Annales Nestlé

Ann Nestlé [Engl] 2007;65:29–38
DOI: 10.1159/000099118

HIV and Lactation

Jane Helen Downs[a] Peter A. Cooper[b]

[a]Dietetics Department, King Edward VIII Hospital, Durban, and [b]Department of Pediatrics, Johannesburg Hospital and University of the Witwatersrand, Johannesburg, South Africa

Key Words
Mother-to-child transmission · Breast milk · Infant mortality · Maternal mortality · Antiretroviral therapy

Abstract
It is well established that more than 90% of children with HIV acquired it through mother-to-child transmission (MTCT). It is estimated that 750,000 children worldwide become infected with HIV every year, and most of these are in sub-Saharan Africa. Routes of MTCT include: transplacental during pregnancy, during birth, through breast milk and bleeding nipples. The percent risk of MTCT varies with each of the aforementioned routes. In the absence of specific interventions, the rate of MTCT is approximately 15–20% and, with prolonged breastfeeding (>6 months), the rates double to 35–40%. Although the use of breast milk substitutes (BMS) may appear to be the obvious choice to reduce the risk of MTCT via breast milk and bleeding nipples, this option may prove to be deleterious for infants born to mothers in limited resource settings. In such settings, the high risk of infant mortality is due to severe diarrhea and malnutrition, related to unsafe BMS feeding and suboptimal breastfeeding (that is, failure to exclusively breastfeed for the first 6 months of life). According to a recent WHO report (2006), it is estimated that globally as many as 1.45 million lives (children under 2 years of age) are lost per annum due to suboptimal breastfeeding in developing countries, versus the estimated 242,000 infant deaths related to maternal MTCT. The WHO guidelines for infant feeding in HIV are an important framework of principles that governments, policymakers and health workers need to consider when compiling prevention of MTCT policies and protocols. Both developed and developing countries have communities which do and do not have access to safe water and electricity; hence the policies need to address the needs of different communities. The WHO guidelines advise, 'when replacement feeding is acceptable, feasible, affordable, sustainable and safe, avoidance of all breastfeeding by HIV-infected mothers is acceptable'. Vertically acquired HIV infection has been virtually eliminated in developed countries through the appropriate use of antiretroviral therapy, the use and timing of elective cesarean section, and support for the avoidance of breastfeeding, resulting in a MTCT rate reduction to less than 1–2%.

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Introduction

It is well established that more than 90% of children with HIV acquired it through mother-to-child transmission (MTCT) [1]. It is estimated that 750,000 children worldwide become infected with HIV every year, and most of these are in sub-Saharan Africa. Routes of MTCT include: transplacental during pregnancy, during birth, through breast milk and/or bleeding nipples. The percent risk of MTCT varies with each of these routes. In the absence of specific interventions, the rate of MTCT is approximately 15–20% and, with prolonged breastfeeding (>6 months), the rates double to 35–40% [2].

Although the use of breast milk substitutes (BMS) may appear to be the obvious choice to reduce the risk of MTCT via breast milk and bleeding nipples, this option may prove to be deleterious for infants born to mothers

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0517–8606/07/0651–0029$23.50/0

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J.H. Downs
PO Box 50128, Musgrave
Durban, KwaZulu Natal, 4062 (South Africa)
Tel. +27 31 3603 293, Fax +27 31 2016 442
E-Mail jane.downs@kznhealth.gov.za

in limited resource settings. In such settings, the high risk of infant mortality due to severe diarrhea and malnutrition is often related to unsafe BMS feeding and/or suboptimal breastfeeding (that is, failure to exclusively breastfeed for the first 6 months of life). According to a recent WHO report (2006), it is estimated that globally as many as 1.45 million lives (children under 2 years of age) are lost per annum due to suboptimal breastfeeding in developing countries versus the estimated 242,000 infant deaths related to MTCT [3].

The decision whether to opt for BMS or breastfeeding and the risk of MTCT are further complicated by other influencing factors listed in table 1.

The WHO guidelines for infant feeding in HIV are an important framework of principles that governments, policymakers and health workers need to consider when compiling prevention of MTCT (PMTCT) policies and protocols. Both developed and developing countries have communities which do and do not have access to safe water and electricity; hence the policies need to address the needs of different communities. The WHO guidelines advise 'when replacement feeding is acceptable, feasible, affordable, sustainable and safe, avoidance of all breastfeeding by HIV-infected mothers is acceptable' [3].

Vertically acquired HIV infection has been virtually eliminated in developed countries through the appropriate use of antiretroviral therapy, the use and timing of elective cesarean section, and support for the avoidance of breastfeeding, resulting in a MTCT rate reduction to less than 1–2% [4].

Table 1. Factors influencing the decision for BMS or breastfeeding

- Human rights
- Maternal viral genotype and inter-subtype recombination
- Maternal viral load and CD4 count
- Maternal health and nutritional status during pregnancy and lactation
- Cultural factors
- Maternal death soon after delivery
- Psychological factors
- Government policies
- Inadequate training and availability of counselors to advise mothers both pre- and postnatally
- Failure to provide early highly active antiretroviral therapy to mothers with a CD4 count of <200 by 25 weeks of pregnancy, due to insufficient human resources and equipment to process CD4 count results
- Poor implementation of prevention of MTCT programs

Human Rights

Regardless of a mother's level of education and literacy, she has the right to know the potential benefits and risks associated with both BMS feeding and breastfeeding. In a truly democratic society, the mother should also have the right to choose the route of feeding for her child. Ideally, the father of the infant should be involved in this process [Downs and Cooper, personal observations].

