REDUCING ENVIRONMENTAL RISK TO PREVENT HIV TRANSMISSION IN SUB-SAHARAN AFRICA

Eileen Stillwaggon[a]

HIV/AIDS policy fails to address the reasons why sex and birth are more risky in Africa. Malnutrition lowers immunity and increases viral load in HIV-infected persons, making them more contagious. Malaria also increases viral load and thus the risk of sexual and vertical HIV transmission. Schistosomiasis increases risk of sexual transmission of HIV by lowering immune response and by causing genital lesions and inflammation. The weaknesses of developing economies and governance structures also interact with health variables. Often the best investment for improving health and preventing disease is outside the health sector. HIV prevention must go beyond last-minute interventions, such as promoting abstinence or condom use, and address the economic context in which risky behaviors occur.

1. Introduction

Global AIDS policy is at an impasse, and policy makers admit privately that they have no answer to the continuing spread of HIV, especially in Africa. For two decades, aid organizations have pursued the same narrow policies while prevalence of HIV in the region and around the developing world continues to climb. The sterility of global programs for HIV prevention is exemplified by the only debate that manages to capture media attention – whether abstinence or condoms are the solution to this very complex biological and socio-economic problem. That debate demonstrates what is wrong with AIDS policy – it only addresses sexual behavior. Although sexual behavior is important, it does not explain the great variation in HIV prevalence around the world nor is it very sensitive to policy interventions for HIV prevention.

[a] Eileen Stillwaggon is Associate Professor of Economics at Gettysburg College. Her research includes work in Tanzania, Zimbabwe, South Africa, Argentina, Ecuador, Dominican Republic, Lithuania, and on the Ute Reservation, USA.

This work discusses why AIDS policy has failed, explains some of the fundamental, but overlooked, causes of rapid spread of HIV/AIDS in sub-Saharan Africa, and suggests some ways policymakers can intervene effectively to reduce the transmission of HIV by reducing risk in the environment. Further, this work argues that recognizing and exploiting positive externalities, or spillovers, is necessary for achieving the Millennium Development Goals.

Section 2 describes briefly how AIDS policy was derailed by the assumption that differences in sexual behavior adequately explain differences in prevalence of HIV between countries. Section 3 provides some background on the biological interactions among nutrition, tropical diseases, and HIV and suggests inexpensive solutions that reduce the biological risk of HIV transmission during sex and birth. Section 4 provides an example of a non-health investment that reduces the risk of HIV spread while correcting a problem of economic development. Section 5 concludes with an assessment of how to improve allocation of funds for HIV prevention, emphasizing targets that are policy-sensitive[1] and have positive spillovers. The article argues that achieving health goals requires direct investment in broad health programs and complementary investment in poverty eradication and economic development.

2. Policy Derailed

HIV-prevention policy has failed partly because it is driven by the assumption, explicit or implicit, that differences in sexual behavior are sufficient to explain differences in HIV prevalence between populations. Numerous social science works and some policy documents explicitly make that case, relying on hypothesis and anecdotal evidence to support their argument (e.g., Caldwell et al., 1989; Ford, 1994; Rushing, 1995; UNFPA, 1999). Other policy documents implicitly uphold a behavioral explanation for differences in HIV prevalence because the interventions they support for HIV prevention are almost exclusively behavioral. The hypothesis that rates of concurrent multi-partnered sexual activity vary widely among countries is not based on empirical evidence and, on the contrary, is rejected by the few careful studies of sexual behavior and HIV rates that have been

conducted (Cleland and Ferry [WHO], 1995; UNAIDS, 1999).[2] Differences in sexual behavior cannot explain 50-fold differences in HIV prevalence around the world. Yet global AIDS policy relies almost entirely on behavioral interventions – abstinence or condoms – for HIV prevention. (See Section 3 for multiple sources.)

