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**BEYOND INFORMED CHOICE: INFANT FEEDING
DILEMMAS FOR WOMEN IN LOW-RESOURCE
COMMUNITIES OF HIGH HIV PREVALENCE**

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Beyond Informed Choice: Infant Feeding Dilemmas for Women in Low-Resource Communities of High HIV Prevalence

Abstract

Short regimens of anti-retroviral drugs can significantly reduce the transmission of HIV from mother to child which occurs around the time of delivery, but these drugs do not significantly reduce HIV transmission through breast-feeding. In order to prevent transmission, some have called for the provision of milk formula for HIV-positive women. However, linking milk formula, which is of questionable safety, with anti-retroviral drugs, which are of known benefit, may be dangerous. It may also delay implementation of programmes which provide wider access to anti-retroviral drugs, as well as making access to these drugs contingent (implicitly or explicitly) on willingness to use formula. Implementing international guidelines which support giving HIV-positive women an informed choice between infant feeding alternatives is difficult in practice. The focus on a dichotomised choice has the effect of neglecting to make each choice safer. New findings suggest that the magnitude of HIV transmission associated with breast-feeding can be substantially reduced with optimal breast-feeding practices, including those which maintain the exclusivity of breast-feeding and prevent the development of breast problems. These new findings have created greater awareness of the quality of breast-feeding and have drawn attention to serious deficiencies in the counseling services which assist women regarding lactation issues within maternal and child health services in general, and within programmes aimed at the prevention of mother-to-child HIV transmission in particular. Even if access to anti-retroviral drugs can be improved, training and motivation of counsellors will remain a cornerstone of programmes which are effective in preventing transmission of HIV to children.

Introduction

The prevalence of HIV infection among child-bearing women in much of southern Africa now surpasses even some of the most pessimistic projections, made when surveillance of the epidemic began. Based on current available international data for southern Africa, 36% of all adults aged between 15 and 45 years are estimated to be living with HIV infection in Botswana; the figures are 25% in Zimbabwe, 20% in South Africa, 19% in Namibia, and 20% in Zambia. These are the countries in the world most severely affected by the epidemic. (http://www.unaids.org/epidemic_update/report/).

The prevalence of HIV infection among child-bearing women directly influences the magnitude of the epidemic among children. In the absence of intervention and in a

population of near-universal breast-feeding, around a third of the number of children of HIV-positive mothers will themselves acquire the infection (De Cock *et al*, 2000:). Approximately a quarter of these HIV-infected children will die before their first birthdays (Taha *et al*, 2000; Spira *et al*, 1999) and, among those who survive to a year, severe morbidity will accrue relentlessly before they succumb to the infection - placing substantial burdens on their caregivers and on the health service.

Biology of mother-to-child HIV transmission

Mother-to-child HIV transmission can occur during pregnancy, during the process of delivery and throughout the duration of breast-feeding, although the efficiency of transmission through each of these routes differs. The placenta is a relatively effective barrier against intrauterine HIV transmission. Fewer than 6% of infants of HIV-infected mothers are thought to acquire the infection before they are born. Parturition poses a greater risk, with ~14% of the infants of HIV-infected mothers acquiring infection during labour and delivery. Transmission may occur in labour through maternal-fetal micro-transfusions of blood and via direct mucosal contact of the infant with infected fluids and blood in the birth canal (De Cock *et al*, 2000; Mofenson, 1995; Newell, 1998). A prolonged period of time between rupture of membranes and delivery increases the risk of transmission (Kuhn *et al*, 1997; Landesman *et al*, 1996) whereas cesarean delivery prior to rupture of membranes decreases the risk (Kuhn *et al*, 1994; International Perinatal HIV Group, 1999; European Mode of Delivery Collaboration, 1999). Studies conducted in the United States and Europe, prior to the introduction (around 1994) of anti-retroviral drugs for prevention of mother-to-child HIV transmission, and among populations of HIV-infected women (among whom breast-feeding was extremely rare and strongly discouraged) observed rates of mother-to-child transmission in the order of 15-25% Matheson *et al*, 1995; European Collaborative Study, 1992). The majority (~70%) of these infections is likely to have occurred during delivery or shortly beforehand (Newell, 1998).