Maternal Viral Genotype and Inter-Subtype Recombination

The viral genotype and inter-subtype recombination may influence the rate, timing or both of MTCT of HIV-1. The latter was investigated, in a study performed in Tanzania, on mothers residing in Dar es Salaam, the majority of whom had recombinant HIV infections (41.0%), followed by the HIV-1 subtype A (26.2%) or the subtype C (13.1%). In a multivariate analysis, which took into account maternal CD4 cell counts, HIV disease stage, and proviral load in breast milk, it was found that the odds of breast milk transmission were 7.2 times higher if the mother carried an inter-subtype recombinant genome in comparison to a subtype C virus ($p = 0.02$). Viruses with recombinant long terminal repeats (LTRs) were 4.9 times more likely to be transmitted through breastfeeding than viruses with non-recombinant LTRs of subtype A, C or D. These results suggest that the inter-subtype recombinant genomes, and especially recombination within the LTR, might render HIV-1 more viable for transmission via breast milk versus non-recombinant subtypes of A,C and D [5].

Maternal Viral Load and CD4 Count

A very important advance in the prevention of MTCT in the last 10 years has been the recognition of the importance of starting highly active retroviral therapy (HAART) in mothers with a CD4 count of <200 by 25 weeks of gestation. This not only results in a significant reduction in viral load, making natural or vaginal birth safer (especially in countries with limited resources in which cesarean section cannot be performed on every HIV-positive pregnant women), but also reduces the viral load in breast

milk, reducing the risk of MTCT in mothers who opt to breastfeed in the first 4–6 months of the infant's life.

Viral load in breast milk varies in the first 14 weeks after delivery. Higher levels of HIV RNA viral load in breast milk have been observed in mothers with subclinical mastitis and severe immune suppression (CD4 count of $<200 \times 10^6$ cells/l) [6].

Interestingly, it has been observed that the cell-free viral load in breast milk at 1, 6 and 14 weeks postpartum varies considerably between the right and left breast of an individual woman at any given time. Breast milk HIV-1 load was undetectable in approximately one third of the samples [7].

The Role of Maternal and Infant Drug Prophylaxis

There appears to be international consensus that HIV-infected pregnant women with a CD4 count of <200 cells/mm (or have WHO clinical stage 3 or 4 disease and a CD4 count of <350 cells/mm), should start on HAART by 25 weeks gestation or even in the first trimester (the benefits outweigh the risks of tetragenicity) [8]. HIV-infected women with a CD4 count of >200 (and have WHO clinical stage 1 and 2 disease) should be provided with a short course of zidovudine (ZVD) + lamivudine (3-TC) rather than any single antiretroviral drug (for example: neviropine [NVP] or ZVD) [9]. It is important to note that there is growing concern regarding the risk of HAART drug resistance in mothers who start HAART within 6 months following a single dose of NVP [8]. Policymakers may thus need to revise their protocols accordingly.

The use of antiretroviral prophylaxis is not without controversy. Recent concerns regarding hemopoiesis, prematurity and mitochondrial abnormalities in infants and children exposed to antiretroviral therapy have resulted in the need to consider the potential risks and benefits of prophylactic antiretroviral therapy [10–12].

There have been some concerns regarding the use of trimethoprim-sulfamethoxazole (TMP-SMZ) for HIV prophylaxis in HIV-positive pregnant women. These concerns include the possible risk of tetragenicity when used in the first trimester, and the potential to induce neonatal hyperbilirubinemia, to displace bilirubin from its albumin-binding sites, or both, when given to mothers near term and during early breastfeeding. Forna et al. [13] performed a systematic review of the evidence regarding the toxicity of TMP-SMZ prophylaxis in pregnant women and breastfeeding women, to assist in guiding practice in limited resource settings. It was found that most of the reviewed studies demonstrated that TMP-SMZ was not associated with hyperbilirubinemia when administered to mothers during pregnancy and when breastfeeding. No cases of kernicterus were reported in neonates after maternal ingestion of sulfonamides. However, there was mixed evidence linking ingestion of TMP-SMZ and other sulfonamides in early pregnancy, with increased risk of oral clefts, neural tube defects, cardiovascular and urinary tract abnormalities. Some studies found that supplementation with folic acid may assist in ameliorating some of these potential risks. In summary, existing data indicate that the risk of serious injury to the neonate from daily maternal use of TMP-SMZ prophylaxis during pregnancy and breastfeeding is small. Given the substantial benefits of TMP-SMZ prophylaxis for HIV-positive women living in limited resource settings, this review indicates that it is safe to abide by the WHO guidelines in recommending daily TMP-SMZ prophylaxis for HIV-positive women.

In a randomized clinical trial carried out in Botswana, known as the 'Mashi' study, the efficacy and safety of breastfeeding plus infant ZVD prophylaxis for 6 months versus formula feeding plus infant ZVD for 1 month to reduce MTCT were evaluated between March 2001 and October 2003. In this study 1,200 HIV-infected pregnant women were randomized from 4 district hospitals. Infants were evaluated at birth, monthly until age 7 months, at age 9 months, then every third month through age 18 months. All the mothers received ZVD 300 mg orally twice daily from 34 weeks gestation and during labor. Mothers and infants were randomized to receive single-dose NVP or placebo. Infants (n = 1,179) were randomized to 6 months of breastfeeding plus prophylactic infant ZVD or formula feeding plus 1 month of ZVD. At 7 months, the HIV infection rate for formula-fed infants was 5.6 and 9.0% in the breastfed group; however, the cumulative infant mortality was higher in the infant formula-fed group (9.3%) versus 4.9% in the breastfed group. At 18 months, the cumulative mortality and HIV infection rates were not significantly different (13.9% in the formula-fed group and 15.1% in the breastfed group). These results highlight the risks of formula-feeding infants and the difficult feeding choices for mothers in sub-Saharan Africa, and the need to perform further research on alternative strategies. Implementation of HAART in pregnant mothers with a CD4 count of <200 at 25 weeks gestation may have also reduced the risk of HIV transmission and infant mortality [14].

