

Cost-Effectiveness of HIV Prevention in Developing Countries

HIV InSite Knowledge Base Chapter
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Cost-Effectiveness of HIV Prevention in Developing Countries

Introduction

This chapter posits that HIV prevention interventions in developing countries can reduce the incidence of HIV infection and sometimes save financial resources in the process. It also provides an overview of the basic theory underlying cost-effectiveness analysis. Although the chapter focuses on prevention, treatment and research are also indispensable to addressing the epidemic; these three tracks must be viewed as inseparable components of the overall response to the AIDS pandemic.

Why Cost-Effectiveness Analysis?

Despite the widely acknowledged severity of the global HIV crisis, resources available to combat the epidemic are severely limited. The combined contribution of official international aid for HIV prevention and treatment from the 22 rich nations of the Organization for Economic Cooperation and Development (OECD) is well below 3% of the amount needed to stem the pandemic.(1) Because resources are currently so constrained, it is imperative that available funds be spent for interventions that are cost-effective, ie, interventions that avert a high number of HIV infections compared with alternative uses of the funds.(2) Over time, cost-effectiveness information can also support the rational allocation of resources as funding is scaled up to more closely match real need. By increasing the likelihood that new funds will be spent efficiently, cost-effectiveness analyses may also strengthen the political will to commit these funds.(3)

Cost-effectiveness analysis can guide the policy process in several specific ways. First, because it is ultimately about choosing among alternatives, cost-effectiveness analysis requires a clear description of all relevant policy options. Such an inventory of options is otherwise rarely made. Defining the desired outcome (eg, reduction in HIV incidence in a particular population) can stimulate new thinking about the best means to achieve this end. It can also help to crystallize the most policy-relevant assessment of intervention data, for example: "How much behavior change must a program deliver to be worthwhile?"

Second, cost-effectiveness analyses take perspective into account. A program that may not be cost saving nor even cost-effective to a particular governmental agency may nonetheless be desirable from a societal perspective. This shifts the terms of the policy debate away from narrow fiscal effect on a particular governmental entity and toward a broader assessment of societal good, including possible savings to the national budget. In this way, cost-effectiveness analysis can move politically moribund alternatives onto the active agenda.

Third, the importance of politics in HIV does not preclude a role for cost-effectiveness analysis, but instead means that such appraisals must be compelling enough to influence a

process with many actors and aims. Credible cost-effectiveness analyses can thus be a means of political persuasion. Rather than supporting a policy decision merely because it appears to be effective or because it enjoys broad political support, systematic analysis pushes another and perhaps more useful question to the fore: Is it the best use of available resources?

Finally, and most important, the failure to pursue rational resource allocation is done only at the peril of overspending scarce prevention dollars on less effective programs, and underspending on more effective ones. Ultimately these missed opportunities mean lost lives.

These concerns are not hypothetical. Ainsworth and Teokul argue that the failure to prioritize the scarce resources available to combat AIDS is a major cause of the lack of an effective response to the pandemic.⁽⁴⁾ Rather than focusing on interventions that are most likely to be effective and cost-effective, governments and donor agencies support programs that are politically popular and uncontroversial. Almost by definition, these exclude strategies focused on high-risk groups such as sex workers, men who have sex with men, and injection drug users. These are precisely the groups most likely to become infected and to spread the disease into the general population. Recognizing the need for a scaled-up response, international donors have supported so-called "multisectoral" or "expanded" programs intended to increase the political and economic resources available to fight the epidemic. But these efforts too often end up spreading funds over a wide range of programs with little focus. Also, because they are multisectoral, they bring agencies into the AIDS arena that may have little relevant experience or competence. The result again is a lack of priority setting.⁽⁴⁾

Cost-effectiveness analysis cannot and should not substitute for the political process. Nevertheless, cost-effectiveness information can focus the attention of decision-makers on the interventions with real potential to contain the epidemic and to aid in setting priorities within a reduced menu of options. Credible cost-effectiveness analysis can do this by providing needed information to decision-makers who are already disposed to focus on interventions that can make a difference. Where this political consensus has not been achieved, cost-effectiveness analysis can bolster the arguments of those advocating less popular but more cost-effective strategies. Although political processes, not economic appraisal, determine policy, cost-effectiveness analysis can help shape the political agenda.