If the uninfected infants of HIV-infected mothers are breast-fed, an additional 14% are expected to acquire the HIV infection (Dunn *et al*, 1992), thus bringing the overall transmission rate up to around 34%. Studies conducted in Africa among populations of HIV-infected women, among whom breast-feeding was near-universal and of long duration, observed rates of mother-to-child transmission in the order of 25-35% (Bobat *et al*, 1996; Miotti *et al*, 1999). A clinical trial conducted in Nairobi, Kenya, designed specifically to quantify the magnitude of post-natal HIV transmission, estimated the excess risk of post-natal transmission to be 16% (21% in the formula-feeding arm and 37% in the breast-feeding arm) (Nduati *et al*, 2000) - which is remarkably consistent with the 14% estimated on the basis of prior non-experimental studies. If a woman who is uninfected during pregnancy becomes HIV-positive after her child is born, and while still breast-feeding, her child is also at risk of post-natal acquisition of the infection. Of women who have primary HIV infection

while breast-feeding, about 30% are thought to transmit HIV to their infants via this route (van de Perre *et al*, 1991). This risk has proved difficult to quantify precisely, given the relative rarity of and the difficulty in detecting new infections among women during lactation.

The single strongest predictor of mother-to-child HIV transmission is the amount of HIV RNA which can be quantified in the mother's circulatory system (Cao *et al*, 1997; Garcia *et al*, 1999; Jackson *et al*, 1996; Katzenstein *et al*, 1999; Thea *et al*, 1997). The quantity of HIV RNA in the blood, sometimes loosely called 'viral load', is correlated with other markers of how far HIV-related disease has progressed, including depletion of CD4+ T-helper cells and various clinical symptoms. Women with more advanced disease, measured by any of these clinical or laboratory markers, are more likely to transmit HIV to their children. HIV RNA in the blood correlates with the quantity of HIV detectable in breast milk and in cervico-vaginal fluids (Panther *et al*, 2000; Gaillard *et al*, 2000; Mandelbrot *et al*, 1999; Ait-Khaled *et al*, 1998; Nduati *et al*, 1995; Semba *et al*, 1999), the sources of HIV to which the child is directly exposed. Advanced HIV infection is associated with reduced fertility (Gray *et al*, 1998); thus pregnant HIV-infected women tend to be a little healthier than HIV-infected women in the population overall.

Benefits of anti-retroviral drugs

A major break-through in the prevention of mother-to-child HIV transmission was provided in 1994 by the Pediatric AIDS Clinical Trial Group (PACTG) (protocol number 076). This was a clinical trial of a three-part prophylactic regimen of zidovudine (also known as AZT) (Connor *et al*, 1994). The study, which was conducted in the U.S. and France among women who had not taken AZT before, who were relatively healthy and who did not breast-feed, observed a two-thirds reduction in mother-to-child HIV transmission in treated subjects (8% transmission), compared to placebo controls (23% transmission) (Connor *et al*, 1994). The study provided proof of the principle that anti-retroviral drug prophylaxis can reduce mother-to-child HIV transmission. Uptake of the regimen in clinical practice in the U.S. and Europe has been remarkable, and has been coincident with dramatic declines in new HIV infections among children (Fiscus *et al*, 1996; Centres for Disease Control and Prevention, 1993, 1994, 1996; Lindegren *et al*, 1999).

Despite its public health impact in the U.S. and Europe, the PACTG 076 regimen was never seriously considered as an option for poor countries, largely because of drug costs and the complexity of the regimen. Following the success of PACTG 076, several placebo-controlled clinical trials were carried out in Africa and Asia, consisting of various short-course anti-retroviral drug regimens designed to be more practical for implementation in low resource settings. The aim was also to determine their efficacy among breast-feeding populations. These trials were sharply criticized for using placebo

controls when an existing therapy, namely the PACTG 076 regimen, was known to be efficacious. More discussion of this debate can be found elsewhere (Bayer, 1998).

The efficacy of the short-course regimens can only be compared with the efficacy of the PACTG 076 protocol by considering their impact either in non-breast-feeding populations or, when studied in breast-feeding populations, by considering their short-term impact on transmission (detectable by six weeks of age). Infections detectable by this age are attributed mostly to transmission occurring before and during birth; post-natal transmission up to the age of six weeks contributes a relatively small percentage of these infections. Short-course regimens of AZT, as well as a very short and simple regimen of a different class of anti-retroviral drug called nevirapine, were observed to result in an approximate 50% reduction in transmission by the age of six weeks (Shaffer *et al*, 1999; Wiktor *et al*, 1999; Dabis *et al*, 1999; Guay *et al*, 1999). Although possibly less efficacious than the PACTG 076 regimen, these short-course regimens have made prevention of mother-to-child HIV transmission in poor countries an immediate possibility, rather than a distant hope as was seen as in the recent past.

Long-term follow-up of the outcomes of these short-course regimens have observed significant reductions in mother-to-child HIV transmission, even among populations breast-feeding for up to 24 months (Guay *et al*, 1999; DITRAME ANRS 049 Study Group, 1999). It should be noted, however, that the relative reduction in all transmission is less in breast-feeding than in non-breast-feeding populations (Table 1).