The anti-malarial agent chloroquine has activity against HIV. In Zambia, the effect of two anti-malarial

agents, chloroquine and sulfadoxine-pyrimethamine, on breast milk HIV RNA levels among 30 HIV-infected breastfeeding women was evaluated. After adjusting for CD4 count and plasma viral load, chloroquine was associated with a trend towards lower levels of HIV RNA in breast milk compared with sulfadoxine-pyrimethamine. Further research is required to determine the potential role of chloroquine in the prevention of MTCT through breastfeeding [15].

Infant Vaccines

Although the provision of infant vaccine regimen from birth would not only assist in PMTCT, but also protect adolescents when they become sexually active, such a regimen is still a long way from becoming a reality. Researchers around the world are actively working on developing a safe vaccine for infants [16].

Maternal Nutritional Status during Pregnancy and Lactation

Adequate nutritional status may potentially reduce vertical MTCT by affecting several maternal or fetal and infant risk factors for transmission, including: enhancing systemic immune function in the mother or fetus/infant; reducing the clinical, immunological or viral progression in the mother; reducing viral load or the risk of viral shedding in the lower genital secretions or breast milk; reducing the risk of prematurity and low birth weight; and maintaining the gastrointestinal integrity of her fetus or child. Although a low vitamin A level was shown to be associated with a higher risk of vertical transmission in prospective observational studies, in randomized, controlled trials neither vitamin A nor other vitamins were shown to have a significant effect on vertical transmission during pregnancy or the intrapartum period [17]. An extensive review of the micronutrient intervention trials in pregnant and lactating women to influence the growth, health and HIV status of their offspring can also be found in this issue of *Annales Nestlé* [18].

There are little data available on the effect of lactation on the nutritional status of HIV-infected women. A study was recently published by Papathakis et al. [19] in which body composition changes during lactation in HIV-infected and HIV-uninfected South African women were evaluated. Measurements were performed at 8 and 24 weeks postpartum in 92 HIV-infected lactating women, and 50 HIV-uninfected lactating women. Of the HIV-infected lactating women, 95% had a CD4 count of >200 cells/µl. At 8 weeks after delivery, the heights, weights, body mass index and fat-free mass of the 2 groups of women were not significantly different. However, 24 weeks after delivery, the HIV-infected mothers had a mean weight loss of 1.4 kg versus a 0.4 kg mean weight gain in the HIV-uninfected mothers. The HIV-infected lactating women lost subcutaneous fat weight but maintained fat-free mass.

The impact of breastfeeding on the health of HIV-infected mothers and their children in Malawi (sub-Saharan Africa) was evaluated between April 2000 and March 2003. Mothers were enrolled at the time of their child's birth, and they returned for follow-up assessments when their child was aged 1 week, 6–8 weeks, then 3, 6, 9, 15, 18, 21 and 24 months. A total of 2,000 HIV-infected women were enrolled in the study. During the 2 years of study, 44 (2.2%) of the mothers and 310 (15.5%) of the children died. The median duration of breastfeeding was 18 months, exclusive breastfeeding 2 months, and mixed feeding 12 months. After adjusting for maternal viral load and covariates, breastfeeding patterns were not significantly associated with maternal morbidity or mortality. Breastfeeding was associated with a reduced mortality among infants and children; the adjusted hazard ratio for overall breastfeeding was 0.44, for mixed feeding 0.45 and for exclusive breastfeeding 0.40. The latter protective effects were seen in both HIV-infected and uninfected infants [20].

Duration of Breastfeeding and Mixed Feeding and BMS

Transmission through breastfeeding can occur at any point during lactation, and the cumulative probability of acquisition of infection increases with the duration of breastfeeding [21].

In Nairobi (Kenya), in the only randomized intervention trial published to date, the morbidity and mortality in breastfed and formula-fed infants of HIV-1-infected women were evaluated in four antenatal clinics. Mothers were randomized to either formula feeding (n = 186) or breastfeeding (n = 185), and the infants (n = 371) were followed up at 12 and 24 months. Free formula was not provided to mothers in this study. The number of children who were alive and free of HIV infection at 2 years of age was significantly lower in the breastfed compared to the formula fed group. The cumulative proportion of

HIV infection at 2 years of follow-up was 21% in the formula fed arm, and 37% in the breastfed group (p = 001). It was concluded that with appropriate education and access to clean water, formula feeding can be a safe alternative to breastfeeding for infants of HIV-1-infected mothers in resource-limited settings [22].

In a large study carried out in Harare, Zimbabwe, in which the effect of exclusive breastfeeding on infant mortality was investigated, a total of 14,110 mother–newborn pairs were enrolled. Of these, 4,495 mothers were HIV-infected and 2,060 of their pregnancies resulted in live births. They were followed up for 2 years. The overall postnatal MTCT was 12.1%, and 68.2% of these occurred after 6 months. Highlighting the increased risk of prolonged breastfeeding after 6 months. Early mixed feeding was associated with a greater risk for MTCT at 6, 12 and 18 months [23].