Cost-Effectiveness Analysis: Basic Theory

A central concern of economics is how best to use available resources in a world where desires, if not needs, always exceed the capacity to fulfill them. The key concept informing consideration of this issue is "opportunity cost." Opportunity cost refers to the concept that use of resources one place precludes their use elsewhere. It is concerned with real resource consumption, rather than with mere financial effects. Thus, the real cost of a particular expenditure is the best alternative use of those funds, now foreclosed.

These statements may seem trivial because they devolve to the truism that money spent here cannot be spent there. But, like the prospect of being hanged in the morning, "opportunity cost" focuses the mind wonderfully, and therein lies its utility. It can counteract the bureaucratic tendency to unthinkingly continue this year what worked last year. Thinking about opportunity cost can thus stimulate creativity about the best use of resources given current needs and alternatives.

The opportunity cost concept suggests that it is not enough to do something useful with the resources available. Action with a net positive effect is still wasteful if the foregone alternative would have had higher value. It prompts the question, "Because money is limited (budgets are constrained), what is its best use at the margin (the next available dollars)?" Budgets, however, are always constrained, and the margin is the economist's permanent residence, so opportunity cost and the challenge to allocate resources rationally are always present. Opportunity costs and rigorous thinking about resource allocation inoculate decision-makers against the kind of thinking that prompts statements such as, "We are concerned with saving children's lives. Money cannot be a determining factor." What such statements overlook is that "money" is not "mere money" to be subordinated to the saving of lives. Cost is another name for an unrealized benefit somewhere else. That benefit might result in the saving of more children's lives than the use being defended.

The problem of resource allocation then becomes, "Where can the greatest benefit be obtained for a given expenditure?" Cost-effectiveness analysis provides a conceptual framework and practical tools to assist with that determination. It is purely instrumental. As with economics generally, cost-effectiveness analysis is value-neutral regarding goal selection. One must look elsewhere to decide what is worth having. Once a goal is determined (eg, reduced HIV incidence), the role of cost-effectiveness analysis is to help reach it with as small an expenditure (opportunity cost) as possible. It is concerned, in other words, with efficiency.

The measure of efficiency used in cost-effectiveness analyses is the cost-effectiveness ratio, which is the ratio of program costs to a health-related outcome such as lives saved, life-years saved, or cases of HIV prevented:

$$\text{Cost-effectiveness ratio} = \frac{\text{Cost of program} - \text{medical and other costs saved}}{\text{Health benefits}}$$

The numerator equals the cost of delivering the intervention minus the medical costs saved by preventing the transmission of HIV and other economic benefits of prevention. The smaller the cost-effectiveness ratio, the more economically efficient the program.

One widely used measure of health benefits (the denominator in this equation) is the Disability-Adjusted Life-Year, or DALY. DALYs gained from an intervention are the sum of the years of life saved, where each life-year has received a weight to reflect both quality of life and the economic productivity of that life-year. DALYs provide a common metric of health benefits that allows for comparison of outcomes from different types of programs and populations.

The most comprehensive cost-effectiveness measures reflect a societal perspective in which all relevant costs are counted, regardless of who incurs them. This is standard methodology⁽⁵⁾ and includes the broadest possible assessment of program effects. However, it is quite possible for an intervention to be cost-effective from a societal point of view, but still require unaffordable outlays from a ministry of health or other public health sector payer. The ideal analysis, therefore, would include calculations from the perspective of both the public health sector payer and society as a whole. If an intervention is cost-effective from a societal perspective, but not from the payer's perspective, a case might be made for subsidies or external contributions.