Policymakers seem to be convinced (without evidence) that Africans are having more sex than Americans. They do not ask why US college campuses, where rates of chlamydia and genital herpes are as high as 30 to 40 percent (CDC, 1997, 1998; Fleming et al., 1997; Kost and Forrest, 1992; Michael et al., 1994; Webster et al., 1993), do not also have high rates of HIV. Why did people formulating AIDS policy forget almost everything they knew about the requirements of disease transmission? Sex is part of it. People get distracted by sex, and because HIV is sexually transmitted many people ignore the fact that becoming infected with any disease, even a sexually transmitted disease, requires the combination of pathogen, host, and environmental factors.

The distraction of sex is compounded by persistent and pervasive, although often sub-conscious, Western notions of Africans that have had decisive influence on the path of global AIDS policy. The behavioral paradigm depends on an ethnographic approach that characterizes Africans as exotic, a notion that resonates for Europeans and North Americans because of an abundant literature of nineteenth-century racial science. European representations of Africans as exotic specifically emphasized sexual otherness (see Dubow, 1995; Gilman, 1985, 1990, 1992; Gould, 1981; Stepan, 1982, 1990). While legitimate scholars today reject racial science and the eugenics movement that derived from it, the AIDS-in-Africa discourse continues to be marred by an anthropological approach that begins from an assumption of racial difference. That difference is found in supposed cultural origins of the AIDS epidemic and continues to be promoted through anecdotal argument (e.g., Ashforth, 2002; Delius and Glaser, 2002; Forster, 2001).[3]

What the behavioral focus misses are the context of poverty in developing countries and the environment of hazards that poverty creates, making sex (and birth and medical care) more risky for poor people. The fundamental causes of more rapid spread of HIV amidst poverty are biological and socio-economic. Thus far, AIDS policy has relied too

much on anecdotal ethnography and unproven behavioral hypotheses and too little on biology and economics.

3. The Environment of Risk: Biological Causes and Solutions

There are biological reasons why HIV has spread more rapidly in poor populations, especially in sub-Saharan Africa, including the effects of environmental factors in weakening immune response. Malnutrition and parasitic illness make people more vulnerable to any infectious disease, whether it is spread by air, water, insects, or sex. HIV is no exception. Moreover, there are specific mechanisms by which malnutrition and parasitic illness increase the risk of sexual and vertical transmission of HIV. Consequently, eradicating malnutrition and parasitic illness are central to an effective HIV-prevention strategy, not an unrelated development goal.

Nutrition and the Immune System

Protein and energy malnutrition and deficiencies of specific micronutrients, such as iron, zinc, and vitamins, contribute to increased susceptibility to infectious and parasitic diseases. Moreover, infection and malnutrition are synergistic; fever increases the demands for energy at the same time that appetite decreases, and diarrheal diseases cause a rapid loss of nutrients (Beisel, 1996; Scrimshaw and SanGiovanni, 1997).

Both under– and mal-nutrition weaken every component of the immune system, and the effect of that damage is both immediate and long lasting. Consumed proteins provide the building blocks (amino acids) for new cells that can be used in T-cell replication/development and wound healing; vitamins (such as B, E) have antioxidant effects that decrease the stimulus for replication of pathogens; micronutrients (such as iron and zinc) can act as co-factors in pathways involved in T-cell development.

Numerous studies have demonstrated the results of even moderate protein-energy malnutrition (PEM) on the physical barriers to infection, epithelial (skin) and mucosal protection (Woodward, 1998). The lymphatic system is also harmed, affecting T-cell production (Beisel, 1996; Chandra, 1997). Children with PEM, regardless of degree or type

(stunting or wasting), have reduced immunity (Chandra, 1997; Woodward, 1998). Protein consumption promotes cell replication and so is very important in resistance to infection (Scrimshaw and SanGiovanni, 1997; Cunningham-Rundles, 1998; McMurray, 1998).

Micronutrient deficiencies also weaken various components of the immune system, even when the deficiencies are relatively mild (Chandra, 1997). Iron deficiency, the most widespread nutritional deficiency in the world, is especially common in women and children and is one cause of anemia. The World Health Organization estimates that, in sub-Saharan Africa, 41 to 60 percent of females and 28 to 60 percent of males (the range depending on age) are anemic (Stoltzfus et al., 2004). Iron is essential in promoting resistance to infection, through the lymphatic system, T-cell production, and other immune-response components (Scrimshaw and SanGiovanni, 1997).

