot studies,<sup>62</sup> it was recently recommended for wider use.<sup>65</sup>

### *Practice point*

- Women infected with HIV should be supported to make an informed choice about ART.

## STEP 7: INFANT-FEEDING OPTIONS FOR HIV-POSITIVE WOMEN\*

Withholding breastmilk is the most effective method of preventing breastmilk transmission of HIV. Alternatives include breastmilk substitutes or modifications of breastfeeding. For the mother who chooses to breastfeed, there are strategies that can be used to make breastfeeding safer.

- Breastmilk substitutes. These include commercial infant formula, home-prepared formulas based on animal milks or whole animal milk.
- Modifications of breastfeeding. These include heat-treated breastmilk and wet nursing.
- Safer breastfeeding. Strategies for making breastfeeding safer include breastfeeding exclusively, providing nutritional support to the mother, using good breastfeeding technique, treating breast problems and stopping breastfeeding early.

### *Practice points*

#### **Breastmilk substitutes**

Commercial infant formula should be considered an option by HIV-positive women when:

- The family has reliable access to sufficient formula for at least six months. (Feeding an infant for six months requires an average of 20kg powdered formula [44 450g tins]).
- The family has the additional resources—water, fuel, skills and time—to prepare and feed the formula hygienically and according to instructions.
- Home-prepared formula is a reasonable option by an HIV-positive woman when:
- Commercial infant formula is not readily available or is too expensive for the family.

\*This section was adapted from UNICEF/UNAIDS/WHO48

- Supplies of animal milk or other milks are reliable and the family can afford it—about half a liter per day—for at least six months.
- The family has the additional resources to make the necessary modifications and feed the formula safely.

Unmodified cow's milk could be considered as an option for an HIV-positive woman when:

- Commercial infant formula is not available or is too expensive.
- There is a reliable supply of cow's milk, but the family lacks the resources to modify cow's milk to make home-prepared formula.

All of these alternatives carry additional risks of infection and malnutrition and therefore require early case management of illness and careful growth monitoring.

## MODIFICATIONS OF BREASTFEEDING

The mother's own breastmilk can be expressed, boiled, cooled and fed by cup. This takes advantage of the nutritional superiority of breastmilk, while the heat kills any virus that may infect the infant. The process requires time, resources and support however, so it may not be a practical long-term option. Mothers with breast problems that increase the probability of infection can use heat treatment in the short-term while receiving treatment.

Wet-nursing is also an option if an uninfected woman is willing and able to provide this service for as long as needed. The wet nurse should be counseled as per Steps 1 to 3 above.

## SAFER BREASTFEEDING

Counseling on safe breastfeeding should be provided for the HIV-positive woman who chooses to breastfeed. The mother should breastfeed exclusively, consume adequate amounts of a nutritious diet (including supplements if available), use good breastfeeding technique to prevent breast problems, seek

treatment for breast problems and candida if they occur and practice safe sex (see Steps 1, 2, 3 and 5a). She should also be counseled on how and when to safely introduce an alternative diet.

Shortened duration of breastfeeding reduces an infant's exposure to the virus. In addition, the risks of artificial feeding are reduced as the infant gets older. At some point, there will be less risk of death due to artificial feeding than risk of HIV infection through breastfeeding (Figure 1). In terms of HIV-free survival, this is the best time to switch to artificial feeding. The exact timing cannot be known for certain, but will depend on the situation and the mother's ability to provide an alternative diet that is both affordable and safe.

## MICRONUTRIENT SUPPLEMENTATION

Animal milks are deficient in essential micronutrients. Commercially prepared infant formula is fortified with these micronutrients, but babies fed home formulas and whole animal milks need micronutrient supplements. If micronutrient supplements are not available, complementary foods rich in iron, zinc, vitamin A and folic acid should be introduced by age four months.

## AVOIDING DEHYDRATION

Non-breastfed infants are at increased risk of diarrheal disease and severe dehydration. Mothers and health workers may need to provide extra water (that has been boiled and cooled) during diarrheal episodes. Risk of dehydration is particularly high if the infant under age six months receives unmodified cow's milk, due to its higher concentration of solutes.