Assessing Cost-Effectiveness Analyses

The results of cost-effectiveness analyses are driven mainly by the assumptions that underlie them, such as intervention effectiveness or baseline HIV incidence. A jaundiced extension of this truism is that one can therefore use cost-effectiveness analyses to argue anything. The best protection against the manipulation of cost-effectiveness analyses is complete and clear presentation. Although this section cannot inventory all the elements of a good cost-effectiveness analysis, nor all of the pitfalls that may snare the unwary consumer of economic appraisals, there are a few general principles. The first and most important is "No black boxes". In other words, all the key assumptions that drive the analysis--or, anticipating the consumer, that might be expected to do so--should be clearly identified and justified. These include both modeling assumptions that determine how inputs are related mathematically to produce the final cost-effectiveness ratio, and data assumptions concerning the estimated value of those inputs. A convincing rationale should be presented for each. Consumers should ask, "Are they appropriate for the setting? Are they thoroughly examined in the sensitivity analyses where the effect of changed assumptions on results is studied? Are the estimates derived from reliable sources?"

A second rule is "Note the perspective". This means being aware of the level (eg, individual clinic, agency, national government, society as a whole) at which costs and benefits are being accounted. This should be made explicit, but often is not. The consumer should ask, "Is the analytic perspective appropriate to the policy question being addressed? How might a different perspective change the results?" Cost-effective interventions, except those that are also cost saving, still require a net increase in funds. An analysis that assesses only the financial effects on a health care agency or clinic may conclude that a given intervention is unaffordable. This could happen, for example, if averted future medical care costs do not accrue to the implementing agency. However,

from the perspective of a higher level of government that does receive the savings in medical cost, the intervention could be cost-effective or even cost saving.

A third rule is, "Confront the uncertainties". A good cost-effectiveness analysis presents the results of a "base case" analysis that incorporates the best estimates for each input. These findings are then supplemented by extensive use of sensitivity analyses, which explore how variations in the value of key inputs affect the results. The sensitivity analyses are very useful in determining the range of circumstances in which a given intervention is likely to be cost-effective. These explorations can be instructive in their own right: Figure 1 shows how the number of HIV cases averted by a program of female condom distribution to sex workers (SWs) in South Africa varies according to the HIV prevalence in the client population.⁽⁶⁾ Cases averted increase as prevalence rises to 60%. Thereafter, it falls as higher prevalence means fewer HIV-negative susceptibles who can be protected through female condoms. This includes both fewer HIV-negative SWs and fewer HIV-negative clients.

A final rule could be called, "Compared to what?" A cost-effectiveness ratio is strictly a relative measure. The finding that an intervention is cost-effective simply means that one can expect as much or more health benefit from spending a given amount of money on that intervention as on alternative uses of the same money in that setting. For example, US\$3,000 per case of HIV averted may be cost-effective in one setting but not in another of equal wealth where the portfolio of cheaper programs has not yet been exhausted. The problem is that there is usually little relevant information on the cost-effectiveness of the other options. The analyst is then thrown back on a more general standard of what is viewed as cost-effective in sub-Saharan Africa or in developing countries generally. As more cost-effectiveness information becomes available, it will become possible to tune these comparisons more closely to the specific setting under consideration. In the meantime, the analyst should explain the rationale for using a particular cost-effectiveness threshold.

HIV Prevention Cost-Effectiveness: Findings for Developing Countries

There is a rapidly growing and compelling body of literature on the efficacy and cost-effectiveness of HIV prevention interventions in resource-poor countries. These studies contain important lessons--not intuitively obvious--about strategies to limit the spread of HIV. For example, one study concluded that the benefit of prevention is highest if programs are introduced when HIV prevalence is still low.⁽⁷⁾ This was the case in Senegal, where early and concerted government effort helped to forestall new HIV infections before prevalence escalated. At the end of 1999, the last year for which UNAIDS provides country-level data, Senegal's adult HIV prevalence was 1.77%.⁽⁸⁾

Most studies on the cost-effectiveness of HIV prevention emphasize the superior efficiency of targeting high-risk groups over nontargeted interventions. Examples of high-risk groups include sex workers and their clients, others with multiple sex partners, men who have sex with men, and injection drug users. Yet targeting those who are already infected may also be a highly cost-effective strategy for behavioral change

interventions. For example, an analysis of voluntary counseling and testing in Kenya and Tanzania found that cost-effectiveness increased in tandem with the proportion of HIV-positives in the client population.(9)

Major interventions for which sound cost-effectiveness data are currently available (and which are applicable to resource-poor settings) include:

sex worker interventions

male and female condom promotion

control of sexually transmitted diseases (STDs)

voluntary counseling and testing

blood supply safety measures

prevention of mother-to-child transmission

Table 1 summarizes the findings of studies conducted in sub-Saharan Africa of six key HIV prevention interventions. In all cases, the intervention is cost-effective. The sections below synthesize key findings related to each intervention.