Table 1: Anti-Retroviral Drug Regimens Demonstrated to Prevent Mother-to-Child Transmission

Study	Drug used	Regimen	% reduction in transmission detectable by 6 weeks	% reduction in transmission detectable by the end of all breast feeding
PACTG 076 U.S. France 1994 (Connor <i>et al</i>).	Zidovudine	Oral 5 times per day during pregnancy from -26 weeks, intravenous infusion during labour and delivery, oral 4 times per day to the newborn for 6 weeks	65% reduction (from 23% to 8%)	Not studied among breast-feeders
CDC Bangkok, Thailand 1999 (Shaffer <i>et al</i>).	Zidovudine	Oral 2 times per day during pregnancy from -36 weeks, oral every 3 hours during labour, no newborn dose	53% reduction (from 19% to 9%)	Not studied among breast-feeders

45% reduction (from 22% to 12%)	Zidovudine	Oral 2 times per day during pregnancy from ~36 weeks, oral every 3 hours during labour, no newborn dose		30% reduction (from 31% to 22%) combined analysis of both studies
DITRAME Abidjan, Cote d'Ivoire & Bobo-Dioulasso 1999 (Dabis <i>et al</i>).	Zidovudine	Oral 2 times per day during pregnancy from ~36 weeks, oral every 3 hours during labour, no newborn dose, oral 2 times per day for 7 days post-partum for mother	32% reduction (from 22% to 15%)	
HIVNET 012 Kampala, Uganda 1999 (Guay <i>et al</i>).	Nevirapine	One tablet at onset of labour, one dose of syrup to newborn within 72 hours of birth	43% reduction (from 21% to 12%)	38% reduction (from 31% to 16%)

In non-breast-feeding populations, short-course regimens reduce the risk of transmission by around a half. In breast-feeding populations, taking into consideration all transmissions which accrue until the cessation of all breast-feeding, short-course regimens reduce the risk of transmission by around a third (Guay *et al*, 1999; DITRAME ANRS 049 Study Group, 1999). This is because the total amount of transmissions in the absence of drug intervention is greater in breast-feeding than in non-breast-feeding populations, and because the drugs, as given, offer only a reduction in the transmission which occurs during the time of labour and delivery. HIV transmission during the post-natal period remains largely unaffected.

The critical research question now regarding prevention of mother-to-child HIV transmission is how to implement programmes which will make the anti-retroviral drug interventions available to the many HIV-infected pregnant women who need them. It has proved especially difficult to move from the clinical trial results, which have demonstrated the unambiguous benefit of these relatively simple, and relatively inexpensive (in terms of drug costs) interventions, to their use in public programmes. What is required is at least a rudimentary and obstetric service in which the risks and benefits of HIV testing can be explained, and HIV testing conducted. The glaring deficiencies in such systems in most parts of the world where the epidemic is at its worst nevertheless does not preclude the implementation of preventive measures. Rather, prevention of mother-to-child transmission could provide the impetus to help strengthen ante-natal and obstetric services, which in turn may benefit other aspects of maternal and child health. The implementation of quality HIV counseling and testing as a routine and fundamental component of ante-natal care could offer the opportunity for synergistic benefits related to prevention of adult sexual transmission. Constructive efforts in several areas in Africa have begun to put in place voluntary testing and counseling services and systems, which make the drugs available for prevention of mother-to-child transmission. Even if successful anti-

retroviral drug programmes can be implemented, transmission of HIV through breast milk will persist. Breast-feeding-associated transmission will then become the dominant form of pediatric transmission of HIV throughout the world.

Should milk formula be part of the package?

A deceptively simple solution to post-natal transmission of HIV through breast-feeding is its complete avoidance, and its replacement from birth with infant milk formula. No epidemiological research is needed to show that complete avoidance of all breast-feeding will entirely prevent the post-natal transmission with which it is associated: no exposure, no infection. However, avoidance of all breast-feeding in the communities most affected by HIV is not an optimal or realistic practice for many reasons, foremost of which is safety.

Some activists in South Africa have linked demands for government-provided anti-retroviral drugs which prevent mother-to-child HIV transmission with demands for government provision of milk formula. Some United Nations-sponsored demonstration projects in several other African countries, including Zambia, Kenya and Botswana, have provided a generic (i.e. non-brand name) milk formula as a part of their package of services to prevent mother-to-child HIV transmission. The underlying linkage between anti-retroviral drugs and milk formula is an assumption that anti-retroviral drug prophylaxis is effective only if combined with avoidance of all breast-feeding. This assumption has clearly been shown to be false (DITRAME ANRS 049 Study Group, 1999). The linkage between the provision of drugs and milk formula together is dangerous, since some of the problems pertaining to the implementation of milk formula use, which do not pertain to implementing the drug intervention, may needlessly delay the expansion of programmes to provide wider access to anti-retroviral drugs. Confusion in the minds of both health care providers and clients may create coercive circumstances in which access to anti-retroviral drug prophylaxis is made contingent (implicitly or explicitly) upon a mother's willingness to use formula.