In the year 2000, Coutsoudis et al. [24] attracted widespread attention regarding the potential risks of mixed feeding versus exclusive breastfeeding. In a study carried out in Durban, South Africa, in which the infant feeding practices of 549 HIV-infected women were evaluated, it was found that by age 3 months infants who were exclusively breastfed were less likely to be HIV-infected (14.3%) than those who received mixed feeding (24.1%) [24].

In a meta-analysis of data pertaining to late postnatal transmission of HIV-1 in 4,085 breastfed children in 9 trials, it was found that in 539 of the children the timing of infection was known, and of these, 225 (42%) had late postnatal transmission (breastfeeding after 6 months). The cumulative probability of late postnatal transmission at 18 months was 9.3% [25].

There appears to be a high prevalence of mixed feeding (instead of exclusive breastfeeding) in countries with limited resources [26]. Some studies have cited that many women start mixed feeding due to insufficient breast milk; however, the decision to mix feed is probably multifactorial. In a longitudinal study in a rural community with limited resources and a high prevalence of HIV (Mtubatuba, KwaZulu Natal, South Africa), 119 infants were followed up for 16 weeks. In addition, a cross-sectional survey of the mothers of 445 infants was performed. It was observed that as few as 10% of the infants were exclusively breastfed for 6 weeks. The most common reason for mixed feeding was perceived to be insufficient breast milk. Another concerning observation in the longitudinal aspect of the study was that 46% of the infants received non-breast milk fluids or formula feeds within 48 h of birth. The feeding choices of the mothers were mainly self-determined (43%), whereas health workers (22%) and grandmothers (16%) were cited as the main sources of advice [27]. These results infer the need for more effective training of healthcare workers, and marketing campaigns that target women in resource-limited settings with regard to the importance of exclusive breastfeeding for the first 4–6 months.

In a study in South Africa [28] in which the influence of the mode of feeding on child morbidity was evaluated at clinic visits at 1 and 6 weeks, 3 months and every 3 months thereafter for 15 months, it was observed that HIV-infected infants who were never breastfed had poorer outcomes than those who were breastfed. Nine (60%) of those who were never breastfed had 3 or more morbid episodes compared with 15 (32%) of the breastfed children. During the first 2 months of life, never-breastfed infants (regardless of HIV status) were nearly twice as likely to have had an illness episode than breastfed infants. These results highlight the risks of formula feeding in limited resource settings. This study was performed prior to the implementation of the South African Comprehensive Antiretroviral Program.

Further research is required to provide greater insight regarding the reasons mothers chose not to breastfeed exclusively, especially in communities with limited resources. In addition to the factors mentioned above, working mothers may get inadequate maternity leave, have no childcare facilities in the workplace, and may work long hours, all of which make the establishment and continuation of exclusive breastfeeding very difficult. In many countries, there is a lack of legislation to protect breastfeeding in the workplace. Ironically, many hospitals (in which women usually constitute two thirds of the workforce), which are certified as 'baby friendly', do not have childcare facilities on site; hence female hospital workers do not have the option to breastfeed their infants during the day. It seems unreasonable and duplicitous to expect a health worker to promote and support breastfeeding if she herself does not have access to do so in her workplace [Downs, personal observation].

Infant intestinal permeability has also been associated with a higher risk of MTCT. In a study in which 272 infants of HIV-infected women in South Africa were examined at ages 1, 6 and 14 weeks and underwent a lactulose/mannitol dual sugar test, it was found that infants who had become HIV-infected by 14 weeks had a significantly higher intestinal permeability at 6 and 14 weeks, and slightly higher urinary neopterin (indicator of immune system activation) excretion at all times than uninfected infants. The mode of feeding had no effect on the excretion of neopterin, an index of immunostimula-

tion. These findings suggest that infant HIV infection induces changes in gut permeability, and possibly immune system activation before clinical symptoms become apparent [29].

If mothers are going to be encouraged to stop breastfeeding at 6 months, there is a need for policymakers and health workers to ensure that mothers receive adequate information and counseling on complementary or weaning foods [30].

Cultural Factors Which Influence Infant Feeding Practices

In some cultures the grandmother or the father of the child makes the decision regarding the route and duration of infant feeding. In such cultures, these decisions will usually supersede any advice given at a health facility.

Interestingly in a study in Zimbabwe, factors influencing the choice of infant feeding methods among urban Zimbabwean women (200 women at clinics in Harare and Chitungwiza) were investigated in the context of HIV transmission. It was found that husbands (58%) had a greater influence on feeding practices than nurses (42%), suggesting that social influences have a greater influence than the advice of medical personnel when choosing a feeding method. Thirty-three and 77% of women in Harare and Chitungwiza, respectively, were aware of the link between HIV transmission and breast milk. Forty-nine percent of the women were afraid to breastfeed. The level of education, employment status and the opinions of the family were all found to influence HIV-infected pregnant women's decisions on the route of infant feeding [31].

However, in a study carried out in rural Zimbabwe, more than 90% of 164 mothers interviewed reported that breastfeeding their infant was a personal decision. A third of these respondents also mentioned they had taken into account the health workers messages. The researchers recommended that increased infant feeding support in limited resource rural populations was required. Such support should be taken into consideration in the form of training of counseling staff, decentralized follow-up and weaning support [32].