Zinc deficiency, even in mild cases, can cause a large decrease in immune response (Beisel, 1996; Cunningham-Rundles, 1998). Zinc deficiency also impedes wound healing, undermines skin integrity as a barrier to infection, and weakens resistance to parasite infection, which aggravates malnutrition (Chandra, 1997). World Health Organization estimates of the prevalence of zinc deficiency in sub-Saharan Africa range from 37 to 62 percent, depending on region (Caulfield and Black, 2004). That constitutes a very large population with increased vulnerability to any infectious disease, but especially to transmission of sexually transmitted diseases, which is aided by weakness of the skin and mucosa.

Research over the past 30 years has confirmed the role of vitamin A as a super-vitamin for the immune system (Semba, 1998). Vitamin-A deficiency is very common in tropical areas because the diet of poor people often does not include vitamin-A rich foods (Fawzi et al., 1997). Prevalence of vitamin-A deficiency is higher in sub-Saharan Africa than in other world regions (Rice et al., 2004). Infections increase excretion of vitamin A, producing a deadly synergism of malnutrition, infection, and increased vitamin-A deficiency (Stephensen et al., 1994). Even subclinical cases (that is, not apparent upon examination and testing) of vitamin-A deficiency produce a lower immune response and greater vulnerability to infection, particularly of the skin and mucous membranes (Solomons, 1998). The role of

vitamin A in the promotion of physical barriers to infection (skin and mucous membranes) is especially significant for the prevention of infection with HIV or other sexually transmitted diseases (Semba, 1998).

Numerous studies demonstrate the role of other nutrients, including the B vitamins, vitamin E, and selenium, in maintaining the integrity of the immune system (Beisel, 1996; Scrimshaw and SanGiovanni, 1997; Meydani and Beharka, 1998). Nutrients also act together to bolster the immune system. Vitamin-A deficiency impairs iron utilization and so interacts with anemia. Even vitamin A alone can improve iron utilization (Sommer et al., 1996). Supplementation with vitamin A along with iron in pregnancy can virtually eliminate anemia. Considering the low cost of supplementation with vitamin A, its cost-effectiveness improves even more if we calculate its interaction with iron.

Nutritional deficiencies interact with parasitic illness to make a combined assault on immune status. Vitamin A strengthens immune response to malaria, including its most severe form, *Plasmodium falciparum*, which is most widespread in sub-Saharan Africa. Vitamin-A supplementation is an effective low-cost strategy to reduce malarial illness in young children (Shankar et al., 1999). Interventions that address nutritional deficiencies and parasitic infection are important for their own sake and for HIV prevention. Malaria also causes anemia, and the treatment of anemic children with transfusions of HIV-tainted blood contributed to the spread of HIV in Zaire (Hedberg et al., 1993).

HIV is not a special case; it is an infectious disease that can most easily be transmitted to a person whose immune system is weakened by malnutrition and by the synergistic effects of other infectious and parasitic diseases. An infected partner (or infected mother) is a necessary, but not generally sufficient condition for sexual (or vertical) transmission of HIV to a healthy person. Malnutrition and parasitic illness make sex and birth more risky. In this discussion of nutrition and disease, the interactions among the different Millennium Development Goals are clear. Goal 1, To Eradicate Extreme Poverty and Hunger, is essential for success in pursuing Goal 4, Reducing Child Mortality, and Goal 5, Improving Maternal Health. Improving maternal health and reducing child mortality, of course, also contribute to the reduction of poverty. What is also clear is that eradicating

hunger and parasitic diseases contributes significantly to reducing the spread of HIV as well.

HIV-Specific Interactions With Malnutrition and Parasitic Illness

There are also characteristics specific to HIV that make it spread more rapidly in malnourished and parasite-burdened populations. Viral load is the amount of virus in the blood, semen, and vaginal fluids, and it is the best predictor of HIV transmission between HIV-infected persons and their uninfected partners (Quinn et al., 2000). Malnutrition is associated with higher viral load in HIV-infected persons making them more contagious as sexual partners (Friis and Michaelsen, 1998). Anemia, the most widespread nutritional deficiency among women in developing countries, also increases viral shedding in the birth canal, increasing the risk of transmission from mother to child (John et al., 1997).