It is well established that the rates of mortality from diarrhoea and respiratory diseases is some three to ten times higher in formula-fed than in breast-fed infants (Nicoll *et al*, 1995). Risks associated with formula feeding are greatest in settings which lack access to clean piped water within the home and adequate sanitation, but persist even in settings with moderate infrastructure (Habicht *et al*, 1988). Milk formula is also often incorrectly prepared, thus compromising nutrition. Biologically, the risks associated with formula feeding include contamination of the water and utensils used in its preparation, though these extend beyond the difficulty of preparing the formula correctly and hygienically. Risks associated with formula feeding also pertain to what it lacks: the absence of the protective components of breast-milk. Breast milk contains a host of immunologically-active factors (which cannot be reproduced in milk formula) including

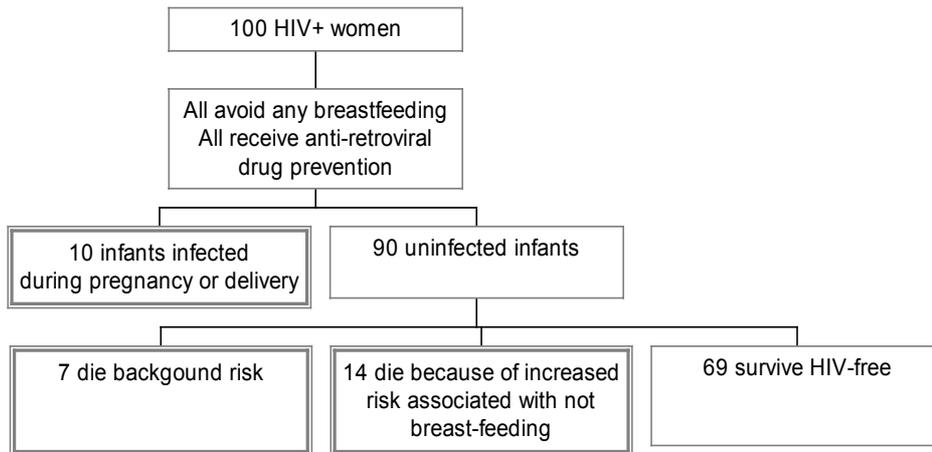
antibodies, cytokines, innate immune factors, and living cells, which protect an infant against infectious diseases (Garofalo *et al*, 1998; Goldman, 1993; Xanthou *et al*, 1995).

Mathematical models have been undertaken to compare quantitatively the competing risks of breast-feeding-associated HIV transmission, on the one hand, with formula-feeding-associated non-HIV mortality on the other. These models have demonstrated that decisions between breast- and formula-feeding are highly sensitive to background infant mortality rates, and to the expected risks associated with avoidance of breast-feeding (Hu *et al*, 1992; del Fante *et al*, 1993; Kuhn *et al*, 1997). In populations with high background infant mortality rates (more than 80 deaths per 1000 live births), avoidance of all breast-feeding (even if strictly confined only to women who are HIV-positive) generally results in larger numbers of adverse outcomes (HIV infections and deaths) than when breast-feeding takes place (Figure 1).

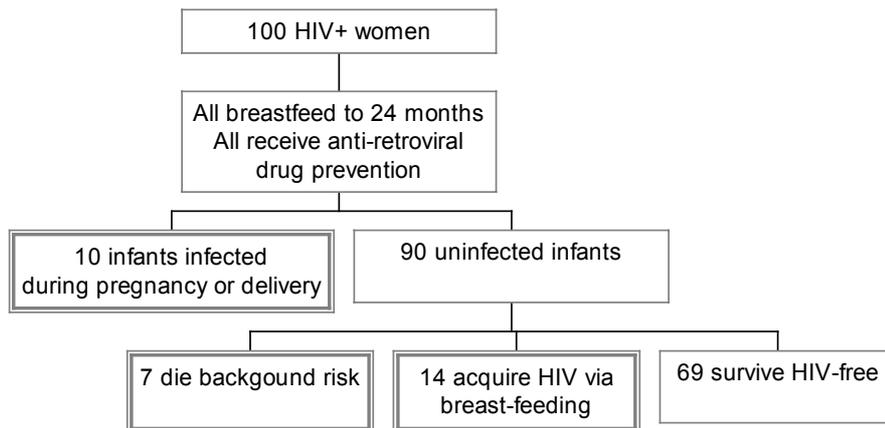
In populations with lower background infant mortality rates, whether or not avoidance of all breast feeding will produce a better or worse outcome is highly dependent on small changes in the parameters included in the models (Hu *et al*, 1992; del Fante *et al*, 1993; Kuhn *et al*, 1997). One observation which is consistent from mathematical models is that shifts away from breast feeding, if not confined to HIV-infected women, always produces the worst outcome and can result in substantial increases in child mortality in the population (Hu *et al*, 1992; del Fante *et al*, 1993; Kuhn *et al*, 1997). This underscores the need for protecting and supporting breast feeding among uninfected women and also the importance of HIV testing. Unfortunately, tailoring infant feeding advice specifically to women's sero-status may contribute to their being stigmatized, and to unintended disclosure of HIV status.