In a longitudinal qualitative study performed in 3 sites in South Africa, the infant-feeding decision-making and practices among HIV-positive pregnant women were examined. During the antenatal period the women expressed that they either intended to exclusively feed BMS or breastfeed. Just fewer than 50% of the women who intended to exclusively breastfeed maintained exclusivity, whilst two thirds of the women who initiated formula feeding maintained that mode exclusively. It was observed that the key characteristics of women who were successful in achieving exclusivity included the ability: to resist pressure from the family to introduce other fluids, and to recall key messages on MTCT risks and mixed feeding. The women who maintained exclusive breastfeeding reported strong beliefs in the benefits of breastfeeding; a supportive home environment was also found to be important. Mothers who opted for exclusive formula feeding reported that having resources such as electricity, a kettle and flask made feeding at night easier [33].

Psychological and Socioeconomic Factors

Mothers living in resource-limited settings in Africa and Asia have multiple challenges, including increased vulnerability to HIV, the burden of feeding and taking care of orphans of family and friends who have died; if they are HIV-infected another challenge is the mode of infant feeding [34].

Mothers in limited resource settings may opt for BMS feeding out of profound fear of MTCT, even though it may carry other risks. In a study conducted in semi-rural areas on the periphery of Lilongwe in Malawi, 22 HIV-infected women were interviewed regarding their perceptions on their health and the effect breastfeeding has on their health. Several of the women believed their nutritional status was declining due to their illness. The women were also concerned that breastfeeding may accelerate the progression of their disease. Although the population size of the study was small, it highlights the importance of thorough counseling [35].

In a further study, the effect of the PMTCT program in South Africa on infant feeding and caring practice in a semi-urban community near Cape Town (Khayelitsha) was investigated. This program provided HIV-infected mothers with the option to either exclusively breastfeed or formula feed for 6 months. The HIV-infected women reported that they had not experienced any negative social effects as a result of not breastfeeding [36]. However, this may not be the case in other South African communities, especially in rural communities in which breastfeeding is the norm.

There have been various reports that HIV-infected mothers find it difficult to stop breastfeeding abruptly at 4–6 months after delivery. It is well established that breastfeeding not only provides a unique form of nutri-

tion for infants, but it also plays an important role in a child's emotional development and a mother's womanhood [37, 38].

Maternal Death Soon after Delivery: Breast Milk Pasteurization and Milk Banks

Maternal death soon after delivery poses a major challenge for governments and communities with limited resources. The estimated risk of mortality of African children born to HIV-infected mother was extrapolated in a pooled data analysis (of African data from 7 randomized MTCT intervention trials), Of the 3,468 children, 378 (11%) died. By age 1 year, an estimated 35.2% of infected children and 4.9% of uninfected children had died. Infant mortality varied per geographical region, and was associated with maternal death [39]. The appropriate type and timing of HAART may not only aid in the prevention of maternal death, but also help to prevent infant death.

Although milk banks were almost completely phased out nearly two decades ago, due to the concern regarding the risk of HIV transmission, in recent years the concept has been revisited. Brazil, in particular, has set up an extensive milk bank program to provide orphaned infants with breast milk. The breast milk is heat-treated in order to inactivate the HIV.

HIV infection has contributed to a significant increase in the birth of very low and low birth weight prematurely born infants; formula feeding in this group of infants has been associated with an increased risk of necrotizing enterocolitis. Consequently, some institutions in South Africa (Cape Town, Pretoria and Durban) have set up breast milk banks to provide these infants with heat-treated breast milk. This is also a useful option for mothers with mastitis [40].

Israel-Ballard et al. [41] have developed a rapid home pasteurization method, termed the 'flash method', which eliminates viral activity and destroys bacterial contamination, but retains nutrient composition. Coutsoudis et al. [2006; unpublished data] have evaluated this method in a peri-urban community in Durban, South Africa, and found it to be a practical and safe form of pasteurizing breast milk for infants 6 months and older. This may prove to be a valuable method for mothers in resource-limited settings who need to return to work within 6 weeks after delivery, and hence reduce the rates of mixed feeding. The latter postulation requires further investigation.

Government Policies and National Programs on PMTCT

Government policies on PMTCT vary according to the resources available. The revision of policies tends to be a slow process, and hence policies are often not in line with current findings or scientific data. In some countries, the written policies may not be available to the health facilities, especially those in rural settings.

Some countries have demonstrated the benefits of the effective implementation of national policies regarding PMTCT, resulting in a significant reduction of MTCT (rates as low as 1–2%). It is important to audit the implementation of policies, to assess whether these are implemented optimally, and are effective [2].

In a recently published survey performed in Britain evaluating the adherence to the British HIV Association 2001 guidelines for the management of HIV-infected pregnant women, it was found that in general the guidelines were being practiced. The main outcome measures included: the appropriate use of antiretroviral therapy; the use and timing of elective cesarean section, and support for the avoidance of breastfeeding. Of 186 centers surveyed in the United Kingdom, 100 (54%) responded with data on 501 eligible pregnancies. The guidelines were generally being practiced, with the exception of a number of cesarean sections being planned later than the recommended 38 weeks of gestation [42].

In Australia, the impact of an education campaign on the management of pregnant women infected with a blood-borne virus (including HIV) was evaluated in 2 consecutive surveys between 2002 and 2004. In 2002–2003 in the first survey, 767 fellows registered with the Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) were mailed survey questionnaires, and in the second survey in 2004, the questionnaires were mailed to 743 of these fellows. After the first survey, there was a multifaceted intervention, including the mail out of survey results and a summary of recommended management, publication of two review articles in the RANZCOG journal, and an oral presentation at the annual RANZCOG scientific meeting. In the second survey (response rate 68%), the respondents reported an increase in screening for blood-borne viruses, change in practice based on a woman's infection status, and advice given to pregnant women regarding the risk of virus transmission through breastfeeding. In 2004, an increase was seen (from 51% in the 1st survey to 59% in the 2nd survey) in respondents who reported that they routinely offered antenatal screening for HIV. There was

a 12% (47% of the respondents) increase in the number of respondents who routinely recommended that HIV-infected pregnant women preferably opt for elective cesarean section. These outcomes demonstrated that knowledge about interventions to reduce MTCT at birth and through breastfeeding improved after a relatively simple education intervention [43].