## UNSUITABLE REPLACEMENT FEEDS

Some types of milks and foods are not recommended as replacement feeds for infants under age six months, and may cause harm. These include skimmed milk, sweetened condensed milk, fruit juices, sugar-water, dilute cereal gruel and milk products such as yoghurt and other acid milks.

## COMPLEMENTARY FEEDING AND WEANING

By age six months, babies need additional food to meet their nutritional requirements. During weaning, milk continues to be an important component of the diet, providing one-half or more of the infant's nutritional requirements between ages 6 months and 12 months, and up to one-third between ages 12 months and 24 months. An infant who is not breastfed needs replacement feeding that provides all required nutrients including fats, carbohydrates, proteins, vitamins and minerals. Health workers should familiarize themselves with locally available foods and their nutritional value in order to provide appropriate nutritional counseling.

## FAMILY PLANNING SERVICES

Fertility returns earlier among women who are not breastfeeding, because they do not have the benefit of lactational amenorrhea. Women who opt for replacement feeding need counseling and provision of appropriate contraceptive methods within four to six weeks of delivery.

## ETHICAL CONSIDERATIONS

Replacement feeding in a population that traditionally breastfeeds is difficult and potentially stigmatizing. These difficulties should be discussed with the client when the replacement feeding option is considered. HIV-infected women and their partners should make the informed choice on infant feeding.

There are concerns that MTCT prevention does not address the health needs of the HIV-infected woman herself. ART has been shown to improve the health and longevity of HIV-infected individuals, but is not readily available in resource-constrained settings.

But affordable non-ART interventions have also been shown to be beneficial. These include isoniazid and cotrimoxazole prophylaxis, good nutrition, prompt and effective treatment of opportunistic infections and ongoing counseling and support. In most of sub-Saharan Africa, care of HIV-infected individuals has been reactive; managed pro-active treatment has not yet developed. Antenatal VCT provides a new opportunity for introducing managed care to improve the well-being and survival of HIV-infected adults. Improved survival of mothers and fathers postpones the time when children become orphans.

## SPILLOVER

The effect of information about the risk of HIV transmission through breastfeeding on the infant-feeding practices of mothers who are HIV-negative or who do not know their status (but who suspect that they are infected) is termed “spillover.” Mothers wanting to protect their infants from HIV transmission may use breastmilk substitutes inappropriately, endangering the health and survival of infants not at risk of HIV infection. Spillover may be minimized by ensuring that:

- Information for mothers on this subject—from all sources—is complete, accurate and unbiased.
- There is easy and affordable access to VCT (to minimize the number of mothers who do not know their status).
- Breastfeeding is actively promoted and protected among the general population through efforts such as the Baby-Friendly Hospital Initiative and strict enforcement of the International Code of Marketing of Breastmilk Substitutes.

## PREPARING THE HEALTH CARE SYSTEM FOR PREVENTION STRATEGIES

Health care systems must be prepared before implementing a program to prevent HIV transmission through breastfeeding. Health workers require knowledge and skills to provide the new services effectively. They should be skilled in HIV counseling and testing, MTCT prevention, lactation management and promotion of good breastfeeding techniques, standard midwifery procedures, management of ART interventions, replacement feeding, nutrition counseling and family planning for HIV-infected couples. The health care system should also be strengthened to provide a continuum of care to manage the mother-infant pair. This should include development of appropriate follow-up health care to reduce risks associated with replacement feeding and establishment of a support network in the family and community.

Interventions to prevent postnatal transmission of HIV should be monitored to document their impact on infant morbidity and mortality of exposed children. Breastfeeding trends among HIV-negative women and those of unknown status should also be monitored.

## COST-EFFECTIVENESS OF STRATEGIES TO PREVENT BREASTMILK TRANSMISSION OF HIV IN RESOURCE-CONSTRAINED SETTINGS

Apart from the safety of artificial feeding, the high cost of infant-feeding options other than breastfeeding is a major deterrent in resource-constrained communities. For households unable to afford continued supplies of ingredients for replacement feeding, provision of free or subsidized supplies has been suggested. This is one component of a series of pilot projects sponsored by international agencies.<sup>66</sup> Although some middle-income countries with relatively low HIV prevalence—such as Thailand (see case study) and Brazil—have provided free formula to HIV-positive mothers, the high cost of such a strategy has raised questions about cost-effectiveness and affordability, especially in

low-income countries with higher HIV prevalence. In many countries where HIV prevalence is high, per capita health expenditure is less than US\$10 per year, and frequent shortages of even the most basic medical supplies are reported. The cost of any intervention to reduce MTCT after delivery may need to be justified on the basis of cost-effectiveness.