Figure 1 (Cohorts A and B on the following page) is an illustration which shows that increases in mortality associated with avoidance of breast-feeding can wipe out the benefit of avoiding breast-feeding-associated HIV-infections in particular circumstances. In the illustration, the number of adverse outcomes (HIV infection or death) is compared between two hypothetical cohorts, each of 100 HIV-infected women who have a background infant mortality rate of 80 deaths per 1000 live-births. In cohort A, all women avoid breast-feeding completely and provide milk formula. In cohort B, all women breast-feed until the babies are 24 months old. The illustration assumes that breast-feeding-associated transmission occurs among 14% of mother-infant pairs, and that providing milk formula increases the risk of infant mortality three-fold.

Cohort A: Total number of adverse outcomes 31



Cohort B: Total number of adverse outcomes 31



Breast-feeding also has many other benefits which are more difficult to quantify. Breast-feeding is convenient and economical and, in many societies, is culturally-entrenched and deeply valued. In settings where breast-feeding is the norm, failure to breast-feed may be tantamount to public announcement of being HIV-positive. Elaborate excuses may allow some women to circumvent this association, and others may bravely wish to confront the stigma which surrounds the disease. While support for disclosure (or for subterfuge if it is desired) should ideally be forthcoming from the health service, this stigma may be one of the major barriers to the use of milk formula. Other benefits of breast-feeding include reduction of fertility by providing an effective method of contraception while extending post-partum amenorrhea and contributing to child spacing on a population level in the

months thereafter (Gray *et al*, 1990; World Health Organisation Task Force on Methods for the Natural Regulation of Fertility, 1998). In many settings, milk formula is simply unavailable or prohibitively expensive. Donation or subsidisation of milk formula may remove the barrier of affordability (for the consumer), but introduces new elements of dependence. Since the child will need the milk formula for at least six months, sustainability of the programme and reliability of supply are critical.

Passing the buck: problems with informed choice

Current international guidelines promote the concept of informed choice in relation to infant feeding options for HIV-positive mothers (Table 2).

The guidelines urge that risks and benefits of breast-feeding and its alternatives be explained and that women be supported in their choice (UNAIDS, 1998). While few would disagree with the principle that the ultimate decision should rest with an HIV-positive woman herself after she has been adequately acquainted with the relevant biological facts, there are several problems with implementing informed choice.

Foremost is the tremendous burden it places on counsellors. Few counsellors are able to convey the concept of competing risks in a way which is clear and correct and, in fact, accurate presentation of the competing risks offers two untenable choices with little reassurance. The competing risks, not in dispute, are bleak. Ideally, counselling messages need to include fair and balanced presentation of both the risks and benefits of infant feeding options, but many counsellors lack adequate knowledge and skills to explain and support both options, and may have little quality time to spend with individuals. Most programmes favor one or other choice for their clients and play down the risks associated with the programme-preferred option. If milk formula is the programme-preferred option, it almost always has to be provided free or highly subsidised, since its market cost places it beyond the reach of most users of public health services in southern Africa. Provision of milk formula implies its endorsement by the health service, regardless of whether or not staff actively encourage its use, since it is a visible consumer item of known monetary value.