In countries with resource-limited communities, mathematical simulation modeling may be a useful tool in predicting the risk of MTCT and infant mortality, to inform on policy decisions, with specific reference to HIV and infant feeding [44].

Inadequate Training and Availability of Counselors for Advising Mothers both Prenatally and Postnatally

In some settings, counselors may allow their personal and sometimes dogmatic opinions to prevail when counseling, instead of providing objective advice regarding the pros and cons of BMS feeding and breastfeeding for the mother's given context. In Moshi, in Northern Tanzania, counselors were interviewed regarding their perspectives on antenatal HIV testing and infant feeding dilemmas facing women with HIV in their community [45]. Their counseling experience ranged from 6 months to 9 years. It was found that, regardless of maternal socioeconomic status, an informed choice of infant feeding method by HIV-infected women, as recommended by UNAIDS/WHO/UNICEF guidelines, was seriously compromised by: the actual advice given; directive counseling; lack of time to cope with a positive test result, and lack of follow-up support. Infant feeding options were not always accurately explained, but counselors believed most women had little choice but to breastfeed, and were unlikely to exclusively breastfeed despite the advice given. It was also observed that the risks and benefits of the options available to HIV-infected women were not only complicated for the women, but for the counselors as well. It was recommended that the counselors needed additional training in non-directive counseling and infant feeding options to ensure a better quality of advice and support to follow-up women at home. In many countries, national policy may exist, but often the practical implementation and training is overlooked or lacking [Downs and Cooper, personal observation].

Piwoz et al. [46] evaluated the difference in international recommendations on breastfeeding in HIV, and the attitudes and counseling messages of 19 health workers in Lilongwe, Malawi. The health workers with experience in counseling believed that HIV-infected mothers should breastfeed exclusively rather than formula feeding, citing poverty as the main reason. All of the health workers had concerns regarding early cessation of breastfeeding due to high levels of malnutrition in their community.

Verbal counseling tends to be the tool of choice in education of HIV-infected mothers on the risks and benefits of the different feeding options. In a program in Harare, Zimbabwe, in which 14,110 mother–baby pairs were enrolled, all were tested for HIV but were not required to know their HIV status. The program used multiple educational tools including: group education; individual counseling; videos, and brochures. Interestingly, once the program was fully implemented, women were 70% more likely to learn their status early, and 8.4 times more likely to breastfeed exclusively than mothers who enrolled when the program first began [47].

Poor Implementation of PMTCT Programs

Mothers may be given a choice regarding the route of feeding but do not receive appropriate counseling regarding safe feeding. In some countries, mothers who opt for BMS feeding do not receive written information in their home language regarding the safe preparation of BMS, the correct dilution of BMS, and insufficient BMS are issued. In some countries, for example in South Africa, mothers who choose to exclusively feed with BMS are only issued with 6–8 cans of BMS on a monthly basis, which only provides approximately 50% of the nutritional requirements of infants aged 4–6 months, resulting in the tendency of mothers to over-dilute the BMS or to mix feed, hence increasing the risk for MTCT and the infants tend to fail to thrive. This is further compounded by an abrupt cessation of the provision of BMS when the infant reaches 6 months of age. Ideally the volume of BMS should be tapered after 6 months of age, and mothers/caregivers should receive with the appropriate written and verbal advice regarding weaning foods [Downs and Cooper, personal observation].

Furthermore, mothers who opt to breastfeed do not always receive adequate breastfeeding support in the form of counseling at clinics and home visits, nor the appropriate advice on infant feeding 6 months after delivery. These mothers are not always advised on methods of pasteurization of breast milk when the infant reaches 4–6 months (policies vary from country to country) [Downs and Cooper, personal observation].

WHO Guidelines

The WHO guidelines pertaining to the prevention of MTCT of HIV and their policy implications, conclusions and recommendations (2001) advise, 'When replacement feeding is acceptable, feasible, affordable, sustainable and safe, avoidance of all breastfeeding by HIV-infected mothers is recommended'. This is an important guideline for all health workers who interface with pregnant and lactating women.

Concern has been expressed that although these guidelines exist, they need to be strengthened through investments in high quality, widely available HIV counseling, support for choice of feeding, and exclusive breastfeeding for those HIV-infected mothers who opt to breastfeed [48].

In Ile-Ife in south-west Nigeria, where breastfeeding is the norm (but not necessarily exclusive), a study in which the acceptability, feasibility, affordability, safety and sustainability of replacement feeding options for HIV-infected mothers was conducted. It was found that barriers to replacement feeding (instead of breastfeeding) included: the high cost of replacement feeds and fuel for cooking; unreliable supply of electricity; poor access to safe water, and poor access to storage facilities [49].

Conclusion

In developed countries, the lowest risk of MTCT is associated with cesarean section birth, appropriate antiretroviral prophylaxis and exclusive formula feeding. In communities with limited resources, both breastfeeding and formula feeding carry risks for HIV-exposed infants, and the balance of risks varies in different settings and over time [50].