An important part of the decision making depends on how “effectiveness” is measured. If cases of infections averted are used, this ignores the risks to infant health and survival of not breastfeeding. Some broader measure of net health benefit—such as lives, DALYs or QALYs\*\* saved—is therefore preferred. If the risk of death due to artificial feeding is actually greater than the risk of transmission—as may be true in many situations (see “Weighing the Risks and Benefits of Prevention of Breastmilk Transmission of HIV” above)—then any discussion of cost-effectiveness is meaningless. Assuming that an alternative infant-feeding strategy would increase HIV-free survival, cost-effectiveness studies that provide information on the cost per life saved or per DALY gained allow these strategies to be compared with competing child survival investments.

Many studies of the cost-effectiveness of efforts to prevent MTCT using ART have been published,<sup>66-73</sup> but only one examined infant-feeding alternatives.<sup>73</sup> No studies in a recent review of published and unpublished MTCT cost-effectiveness studies examine the cost-effectiveness of alternatives to breastfeeding.<sup>74</sup> The only published study of the cost-effectiveness of alternative infant-feeding strategies to prevent MTCT<sup>73</sup> estimates that in South Africa, screening and providing formula to HIV-positive mothers would cost US\$331 per year of life saved, even after accounting for the savings to the health care system in reduced costs of caring for HIV-infected infants. Screening and recommending (but not providing) formula would cost US\$200 per year of life saved. The cost-effectiveness of adding formula to an existing antiretroviral strategy would be an estimated US\$910 per year of life saved.

\*\* The DALY (disability-adjusted life year) and QALY (quality-adjusted life year) have become the “common currency” of cost-effectiveness studies because, unlike specific outcomes such as HIV transmissions averted, they allow a broad range of health interventions to be compared. The DALY and QALY use criteria related to the severity of a condition or disability to quantify the burden of disease for non-fatal as well as fatal conditions. They also allow an adjustment for the duration of life affected.

These costs do not compare favorably with other important child health interventions, most of which cost less than US\$100 per DALY saved.<sup>75</sup>

Although replacement feeding may not pay for itself in health care savings and may not compare favorably with other child survival strategies in cost-effectiveness analysis, there is a strong moral and ethical obligation to use all known strategies to prevent MTCT through breastfeeding. In particular, it is important to provide HIV-positive mothers with information on the risks associated with different infant-feeding strategies and to support these women in whatever infant-feeding strategy they choose. The issue for the mother is less one of cost-effectiveness than of affordability. Although hygienically prepared infant formula may be the preferred replacement feeding option for mothers who choose not to breastfeed, cost considerations may favor less expensive alternatives. The challenge is to find affordable alternatives that are safer than breastfeeding.

## POLICY CONSIDERATIONS

The International Code of Marketing of Breastmilk Substitutes and subsequent related World Health Assembly resolutions place restrictions on the ways in which the formula industry can market breastmilk substitutes such as infant formula. Although the code has been instrumental in reducing the impact of commercial marketing on breastfeeding, violations continue.<sup>76,77</sup> In one study, 10 percent of all mothers interviewed and a quarter of all facilities visited had received free samples of milk, bottles or teats—none of them for research purposes.<sup>78</sup> These violations are not isolated occurrences, but reflect what appears to be a systematic strategy involving multiple violations. In the context of HIV/AIDS—where there is a clear medical need for breastmilk substitutes—the code is even more relevant. It presents no obstacle to the use of breastmilk substitutes by HIV-positive mothers, but protects all mothers from promotional activities and misinformation, ensuring that the information they receive on the risks and benefits of different infant-feeding methods is accurate and unbiased.