Table 2: Extracts from international guidelines provided the United Nations for infant feeding of children of HIV	
Year	Extract from consensus statement
1987 World Health Organization (WHO)	'In individual situations where the mother is considered to be HIV-infected..., the known and potential benefits of breast-feeding should be compared to the theoretical, but apparently small, incremental risk to the infant of becoming infected through breast-feeding. Consideration should be given to the socioeconomic and ecological environment of the mother-child pair and the extent to which alternatives can safely and effectively be used. In many circumstances and, particularly where the safe and effective use of alternatives is not possible, breast-feeding by the biological mother should continue to be the feeding method of choice, irrespective of the HIV infection status.'
1992 WHO / United Nations Children's Fund (UNICEF)	<p>'... roughly one-third of the babies born worldwide to HIV-infected women become infected themselves during pregnancy and delivery, and recent data confirm that some occurs through breast-feeding. However, the large majority of babies breast-fed by HIV-infected mothers do not become infected through breast milk.'</p> <p>'Where the primary causes of infant deaths are infectious diseases and malnutrition, infants who are not breast-fed run a particularly high risk of dying from these conditions. In these settings, breast-feeding should remain the standard advice to pregnant women, including those who are known to be HIV-infected.'</p> <p>'In settings where infectious diseases are not the primary causes of death during infancy, pregnant women known to be infected with HIV should be advised not to breast-feed but to use a safe feeding alternative for their babies.'</p>
1997 WHO/ UNICEF/ United Nations Joint Programme on HIV/AIDS (UNAIDS)	<p>'[S]tudies suggest an average risk for HIV transmission through breast-feeding of 1 in 7 children, born to, and breast-fed by, a woman living with HIV.'</p> <p>'Access to voluntary and confidential HIV counselling and testing should be facilitated for women and men of reproductive age.... Counselling for women who are aware of their HIV status should include the best available information on the benefits of breast-feeding, on the risk of HIV transmission through breast-feeding, and on the risks and possible advantages associated with other methods of infant feeding....It is therefore important that women be empowered to make fully informed decisions about infant feeding, and that they should be suitably supported in carrying them out.'</p> <p>'When children born to women living with HIV can be ensured uninterrupted access to nutritionally adequate breast-milk substitutes that are safely prepared and fed to them, they are at less risk of illness and death if they are not breast-fed. However, when these conditions are not fulfilled, in particular in an environment where infectious diseases and malnutrition are the primary causes of death during infancy, artificial feeding substantially increases children's risk of illness and death.'</p>
1998 WHO/ UNICEF/ UNAIDS	Extended guidelines for 'decision-makers' and 'health care managers and supervisors' is developed. Included are more extensive 'options' as breast-feeding replacements, including 'commercial infant formula,' 'home prepared formula,' 'modified and unmodified cows milk,' 'early cessation of breast-feeding,' 'expressed and heat-treated breast milk,' 'breast milk banks,' and 'wet-nursing.'
1999 WHO/ UNICEF/ UNAIDS	'...a recent early report of evidence that HIV is less likely to be transmitted through exclusive breast-feeding does not warrant a change in the existing WHO/UNICEF/UNAIDS policy...the current guidelines clearly indicate that for HIV-positive mothers who choose to breastfeed, the safest option is to breastfeed exclusively to minimize the risk of other childhood infection such as diarrhoea, using a good technique to reduce the risk of mastitis and nipple damage which could increase transmission of HIV.'

If informed-choice counselling is non-directive, it may neglect individualized assessment of the specific life circumstances of each unique woman. Home environment, access to resources, personal motivation and family support are among the many factors which are likely to vary greatly among women accessing services. A counsellor may be able to consider each of these factors with the client and to offer professional guidance. Furthermore, there may be enormous differences in access to basic services between urban and rural communities, between different urban areas, between neighborhoods within urban areas, and even between residents within local neighborhoods. An explicit formulation of indicators which would tip the balance either in favor of breast-feeding or its complete avoidance could greatly assist counselors, who are generally left to their own devices in making these judgements. Policy-makers have been skittish about suggesting concrete parameters relevant to specific local settings, and which may have either of the above-mentioned results.

Focusing on choices between two options, neither of which is optimal, creates an artificial polarization. Other options which do not fit easily into this dichotomy are overlooked, as are ways in which each practice can be made safer.

Not all breast-feeding is created equal

Breast-feeding cannot simply be considered as a homogenous, all-or-nothing exposure to HIV. Attention to the quality and duration of breast-feeding may offer a new solution to the dilemma of post-natal HIV transmission. Nutritionists make important distinctions regarding the relative qualities of exclusive, partial and predominant breast-feeding (Piwoz *et al*, 1995). Exclusive breast-feeding is defined as breast-feeding in the complete absence of all other fluids and solids and is recommended for children of up to six months of age, during which time breast milk alone can satisfy all the infant's nutritional and fluid needs (Cohen *et al*, 1994). As in the superiority of any breast-feeding over no breast-feeding, within the group of 'any' breast-feeders, there is a well-established superiority of exclusive over non-exclusive breast-feeding regarding protection against life-threatening infectious diseases (other than HIV) in the first six months of life (Brown *et al*, 1989; Black *et al*, 1989; Cesar *et al* 1999). Reasons for the benefits of exclusive over non-exclusive breast-feeding are thought to be related to reduced exposure to bacterial contaminants and to a more restricted range of food antigens, which in turn reduce immune activation in the gastrointestinal tract. These processes may be related to post-natal HIV transmission, since immune activation is a necessary step for the establishment of a primary HIV infection (Smith and Kuhn, 2000). Exclusive breast-feeding is also associated with maturation of the infant's gut. Maintenance of the integrity of the intestinal mucosal barrier may be relevant

for post-natal HIV transmission since this may be a portal of HIV entry (Smith and Kuhn, 2000).