Vitamin-A deficiency is also associated with higher transmission of HIV from mother to child. In Malawi, it was observed that mothers who were severely deficient in vitamin A had a much higher risk of transmitting HIV to their children, perhaps due to the effect of the deficiency on the vaginal mucosa or the integrity of the placenta (Semba et al., 1994; Nimmagadda et al., 1998). Increased viral load in the mother and decreased maternal antibody protection, both associated with impaired T- and B-cell production from vitamin-A deficiency, are also probable causes of greater transmission (Landers, 1996).[4]

Parasites, such as malaria, schistosomes, and soil-transmitted worms, also increase HIV viral load and the contagiousness of HIV-infected persons. The interaction of malaria and HIV aggravates the risk environment in Africa more than elsewhere because of the heavy burden of malaria in Africa. Over 300 million people in Africa suffer from acute malaria each year. More countries in sub-Saharan Africa (39) than in all the rest of the world have high malaria prevalence. Only two countries outside of sub-Saharan Africa have prevalence exceeding 10 percent, whereas 14 African countries do. Particularly noteworthy are Burundi (48 percent), Guinea (76 percent), Malawi (26 percent), and Zambia (34 percent) (United Nations, Millennium Indicators Database; WHO, http://www.afro.who.int/malaria/country-profile/index.html).

Malaria stimulates HIV replication (Xiao et al., 1998), and HIV viral loads are significantly higher in malarial patients than in HIV-infected persons without malaria (Whitworth et al., 2000). High viral load due to malaria coinfection increases the risk of HIV transmission from blood exposure, from mother to child, and through sexual contact. In Malawi, men with malaria were found to have seven times the median viral load of HIV-infected men without malaria (Hoffman et al., 1999). Malaria is a very serious health problem in the developing world, especially in sub-Saharan Africa. Malaria control is essential for reducing HIV transmission in children and adults through its effect on viral load for HIV-infected mothers and sexual partners (Corbett et al., 2002). Controlling malaria would also alleviate one of the world's most devastating health problems and help to achieve Millennium Development Goals 4 and 5, reducing child and maternal mortality.

Schistosomiasis also plays a particularly sinister role in sub-Saharan Africa. *Schistosoma hematobium* is a freshwater worm that colonizes the urinary tract. Women washing clothes or collecting aquatic plants, fishermen, and children and adults who bathe in streams are vulnerable. The worm migrates to the genital tract and its eggs infect the vulva, cervix, and vagina, creating open sores and inflammation and promoting HIV infection in the same way that sexually transmitted diseases do (Leutscher et al., 1998; Feldmeier er al., 2001; Mosunjac et al., 2003). At sexual maturity, the lesions become more numerous and cluster in the cervix, which is the area most vulnerable to HIV infection in young women (Marble and Key, 1995). The sores are an open door for the HIV virus (Feldmeier et al., 1995). The inflammation is the immune system's response to the foreign bodies, the worm ova (Poggensee et al., 2000; Mosunjac et al., 2003). That also increases risk of HIV infection because the inflammation consists of the presence of T cells, which are the cells through which HIV attacks. A cross-sectional study of over 500 women in Zimbabwe found that women with genital lesions due to schistosomiasis were three times more likely to be HIV-infected than those without genital schistosomiasis (Kjetland et al, 2006)

The prevalence of reproductive tract infections of schistosomiasis ranges from 30 to 75 percent of women in endemic areas (Leutscher et al., 1998; Feldmeier et al., 2001; Harms and Feldmeier, 2002; Mosunjac et al., 2003). In Africa alone, 200 million people, men and

women, are afflicted with genitourinary schistosomiasis (Feldmeier et al., 1999), constituting a very large population with increased susceptibility to HIV. In some regions, such as along the shores of Lake Victoria, prevalence exceeds 40 percent of the population (Mwanga et al., 2004).