In conclusion, the goal should be not only to prevent MTCT but also to prevent infant mortality due to other factors. Furthermore, no policymaker or health worker (unless they themselves have experienced the same situation) will ever truly comprehend the magnitude of an HIV-positive mother's anxiety and dilemma in deciding on the form of feeding and, in some cases, the guilt and depression when she discovers her child has contracted HIV via MTCT.

Acknowledgement

Sincere thanks to Nisha Padayachee (Dietitian, King Edward VIII Hospital, Durban) for reviewing this article.

References

1 Luo C: Strategies for prevention of mother-to-child transmission of HIV. Reprod Health Matters 2000;8:144–155.
2 Newell ML: Current issues in the prevention of mother-to-child transmission of HIV-1 infection. Trans R Soc Trop Med Hyg 2006; 100:1–5.
3 Lauer JA, Betran AP, Barros AJ, de Onis M: Deaths and years of life lost due to sub-optimal breast-feeding among children in the developing world: a global ecological risk assessment. Public Health Nutr 2006;9:673–685.
4 Thorne C, Newell ML: Treatment options for the prevention of mother-to-child transmission of HIV. Curr Opin Investig Drugs 2005; 6:804–811.
5 Koulinska IN, Villamor E, Msamanga G, et al: Risk of HIV-1 transmission by breastfeeding among mothers infected with recombinant and non-recombinant HIV-1 genotypes. Virus Res 2006;120:191–198.
6 Willumsen JF, Filteau SM, Coutsoudis A, et al: Breastmilk RNA viral load in HIV-infected South African women: effects of subclinical mastitis and infant feeding. AIDS 2003; 17:407–414.
7 Willumsen JF, Newell ML, Filteau SM, et al: Variation in breastmilk HIV-1 viral load in left and right breasts during the first 3 months of lactation. AIDS 2001;15:1896–1898.
8 World Health Organization – HIV/AIDS Program: Antiretroviral therapy for HIV infection in adults and adolescents in resource-limited settings: towards universal access. E-pub 2006;www.who.int/hiv/pub/guidelines/adult/en/index.html.
9 Leroy V, Sakarovitch C, Cortin-Borja M, et al; Ghent Group on HIV in Women and Children: Is there a difference in the efficacy of peripartum antiretroviral regimes in reducing mother-to-child transmission of HIV in Africa? AIDS 2005;19:1865–1875.
10 Thorne C, Newell ML: Prevention of mother-to-child transmission of HIV infection. Curr Opin Infect Dis 2004;17:247–252.
11 Thorne C, Newell ML: Antenatal and neonatal antiretroviral therapy in HIV-infected women and their infants: a review of safety issues. Med Wieku Rozwoj 2003;7:425–436.
12 Gaillard P, Fowler MG, Dabis F, et al: Use of antiretroviral drugs to prevent HIV-1 transmission through breast-feeding: from animal studies to randomized clinical trials. J Acquir Immune Defic Syndr 2004;35:178–187.
13 Forna F, McConnell M, Kitabire FN, et al: Systematic review of the safety of trimethoprim-sulfamethoxazole for prophylaxis in HIV-infected pregnant women: implications for resource-limited settings. AIDS Rev 2006;8:24–36.
14 Thior I, Lockman S, Smeaton LM, et al: Breastfeeding plus infant zidovudine prophylaxis for 6 months vs. formula feeding plus infant zidovudine for 1 month to reduce mother-to-child HIV transmission in Botswana: a randomized trial: the Mashi Study. JAMA 2006;296:794–805.
15 Semrau K, Kuhn L, Kasonde P, et al: Impact of chloroquine on viral load in breast milk. Trop Med Int Health 2006;11:800–803.
16 Luzuriaga K, Newell ML, Dabis F, et al: Vaccines to prevent transmission of HIV-1 via breastmilk: scientific and logistical priorities. Lancet 2006;368:511–521.