In the HIV research field, most studies of breast-feeding transmission have lumped together all women who breast-fed for any length of time, regardless of quality, into a single category labeled 'any' breast-feeding. When, for the first time in a study conducted in Durban, South Africa, an attempt was made to split apart the specific practices of individual women previously all lumped together as breast-feeders, significant differences in the risks associated with breast-feeding were observed, according to the way in which it was practiced (Coutsoudis *et al*, 1998; Coutsooudis *et al*, 2001). In the Durban study, infants of HIV-infected mothers were stratified into three groups: (1) those who were never breast-fed; (2) those who were breast-fed exclusively up to the age of three months or longer; and (3) those who were breast-fed but who were also supplemented with other liquids or solids, beginning prior to three months of age. HIV transmission rates in these three groups (up to fifteen months of age) were compared. Exclusive breast-feeding (i.e. allowing no other liquids or solids, even water) among infants of HIV-infected mothers resulted in significantly lower rates of transmission than breast feeding supplemented with liquids and/or solids. Transmission rates among exclusive breast feeders and those never breast-fed were similar up to six months of age (Coutsoudis *et al*, 1998; Coutsooudis *et al*, 2001).

The results of the Durban study suggest that if breast-feeding remains strictly exclusive, HIV transmission via this route can be prevented. Exclusive breast-feeding cannot persist indefinitely, however, and by six months of age the infant requires complementary foods in addition to breast milk. It was observed in the Durban study that new HIV infections began to accrue at ages of over six months once breast feeding ceased to be exclusive (Coutsoudis *et al*, 2001). Stopping breast-feeding early may be one way to avoid these later infections. Early cessation of breast-feeding, while perhaps less difficult and dangerous than complete avoidance of all breast-feeding, is not without risk. Qualitative research has identified that lack of resources within households for the purchase of adequate amounts of family food is a major impediment to shortening the duration of breast-feeding. Ordinarily, breast-feeding continues to provide children older than six months with substantial proportions of their nutritional requirements.

The findings of the Durban study need to be investigated further, and three large clinical studies are currently underway for this purpose in urban and rural KwaZulu-Natal, as well as in Lusaka, Zambia, and in Abidjan, Cote d'Ivoire. Infant feeding recommendations will need to be responsive and flexible enough to be modified as the results of these studies become available. However, it has become clear following the results of the Durban study that there are serious deficiencies in lactation management within maternal and child health-care services in general, and in programmes to prevent mother-to-child HIV transmission in particular.

Maintaining breast health

Promotion of exclusive breast-feeding is one of the core components of programmes designed to support good breast-feeding practices - which are the ones that are optimal for the child's health, comfortable and practical for the mother, and which tend to prevent the development of breast problems. As such, regardless of whether or not the role of exclusive breast-feeding in the transmission of HIV is confirmed, HIV-positive women who elect to breast-feed are entitled to the best possible support from the health service for this choice. Exclusive breast-feeding is very rare in most parts of the world, including southern Africa. For instance, surveys estimate the prevalence of exclusive breast-feeding among children between two and four months of age to be 27% in Zambia, 17% in Kenya and 11% in Malawi (UNICEF, 1999). These percentages may be even lower since strict definitions of exclusive breast-feeding are not applied in the surveys. Many reasons why there is not exclusive breast-feeding have been identified, including cultural traditions, work outside the home, and perceptions of insufficient milk production. However, there is considerable world-wide experience in the support and promotion of exclusive breast-feeding outside of the HIV context. Randomised trials of relatively simple community-based and health service-based interventions have demonstrated that it is possible to achieve significant improvements in the adoption and duration of exclusive breast-feeding (Morrow *et al*, 1999). HIV-infected women may be more receptive to modification of infant feeding practices given the emotional significance of HIV infection. Implementing lactation support programmes will require investment in training and supervision of counsellors.