## LESSONS LEARNED AND FUTURE DIRECTIONS

Experience is accumulating on interventions to prevent MTCT in resource-constrained settings. The case studies included here provide two examples; there are many other pilot projects being sponsored by UN agencies.<sup>79</sup> Early data from these and other initiatives suggest that even if free formula is supplied, acceptance is still relatively poor. In the first half-year of operation in Côte d'Ivoire, for example, only half the HIV-positive mothers offered free formula accepted it.<sup>80</sup> In a similar trial project in a peri-urban district in South Africa, although nine out of 10 mothers accepted the offer of free formula, only 64 percent of the calculated requirements of these infants was actually distributed.<sup>81</sup> The reasons for these shortfalls are not well understood and are being investigated. As these and other efforts to provide alternatives to breastfeeding are implemented, the impact on infant-feeding practices must be carefully monitored—not only the practices of HIV-positive mothers, but also those of mothers who are HIV-negative or who do not know their status. Careful monitoring of these programs also provides an opportunity to answer a number of important programmatic questions including:

- How can health care workers best provide the information that HIV-positive mothers need to make infant-feeding decisions, and best support these women in carrying out their decisions?
- How can such infant-feeding counseling and services be provided while minimizing the potential negative impacts (stigmatization of mothers who choose not to breastfeed, shorter birth intervals, illness and mortality due to artificial feeding, spillover, high cost of breastmilk substitutes)?

Other important research questions requiring urgent answers include:

- What is the risk of HIV transmission through breastfeeding under different conditions?
- What factors modify this risk (exclusive versus mixed feeding, maternal nutritional status, ART, infant age, etc.)?
- What is the risk of death due to artificial feeding under the same conditions?

## CONCLUSION

The risk of MTCT through breastfeeding presents a huge challenge for HIV-infected women who must decide how to feed their infants, for health care workers who counsel them and for decision makers who must provide appropriate policy guidelines and resources. The guidance provided here is intended to help direct these efforts, but it is hampered by uncertainty. As the many research and pilot studies planned or already underway provide better understanding and more effective solutions, policy and practice must keep pace with these developments.

## CASE STUDIES

### THAI PROGRAM TO AVOID BREASTFEEDING BY HIV-INFECTED WOMEN

Thailand (population 60 million) since 1988 has experienced a rapidly developing HIV epidemic. In 1996, national HIV seroprevalence was 2 percent among the one million women giving birth annually; it is 1.8 percent as of the this book's publication. Since the early 1990s, the Thai Ministry of Public Health (MOPH) has recommended that HIV-infected women avoid breastfeeding. Before the recent introduction of short-course ZDV, this was the main intervention offered to reduce transmission risk. As part of routine antenatal HIV counseling, pregnant women learn about the risk of postpartum HIV transmission through breastfeeding. Although breastfeeding in general is actively promoted through the Baby-Friendly Hospitals Initiative, women who test HIV-positive are counseled during pregnancy (if identified during antenatal care) or immediately postpartum (a relatively small number identified at delivery) to avoid breastfeeding. During the typical two- to three-day postpartum stay, nurses instruct HIV-infected women how to prepare and use formula.

The Department of Health (DOH, MOPH) is responsible for distributing free infant formula to women who cannot afford to purchase it themselves. The DOH budget has been increased to support regional health promotion offices—which procure formula at a discount of approximately 20 percent through annual negotiations with international

manufacturers, within the guidelines of the Code of Marketing of Breastmilk Substitutes. Although UNICEF generally recommends cup feeding, bottle feeding is preferred in Thailand. A one-year supply of formula costs approximately US\$200 to \$250 (about four to five times the cost of short-course ZDV). The DOH program originally anticipated providing two years of formula for the poorest 10 percent to 20 percent of HIV-infected women. In 1998, target duration was changed to one year in order to provide a higher level of coverage. In fact, an estimated 70 percent of HIV-infected delivering women in many regions of the country receive free formula, although coverage may only be partial after six months and is commonly given for 12 to 18 months.

Despite the recent economic crisis, the program has been able to expand, but the need for support has also increased. Jurisdictions and hospitals not covered by the DOH (such as Bangkok regional, university, military and private hospitals) rely on their own funding and donations to provide formula. Most hospitals distribute tins as originally packaged by the manufacturer. UNICEF recently completed a detailed review of formula feeding among HIV-infected mothers in Thailand.<sup>82</sup> While raising concerns about gaps in coverage and the potential for inappropriate and inconsistent supply and feeding practices, the report concluded that the program was generally well-conceived and well-accepted.