17 Fawzi W: Nutritional factors and vertical transmission of HIV-1. Epidemiology and potential mechanisms. Ann NY Acad Sci 2000;918:99–114.
18 Mehta S, Finklestein JL, Fawzi W: Nutritional interventions in HIV-infected breastfeeding women. Ann Nestlé [Engl] 2006;65:39–48.
19 Papathakis PC, Van Loan MD, Rollins NC, et al: Body composition changes during lactation in HIV-infected and HIV-uninfected South African women. J Acquir Immune Defic Syndr 2006;43:467–474.
20 Taha TE, Kumwenda NI, Hoover DR, et al: The impact of breastfeeding on the health of HIV-positive mothers and their children in sub-Sahara Africa. Bull World Health Organ 2006;84:546–554.
21 John-Stewart G, Mbori-Ngacha D, Ekpini R, et al; Ghent IAS Working Group on HIV in Women and Children: Breast-feeding and transmission of HIV-1. J Acquir Immune Defic Syndr 2004;35:196–202.
22 Mbori-Ngacha D, Nduati R, John G, et al: Morbidity and mortality in breastfed and formula fed infants of HIV1-infected women: a randomized clinical trial. JAMA 2001; 286:2413–2420.
23 Iliff PJ, Piwoz EG, Tavengwa NV, et al; ZVITAMBO Study Group: Early exclusive breastfeeding reduces the risk of post-natal HIV-1 transmission and increase HIV-free survival. AIDS 2005;19:699–708.
24 Coutsoudis A: Influence of infant feeding patterns on early mother-to-child transmission of HIV-1 in Durban, South Africa. Ann NY Acad Sci 2000;918:136–144.
25 Coutsoudis A, Dabis F, Fawzi W, et al; Breastfeeding and IIV International Transmission Study Group: Late postnatal transmission of HIV-1 in breast-fed children: an individual patient data meta-analysis. J Infect Dis 2004; 189:2154–2166.
26 Ehrnst A, Zetterstrom R: Vertical transmission of HIV-1 infection and dilemma of infant feeding. Acta Paediatr 2003;92:990–991.
27 Bland RM, Rollins NC, Coutsoudis A, Coovadia HM; Child Health Group: Breastfeeding practices in an area of high HIV prevalence in rural South Africa. Acta Paediatr 2002;91:704–711.
28 Coutsoudis A, Pillay K, Spooner E, et al: Morbidity in children born to women infected with human immunodeficiency virus in South Africa: does mode of feeding matter. Acta Paediatr 2003;92:890–895.
29 Rollins NC, Filteau SM, Coutsoudis A, Tomkins AM: Feeding mode, intestinal permeability, and neopterin excretion: a longitudinal study in infants of HIV-infected South African women. J Acquir Immune Defic Syndr 2001;28:132–139.
30 Piwoz EG, Huffman SL, Quinn VJ: Promotion and advocacy for improved complimentary feeding: can we apply the lessons learned from breastfeeding? Food Nutr Bull 2004;25: 303–304.
31 Gara CP, Pazvakavambwa I, Maponga CC, Gavaza P: An investigation of the factors influencing the infant feeding methods among urban Zimbabwean women in the context of HIV transmission. Cent Afr J Med 2005;51: 1–4.
32 Orne-Gliemann J, Mukotekwa T, Miller A, et al: Community-based assessment of infant feeding practices within a programme for prevention of mother-to-child HIV transmission in rural Zimbabwe. Public Health Nutr 2006;9:563–569.
33 Doherty T, Chopra M, Nkonki L, et al: A longitudinal qualitative study of infant-feeding decision making and practices among HIV-positive women in South Africa. J Nutr 2006; 136:2421–2426.
34 Piwoz EG, Bentley ME: Women's voices, women's choices: the challenge of nutrition and HIV/AIDS. J Nutr 2005;135:933–937.
35 Bentley ME, Corneli AL, Piwoz E, et al: Perceptions of the role of maternal nutrition in HIV-positive breast-feeding women in Malawi. J Nutr 2005;135:945–949.
36 Chopra M, Piwoz E, Sengwana J, et al: Effect of a mother-to-child HIV prevention programme on infant feeding and caring practices in South Africa. S Afr Med J 2002;92: 298–302.
37 Coutsoudis A: Infant feeding dilemmas created by HIV: South African experiences. J Nutr 2005;135:956–959.
38 Coutsoudis A: Breastfeeding and HIV. Best Pract Res Clin Obstet Gynaecol 2005;19: 185–196.
39 Newell ML, Coovadia H, Cortina-Borja M, et al; Ghent International AIDS Society (IAS) Working Group on HIV Infection in Women and Children: Mortality of infected and uninfected infants born to HIV-infected mothers in Africa: a pooled analysis. Lancet 2004;364:1236–1243.
40 Rollins N, Meda N, Becquet R, et al; Ghent IAS Working Group on HIV in Women and Children: Preventing postnatal transmission of HIV-1 through breastfeeding: modifying infant feeding practices. J Acquir Immune Defic Syndr 2004;35:188–195.
41 Israel-Ballard K, Chantry C, Dewey K, et al: Viral, nutritional and bacterial safety of flash-heated and Pretoria-pasteurized breast milk to prevent mother-to-child transmission of HIV in resource-poor countries: a pilot study. J Acquir Immune Defic Syndr 2005;40:175–181.
42 McDonald C, Curtis H, de Ruiter A, et al: National review of maternity care for women with HIV infection. HIV Med 2006;7:275–280.
43 Giles ML, Garland SM, Grover SR, et al: Impact of an education campaign on management in pregnancy of women infected with blood-borne virus. Med J Aust 2006;184: 389–392.
44 Piwoz EG, Ross JB: Use of population-specific infant mortality rates to inform policy decisions regarding HIV and infant feeding. J Nutr 2005;135:1113–1119.
45 De Paoli MM, Manongi R, Klepp KI: Counsellors' perspectives on antenatal HIV testing and infant feeding dilemmas facing women with HIV in northern Tanzania. Reprod Health Matters 2002;10:144–156.
46 Piwoz EG, Ferguson YO, Bentley ME, et al; UNC Project BAN Study Team: Differences between international recommendations on breastfeeding in the presence of HIV and the attitudes and counselling messages of health workers in Lilongwe, Malawi. Int Breastfeed J 2006;1:2.
47 Piwoz EG, Iliff PJ, Tavengwa N, et al: An education and counseling program for preventing breastfeeding associated HIV transmission in Zimbabwe: design and impact on maternal knowledge and behavior. J Nutr 2005;135:950–955.
48 Coutsoudis A, Goga AE, Rollins N, Coovadia HM: Free formula milk for infants of HIV-infected women: blessing or curse? Health Policy Plan 2002;17:154–160.
49 Abiona TC, Onayade AA, Ijadunola KT, et al: Acceptability, feasibility and affordability of infant feeding options for HIV-infected women: a qualitative study in south-west Nigeria. Matern Child Nutr 2006;2:135–144.
50 Piwoz EG, Ross J, Humphrey J: Human immunodeficiency virus transmission during breastfeeding: knowledge, gaps and challenges for the future. Adv Exp Med Biol 2004;554:195–210.