Severe and mild breast problems among lactating HIV-infected women are strongly correlated with transmission of HIV via breast-feeding. Clinical mastitis, breast abscesses, and cracked nipples have been observed to increase the risk of post-natal transmission more than ten-fold (John *et al*, 2001; Embree *et al*, 2000). An elevated concentration of sodium in breast milk, which is a marker of sub-clinical mastitis, is correlated with the quantity of HIV in breast-milk and is a strong predictor of whether the virus will be transmitted through breast-feeding (Semba *et al*, 1999). Most common breast problems can be prevented with adequate lactation management. Milk stasis is the primary cause of engorged and painful breasts and this may progress to more severe forms of pathology. The condition can be prevented by the efficient removal of milk, which is achieved naturally through frequent demand-feeding, as well as good positioning and attachment of the infant to ensure efficient suckling (WHO/FCH/CAH/00, 2000). The interlinkages between exclusive breast-feeding and good breast-feeding techniques may be one of the explanations for the apparent benefit of exclusive breast-feeding where reduction in HIV transmission is concerned (Smith *et al*, 2000).

Awareness that the quality of breast-feeding may affect HIV transmission also raises new concerns about implementing programmes which include provision of milk formula. A report from a programme in Uganda which provided milk formula observed that while most women did select it, few women abstained from breast-feeding. Most women stated that they would prefer to formula-feed their infants but after delivery, many did not return to the health service often enough to obtain sufficient quantities of formula. When questioned, it was found that most had resorted to some breast-feeding, often providing formula at home but breast in public (Mangoni *et al*, 2001). Thus, many of the nutritional and immunological benefits of breast-feeding were lost and the child continued to be exposed to HIV. Few women who stated that they preferred to breast-feed did so exclusively. It is conceivable that health-service provision of milk formula may undermine women's confidence in the health education message of the adequacy of breast milk. Very little training of health care workers in lactation management, as part of programmes to prevent mother-to-child HIV transmission, has been undertaken.

There are anecdotal reports that fear of HIV transmission through breast-feeding is resulting in declines in breast-feeding in several places in southern Africa. Mathematical models unambiguously show that even if a small proportion of uninfected women start to avoid breast-feeding, infant mortality rates will rise even in middle-income countries with moderate to low infant mortality rates, such as South Africa, Brazil and Thailand (Walley *et al*, 2001). This is often referred to as 'spill-over'. 'Spill-over' of the exclusive breast-feeding message, on the other hand, will substantially improve child health overall. Exclusive breast-feeding also offers an appropriate infant feeding choice for women who do not wish to know their HIV status, or for programmes which aim to provide anti-retroviral drugs to all the 'at risk' population, regardless of their HIV status (Marseille *et al*, 1999; Sinkala *et al*, 2001).

Linking prevention of mother-to-child HIV transmission with treatment

Discussion of the feasibility (its desirability is not in question) of making effective anti-retroviral drug combination therapy more widely available in low resource settings is beyond the scope of this paper. Strengthening primary health-care services in order to implement programmes to prevent mother-to-child HIV transmission can only benefit this essential endeavour. Nevertheless, even if therapeutic anti-retroviral drugs become more widely available, they may not always be indicated for HIV-infected lactating women, many of whom do not yet have advanced enough HIV infection to require them. In addition, continued use of anti-retroviral drugs during breast-feeding may or may not be effective for prevention of post-natal transmission. Regimens are being tested for this purpose and if

found to be effective, new logistical issues will thus be introduced. Given the complexity of post-natal transmission and our lack of understanding as to how anti-retroviral drugs work to prevent it, it would be premature, until the results of these trials become available, to assume that continued use of anti-retroviral drugs during lactation will be effective in reducing post-natal HIV transmission. Access to effective anti-retroviral drugs and to humane medical care may begin to reduce the fear and stigma which surrounds HIV. Hope, inspired by access to life-saving treatment, is likely have positive consequences for prevention programmes, including programmes to prevent mother-to-child HIV transmission (Berkman, 2001).

Conclusion

Consideration of the dilemmas involved in infant feeding choices for women in communities of high HIV prevalence makes clear the impossibility of isolating the HIV epidemic from the social and epidemiological context in which it occurs. The demand for access to milk formula for HIV-positive women, while seemingly a justifiable one, ignores this context and may in the long-run do more harm than good. Medical advances in the form of vaccines or anti-retroviral drug regimens which could be used during lactation may offer a technological rescue from this dilemma. In the meantime, in the communities devastated by this disease, human interaction will remain the cornerstone of effective intervention. Anti-retroviral drugs are certainly necessary. However if effective programmes are to be implemented, training and support of health care workers will need to be strengthened. These are the men and women who interact on a day-to-day basis with people living with the disease and who will need to be involved in grappling with the many biological and social complexities that the HIV epidemic has brought in its wake.

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