Although the impact of formula feeding among HIV-infected women has not been formally evaluated, the work at two large Bangkok hospitals over the past seven years suggests extremely high acceptance (nearly 100 percent), no indications of increased infant morbidity or mortality, no adverse impact on baby-friendly practices and few problems with stigmatization. Because bottle feeding, early mixed feeding and early weaning are relatively common in Bangkok, bottle feeding does not necessarily indicate HIV infection. Women who do not want to tell others about their

HIV status commonly say they are not breastfeeding because of hepatitis A. But more systematic data from both rural and urban settings are needed to assess coverage, acceptability and possible adverse effects.

Thailand recently implemented several large regional programs of short-course ZDV treatment and avoidance of breastfeeding. This combined strategy can reduce transmission risk by 50 percent to an absolute rate of less than 10 percent. With monitoring, these programs may provide more specific information about the acceptability and risks of HIV-infected women avoiding breastfeeding in a variety of settings.

*This case study was written by N Shaffer, HIV/AIDS Collaboration, Nonthaburi, Thailand and the Centers for Disease Control and Prevention, Atlanta; S Kanshana, Bureau of Health Promotion, Department of Health, Ministry of Public Health (MOPH), Bangkok; W Siriwasin, Rajavithi Hospital, MOPH, Bangkok; C Bhadrakom, Faculty of Medicine Siriraj Hospital, Bangkok; T Chotpitayasunondh, Queen Sirikit Institute of Child Health Hospital, MOPH, Bangkok; S Chearskul, Faculty of Medicine Siriraj Hospital, Bangkok; and RJ Simonds, HIV/AIDS Collaboration, Nonthaburi, Thailand and the Centers for Disease Control and Prevention, Atlanta.*

## **THE NDOLA DEMONSTRATION PROJECT**

The Ndola District Health Management Team (N-DHMT), in collaboration with the National Food and Nutrition Commission and the LINKAGES Project of USAID is implementing a demonstration project to introduce HIV voluntary counseling and testing (VCT) and improved infant-feeding counseling into antenatal care and community services in a low-income area of Ndola, Zambia.<sup>85</sup>

The project aims to reduce MTCT by encouraging pregnant women and their partners to be tested for HIV, providing counseling on HIV prevention, improved care and nutrition during pregnancy and

delivery; and infant-feeding options for HIV-positive and uninfected mothers. Antiretroviral drugs are not being offered, due to concerns about cost and sustainability. Hope Humana, a local NGO already involved in HIV/AIDS testing, counseling and support, is training and providing technical assistance to the N-DHMT on all aspects of the HIV testing, counseling and linking services with the community. The USAID HORIZONS Project is providing technical assistance with operations research.

To ensure that the project meets the needs of the local population, project designers carried out assessments of the health clinics' capacity and antenatal, delivery and postnatal care procedures. Community groups, organizations and services that can support project interventions were also surveyed and assessed. In addition, the designers carried out a rapid, formative research study to identify feasible and appropriate infant-feeding recommendations for HIV-positive women.

The formative research study (carried out over two months at a cost of less than US\$3,000) included focus group discussions, key informant interviews, market surveys, household observations, cooking demonstrations and trials of improved practices. These trials solicited feedback from caregivers, health providers and other community members about different practices recommended by UNAIDS/UNICEF/WHO in their guidelines on HIV and infant feeding. The feasibility and best ways to encourage practices such as cup feeding, boiling water, preparing infant formula or diluted and sweetened cow's milk, expressing breastmilk and enriching local recipes for young children were among the subjects discussed and tested with people in their homes.

Findings from the formative research were used to develop strategies for training health providers and counseling mothers, caregivers and other family members about HIV and infant feeding. Specific messages for counseling HIV-positive women on modified breastfeeding and safe replacement feeding options and counseling uninfected women about appropriate infant-feeding practices have been developed.

This case study was written by Ellen G. Piwoz, Academy for Educational Development, Washington, DC.

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