Schistosomiasis is endemic throughout tropical Africa and parts of subtropical Africa. In South Africa, prevalence of schistosomiasis ranges from 60 to 80 percent of schoolchildren in KwaZulu Natal. Prevalence is also high in Mpumalanga, Gauteng, Limpopo (Northern Province), and North West Province. KwaZulu Natal is the province with the highest estimated prevalence of HIV. All of the other provinces with high schistosome prevalence are also the provinces with the highest HIV, except Free State. There are certainly other factors in some provinces, including large urban areas and mines with single-sex barracks that influence HIV prevalence. The correlation of schistosomiasis and HIV prevalence, while not a demonstration of causality, lends epidemiological support to a biological mechanism by which the parasite is thought to increase the sexual spread of HIV.

Effective, Inexpensive Solutions To Widespread Cofactors of HIV Transmission

A malnourished, parasite-laden population gives rise to very different epidemic dynamics from that of a healthier population, but models used by the major AIDS organizations do not take that into consideration.[5] They typically assume a one-risk-fits-all transmission probability, rather than attempting to calculate the differential risk that applies to a population burdened by hunger and disease. The models presume to give answers to the questions: What are the determinants of HIV transmission and epidemic spread? And how can we best prevent HIV transmission? But those questions cannot be answered with models that abstract from endemic health problems. The exclusive focus on behavioral variables leads to very narrow, stop-gap attempts at solutions by organizations that control a large proportion of HIV program funds. Consequently, policy prescriptions ignore that greater risk of HIV infection per sex act or per birth that exists in much of sub-Saharan Africa and similarly poor populations. It makes more sense, and it is easier and cheaper, to

reduce the risk of transmission during sex or birth than to leave people malnourished and parasite-burdened and only attempt to get them to stop having sex, protected or not.

Reducing the risk of HIV and meeting some of the Millennium Development Goals is relatively inexpensive, especially when their interactions are properly recognized. We already have the knowledge and the infrastructure to alleviate many nutritional deficiencies. For most micronutrients, such as iron and vitamin A, a year's requirement can be delivered for the price of one condom. Vitamin-A supplements can be provided twice yearly, and the cost is US$0.02 per capsule (Sommer et al., 1996). Iron supplementation costs US$0.02 per child per year if given weekly, or US$0.08, if given daily (Stoltzfus et al., 1998).

Malaria is a difficult problem, but treatment of worms is not. Deworming medications are safe, cheap, heat-stable, and easily administered by people with very little training. The cost ranges from 5 to 25 US cents, depending on the type of worm, to deliver twice-yearly treatment (Stoltzfus et al., 1998; Montresor et al., 2001; World Bank, 2003). An important benefit of deworming is that it has positive externalities, or spillovers. Even children and adults who are not treated have reduced infection and better school and work attendance because of the reduced worm concentrations in their environment (Miguel and Kremer, 2001). Deworming has always been a good investment. The direct role of malnutrition and parasites in aggravating the spread of HIV highlights the necessity of reinforcing a biological and multifaceted approach to HIV/AIDS.

HIV/AIDS is a complex epidemic, with multiple causes – biological, social, economic, and behavioral. Malnutrition and parasitic illness do not explain all of the variation in prevalence of HIV between populations, but a biological understanding of HIV is an advance over the assumption that differences in behavior adequately explain differences in rates of HIV. What is needed is considerably more research on the interactions among endemic conditions and considerably more spending on broad programs for public health, clean water, adequate food and supplements, health education, and access to health care.

This section has emphasized the need for investments in interrelated health programs for health goals. The next section highlights the importance of investments outside

the health sector for achieving health goals. Both strategies seek to alter the environment before risky behaviors or risky births occur.

4. The Environment of Risk: Economic Causes and Solutions

In addition to the biological cofactors that increase transmission of HIV in sub-Saharan Africa, there are economic and social factors that directly produce an environment of risk. When policymakers can recognize the opportunities to intervene, there are straightforward, effective solutions to those economic risk factors, as well. Until now, the excessive focus on sexual behavior on the part of policy organizations has led to futile, end-game strategies – intervening at the last possible moment with condoms or pleas for abstinence. What are needed are policies that correct economic problems and also reduce the risk of disease.

