Clean Water Helps but Is Not Enough: Challenges for Safe Replacement Feeding of Infants Exposed to HIV

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Lack of consistent access to clean water is a major public health concern in most of sub-Saharan Africa, where the prevalence of human immunodeficiency virus (HIV) is high. Unsafe water is of major concern for the survival of children, because diarrheal disease is one of the leading causes of death among infants [1]. Interventions to improve water quality, sanitation, and hygiene practices have been identified as a means to help reduce the unacceptably high rates of death among infants and young children in low-resource settings [2]. Unsafe water takes on even greater salience in the context of maternal HIV infection. This is because many HIV-infected women living in low-resource settings elect either to avoid all breast-feeding or to wean their infants earlier than usual, with the goal of preventing postnatal HIV transmission. Studies from South Africa and Côte d’Ivoire have found substantial bacterial contamination of water used for infant feeding [3, 4]. Most counseling programs include advice about the necessity of boiling water for the preparation of infant formula, as well as other health education messages about hygiene.

In this issue of the Journal, Harris and colleagues [5] present new data from the Kisumu Breastfeeding Study (KiBS) that provide sobering caution about the limits of water quality interventions. The KiBS was designed to evaluate the effects of antiretroviral treatment initiated during pregnancy and continued during the breast-feeding period on the prevention of HIV transmission to infants. After HIV-infected women were enrolled in the KiBS in Kisumu, Kenya, antiretroviral therapy was initiated, and the women were encouraged to exclusively breast-feed their infants to 5.5 months of age and then completely wean them from breast milk by 6 months of age. For those women who did not meet the criteria for treatment at study enrollment, treatment stopped at approximately this same time. Encouraging preliminary results from the KiBS, as reported elsewhere [6], indicate that antiretroviral treatment is highly effective in reducing HIV transmission.

Midway through the study, routine safety monitoring of the effects of postnatal antiretroviral therapy revealed higher-than-expected rates of diarrhea among infants after weaning. After stopping enrollment and reviewing the data, the investigators decided to evaluate the usefulness of a household-based water quality intervention known as the Safe Water System (SWS) in reducing weaning-related diarrhea. SWS is a tested intervention that has been found to be effective in similar settings [7]. The intervention included provision of safe water storage containers, point-of-use disinfection of water with the use of sodium hypochlorite, and education about hand washing and hygiene. The frequency of diarrhea in infants before and after SWS implementation was then compared. Surprisingly, diarrhea that occurred in the periweaning period and was serious enough to result in a consultation with a health care worker at a clinic did not decrease in frequency after the intervention [5]. The KiBS hygiene and water quality intervention did not remove the dangers associated with early weaning.

What could account for these disappointing results? One possibility is a weak study design, but we disagree with this critique. The unique historical circumstances that made this “quasixperiment” possible provide a robust context for the evaluation they present. The cohorts were very similar before and after the intervention. The investigators present a rigorous and careful analysis that takes into consideration possible threats to the internal validity of their study. A second possible critique is that the water quality intervention was too minimal. Again, we are not convinced by this criticism. The intervention implemented has been evaluated in other similar environments [7], and uptake and acceptability were reasonable. Moreover, the close monitoring and health counseling that are provided by a clinical research...
study ensure that the intervention was not implemented in a vacuum. If the intervention was not effective among the compliant, health-conscious participants in a clinical study with a health service safety net, then we are pessimistic about its likely success in a routine program setting.

What the KiBS results bring most strongly to the foreground is a challenge to our overly simple notions of how replacement feeding can be made safer for infants exposed to HIV. Clean water helps, but it is not enough. A closer review of reports on water quality interventions reveals that few focused on infants (age, <1 year) [7], and none, to our knowledge, focused on infants who were not being breast-fed. Infants are not little adults. Although the extent to which infants might be exposed to environmental contamination depends on their caregivers, infants explore their world in ways not approved of by hygiene education programs. They are also dependent on breast milk. Breast milk provides for the nutritional needs of an infant, but human milk provides more than nourishment. It protects against both the acquisition and severity of infectious diseases [8, 9]. Early weaning increases infectious morbidity in all mammals [10, 11], and it is the most likely reason why the KiBS intervention had only limited effectiveness. The protective benefits of breast-feeding are less about avoiding contamination and more about providing the child with a protective immunologic armamentarium [8, 12]. In settings with limited access to health care and marginal dietary intake, diarrhea is more than a temporary inconvenience. It is a major cause of death, and surviving children often fail to achieve their full growth potential [13].

Although limiting breast-feeding is more dangerous when access to safe water cannot be assured [14, 15], protection from severe diarrhea and respiratory infections is well-established, even in countries like the United States and United Kingdom [16, 17]. Low uptake and short duration of breast-feeding among women of disadvantaged socioeconomic position in the United States are factors that explain racial and socioeconomic disparities in the health of children [18, 19]. That breast-feeding protects not only against enteric disease but also against respiratory infections (in which contaminated water is unlikely to play a major role) further supports the idea that breast-feeding protects less by keeping the germs out and more by putting the good stuff in.

The results of the study by Harris and colleagues, as well as their thoughtful discussion of the implications, are a useful reminder of the limitations of some of our public health interventions. We endorse their conclusion that further investigation of extended maternal antiretroviral therapy is needed to address the longer duration of breast-feeding required in pathogen-rich environments. We add that, in terms of proof of concept, the capacities of both extended maternal antiretroviral therapy and extended infant prophylaxis to reduce postnatal HIV transmission have been demonstrated [20, 21]. We hope that the accumulating data on the hazards of early weaning, which have been known for decades among infants born to uninfected mothers and are now rediscovered among infants exposed to HIV, add impetus to global efforts to make antiretroviral therapy available for HIV-infected pregnant and lactating women. Safe water interventions are also likely to be helpful, but as an adjunct to, not as a replacement for, breast-feeding.

References

17. Chantry CJ, Howard CR, Auinger P. Full