An economic problem of enormous importance in sub-Saharan Africa is caused by border delays that strangle trade. Well-developed trade corridors are essential for the flow of goods and also for the diffusion of new technology, both of which contribute to job creation and opportunities for higher incomes in the hinterland. Cumbersome trade regulations raise costs for trucking companies, shippers, and consumers and discourage trade and investment. Moving goods across borders in Southern Africa can take as long as ten days in Zimbabwe, and up to seven days in other African countries (FHI, 2003). In Uganda border officials do not work on Saturday or Sunday, and in some places border posts close at four in the afternoon (Synergy Project, 2002). Ten-day delays at a border mean: ten days of idle capital (the trucks); ten days of wages for idle skilled and semi-skilled truckers and their assistants; bribes to petty officials to clear paperwork; impediments to shipping perishable goods; impediments to shipping high-value goods because of increased risk of theft; and impediments to shipping low-value goods because of high fixed costs of border delays.

In addition to these very considerable burdens on African economies, border delays are mentioned repeatedly in the AIDS policy literature as contributing to HIV transmission, particularly in sub-Saharan Africa. It is argued that border crossings have been an important source of HIV spread along highways because truckers find that no hotels are available or

that staying with a commercial sex worker is cheaper than staying in a hotel. The health toll on drivers who stay with sex workers at border posts is high. Among truckers in South Africa, 403 AIDS-related deaths for every death from other causes were expected by 2005 (Synergy Project, 2002). A Zambian trucking company lost 39 of its 144 drivers to AIDS in three years (Synergy Project, 2002). To all the other costs of border delays, one must add higher health-care costs for trucking firms for HIV-infected employees; higher training costs to replace workers who have died from AIDS; and higher costs for the national economies as HIV spreads along highways and into town and village populations.

An Economic Policy Solution

The diffusion of HIV/AIDS along trucking routes naturally demands a response from AIDS-policy organizations. There is an immediate, policy-sensitive, and obvious solution to this problem, if it is seen as an economic development issue – eliminating intra-regional customs regulations to permit the free flow of goods across borders. Governments in Africa that are reliant on customs duties for revenue might be very reluctant to reduce tariffs. If so, improving the efficiency of border crossings, without tariff reductions, would still be a significant improvement. Both solutions would reduce costs for shippers and trucking companies and increase trade and incentives to local and regional production, while also eliminating a contributing cause of the AIDS epidemic.

There are numerous historical and political obstacles to the free flow of goods and factors of production across international borders. Although openness is associated with growth in African countries (Sachs and Warner, 1997), most African countries have significant trade barriers that are intended to protect domestic industry as well as generate government revenue (Dean et al., 1994; Sachs and Warner, 1997; Khandelwal, 2004). This is not the place to evaluate all the arguments for and against protectionist trade policy, however, even a limited solution, such as regional trade pacts with a common external tariff, would probably be more beneficial than the current arrangement. The costs of intra-regional barriers are numerous, including the costs to the government of maintaining the system, the private costs listed above, and the pervasive corruption and its insidious effect on good

governance, efficiency, and personal incentives. To all that we must now add the mushrooming costs of the AIDS epidemic, which is partly fueled by border delays.

Border regulations could be dismantled in a very short time because the template and the technology are already available. The European Union is an example of a region that has freed intra-regional trade from costly restrictions but still maintains barriers to external trade. Of course, African economies lack many of the strengths that European economies had at the time of union, but the benefits of a common market could contribute to building stronger economies in sub-Saharan Africa.

North America offers a model for facilitating truck transport, with computerized systems for paperless truck logs and surveillance procedures that allow trucks to maintain highway speeds while passing weighing stations, ports of entry, and agricultural inspection stations (see PrePass at www.prepass.com). The International Chamber of Commerce (ICC) also has a well developed program for trade facilitation, including paperless customs procedures and other border surveillance, such as agricultural and security checks (www.iccwbo.org).

There is a very valuable opportunity here for the Bill and Melinda Gates Foundation or other funding groups to modernize trucking and trade by financing the computerization of customs for the trade corridors in Africa, Asia, and Latin America. Low national income is not an obstacle to trade facilitation. India is computerizing truck checks at state borders. The intention was probably to reduce corruption, a worthwhile goal. But the new procedures also improve oversight and increase profits in other ways, including reduced travel time, lowering capital and labor costs for shippers (Nachiket Doshi, personal communication). Compared with the economic and health costs of border delays, a $100 laptop computer and a transponder for every truck would be a small investment.

The Myopic Behavioral Solution

This structural economic and political problem offers a disappointing example of the failure of aid agencies to recognize policies that would reduce the environment of risk for the spread of HIV/AIDS. USAID, the development agency of the US government, initiated

a costly program, called Corridors of Hope, to reduce HIV transmission at border crossings. It contracted that project to three of its private-sector partners: Family Health International (FHI), Population Services International (PSI), and The Futures Group International (TFGI). The primary activity of each of those organizations is behavior-change communication and condom distribution (see institutional websites: www.fhi.org; www.psi.org; www.tfgi.org). Their solution was, not surprisingly, behavior-change communication and condom distribution at the borders, rather than eliminating costly delays and the need for their services.

USAID trapped itself in a market-failure problem, a case of supplier-induced demand, outsourcing the solution for border delays (transport logistics and customs procedures) to organizations experienced primarily in behavior-change communication. It did not enlist the help of the World Bank, the International Chamber of Commerce, or the European Union, all of which have expertise in trucking and customs facilitation, to solve an economic problem with serious public health effects. The primary cause of the border delays is a problem of economic development – costly trade regulation and corruption – that falls outside the expertise of those organizations USAID contracted and consequently is not addressed in Corridors of Hope. Behavior-change communication is part of the answer, but it does not attack the problem in a sustained way geared for maximum impact.

USAID chose partners with the wrong incentive structure for solving the border problem. A ten-day delay at the border means ten days' supply of condoms that PSI needs to provide. The longer the wait, the more it seems an emergency with no room for more complex ideas like structural change in the economic, social, or bureaucratic setting. If USAID had sought the advice of different organizations, the problem could have been addressed to correct economic problems while preventing the spread of HIV. And the solutions would provide incentives for the business community to cooperate because of reduced costs.

Programs such as reforming border procedures are within the direct control of policy makers because they only require enforcement of administrative changes within the government. Behavior change, in contrast, is not subject to the direct control of

governments. Governments can educate and exhort, but they cannot enforce behavior change or even find out if they have successfully changed anyone's behavior. The priority in strategies should always be those over which the agency can reasonably expect to exert control and those that have the broadest, most sustainable impact because they get to the fundamental cause.

USAID is not alone in its reliance on the wrong organizations and the wrong measures. All of the major organizations involved in HIV prevention – UNAIDS, UNFPA, WHO, the World Bank, the Global Fund, the European development aid agencies, as well as USAID and its private-sector partners – fund almost exclusively behavior-change communication and condom distribution (see HIV at a Glance, http://www.worldbank.org; Schwartländer et al, 2001; USAID, 2001, 2003; Global Fund Disbursements, http://www.theglobalfund.org). Very little HIV/AIDS funding has yet gone to the development of clinics and human capital for health promotion, although there is increasing recognition of the necessity to develop African health sectors to combat AIDS.

Exploiting Externalities in Multi-sectoral Programs

Sometimes the best investment to solve a health problem will be outside the health sector. There are countless ways to promote development and reduce the risk of HIV transmission. In every sector—agriculture, industry, commerce, government, education, and others—there are opportunities to curtail the health crisis in Africa and other developing regions. The modernization of trucking and trade is just one example of obvious ways to help prevent HIV transmission while achieving other worthwhile goals.

Too often, a multi-sectoral approach to HIV prevention, or "mainstreaming," as it has been called, has meant taking a bite out of every ministerial budget in order to fund HIV-prevention activities. Painting AIDS messages on trucks and rail cars does not use the transport budget with maximum effectiveness if trucks still sit for days at the border. Sending agricultural extension agents to training programs to become sex counselors diminishes their impact, unless they can also help farmers increase production and sale of their crops to reduce malnutrition and rural poverty.

5. Conclusion

There are plenty of ways to help prevent HIV by changing the biological and economic context in which the epidemic is spreading. They are often inexpensive and can generate a high rate of return. Behavioral interventions are necessary, but their effectiveness is often a matter of faith more than documented results. So far, neither preaching abstinence nor handing out condoms has had an appreciable impact on the epidemic because sexual behavior is not the most important difference between high-prevalence and low-prevalence populations.

It is not a coincidence that the countries with the highest rates of HIV have serious environmental, economic, and bureaucratic problems. Pragmatic solutions to those problems – from reducing border delays to parasite control – reduce the environment of risk for HIV and are policy-sensitive. Governments can change customs regulations or deliver safe water supplies and multivitamins more easily than they can chase down every person having unprotected sex. Some of the money for HIV prevention should be spent where it has positive spillovers for productivity and development and can directly prevent new cases of HIV.

There is also good news. The methods of eliminating parasitic illness are already known, and the organizations already exist that are equipped to manage eradication campaigns. Strategies for improving the efficiency of economies and governments are already known. The template exists, and the technical assistance could be readily available. The best news is that, because of externalities, or positive spillovers, the whole package of investments in good health and economic development will actually cost less than current projections (e.g. CMH, 2001). Development and health goals are not contradictory. On the contrary, they can only be achieved together and by recognizing and exploiting the benefits that accrue from one to the other.

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Endnotes

[1] Policy-sensitive refers to those targets over which an agency can reasonably expect to exert control. Governments have control over their own regulations, but not over the behavior of individuals in private.

[2] These two studies use accepted methods of survey research. The WHO study found no empirical basis for the assumption that rates of HIV reflect variations in sexual behavior between populations and concluded, "WHO/GPA surveys are thus immensely valuable in correcting wildly inaccurate perceptions of sexual behaviour, that were based on guesswork or small unrepresentative studies" (Cleland et al., 1995, 211). The UNAIDS study found large variations in rates of surveyed sexual behaviors, but found no correlation between high rates of specific behaviors and HIV. Singh et al., 2000, surveyed age at first intercourse in 14 countries. There is an almost perfect inverse relationship between average age at first intercourse and national prevalence of HIV, with the United States and the United Kingdom having the earliest age and lowest rates of HIV and Zimbabwe having the highest prevalence of HIV and latest age of first intercourse among countries surveyed, which contradicts one of the assumptions of the behavioral model (Stillwaggon, 2006). For more extensive discussion of surveys of sexual behavior, see Stillwaggon, 2006.

[3] For more extensive discussion of the influence of racial stereotypes on AIDS policy, see Stillwaggon, 2003, 2006.

[4] Although recent trials of vitamin-A supplementation have not yet been successful in reducing vertical transmission, they suggest useful avenues for research. The environment of poverty, malnutrition, and parasitosis in which HIV flourishes provides a complicated laboratory for trials of any single intervention. Complementary interventions in malaria treatment or other nutritional supplements might be necessary in order to detect the effectiveness of vitamin-A supplementation in this multiburdened population.

[5] The transmission models used by major AIDS-funding organizations assume very few factors in HIV transmission, all related to individual sexual behavior. They do not take into account other medically significant differences between populations, such as prevalence of malaria, TB, schistosomiasis, helminthic infection, or malnutrition, which affect the risk of transmission or infection. Three such models are: the AVERT model, developed by Family Health International (FHI) for USAID (Bouey et al., 1998); the GOALS model, developed by the Futures Group International (TFGI), another USAID partner (www.tfgi.com); and the STDSIM model, used in the World Bank's book, *Confronting AIDS* (van Vliet et al., 1997). Abstracting from all the health factors that differentiate populations, these models use one value for male-to-female transmission risk for all populations and one value for female-to-male transmission risk for all populations. For more extensive analysis of methodological problems involved in HIV/AIDS policy, see Stillwaggon, 2006.