Sex Worker Interventions

Because they have high rates of partner change and because they are frequently likely to be infected with other STDs in addition to HIV, sex workers (SWs) constitute a group that should receive high priority for HIV prevention interventions. If transmission in this group is not interrupted, infection spreads rapidly beyond SWs and their clients to the wives or sexual partners of the clients (who may not know of this risk and who may be powerless to act even if they did know). They can in turn transmit infection to their infants and to the general adult population.

Peer education programs have been shown to be highly effective in reducing transmission from and to SWs.(10, 11) A 1991 analysis carried out among 1,000 SWs in Nairobi found that a program of STD control and condom promotion was able to prevent between 8,000 and 10,000 new cases of HIV infection per year.(12) Given the modest cost of the program, each averted HIV infection costs between US\$8 and US\$12, demonstrating extremely high cost-effectiveness. Interventions of this type are competitive with the most cost-effective HIV and non-HIV public health interventions.

Sexually Transmitted Disease Control

STDs other than HIV, especially those that cause ulceration, significantly increase risk of HIV transmission upon exposure.(13, 14) Enhanced STD control is therefore a

potentially efficacious and cost-effective HIV prevention strategy. A study of the effect of STD services on HIV infection rates, conducted in Mwanza, Tanzania, examined the effects of enhanced STD services (with comparisons to matched communities that did not receive the intervention).(13-15) This research project demonstrated a statistically significant effect of enhanced STD services in lowering HIV incidence by 38% over 2 years. The intervention cost US\$350 per HIV infection averted or US\$13 per DALY gained. This intervention should be considered highly cost-effective.

Voluntary HIV Counseling and Testing

The most definitive study on both the cost and the cost-effectiveness of voluntary HIV counseling and testing (VCT) was carried out in the context of a randomized controlled trial in Tanzania and Kenya.(9) Cost-effectiveness outcome measures included both cost per HIV infection averted and cost per DALY saved. The study examined changes in the cost-effectiveness of VCT by variation in the HIV prevalence of the client population. It also documented the effect of varying the proportion of clients who receive VCT as a couple compared with individuals. The cost per HIV infection averted was US\$249 and US\$346, in Kenya and Tanzania, respectively, and the cost per DALY was US\$13 and US\$18, respectively. The intervention was most cost-effective for HIV-infected people and those who received VCT as a couple.

VCT remained cost-effective across the full range of sensitivity analyses. Analysis of targeting showed that increasing the proportion of couples to 70% reduces the cost per DALY saved to US\$11 in Kenya and US\$13 in Tanzania, and that targeting a population with HIV prevalence of 45% decreased the cost per DALY saved to US\$8 in Kenya and US\$12 in Tanzania. Targeting HIV-infected people is also a highly cost-effective strategy as they may be more disposed to behavior change than the uninfected. The per-client cost of VCT reported in this study was US\$29 in Tanzania and US\$27 in Kenya.(9). These figures are somewhat higher than other estimates. If these cost estimates from the Kenya and Tanzania trials exceed those in most other settings, this would suggest that VCT is even more cost-effective than was reported in this study.

Male Condom Promotion

A number of studies have demonstrated the effectiveness of male condom promotion in reducing the frequency of risky sex and HIV incidence in high-risk populations.(10, 11) Other studies document the cost per condom distributed.(16) Although there are no published studies on the cost-effectiveness of male condom promotion considered as a stand-alone intervention, male condom promotion is included as an adjunct to a package of services that also includes peer education and STD control.(12) These programs, considered as a whole, are highly cost-effective.

Furthermore, a recent analysis of the cost-effectiveness of the female condom (discussed below) suggests that programs of female condom promotion are likely to be very cost-effective in areas of high prevalence, even among women with moderate rates of partner change. Since the female condom costs roughly 10 times as much as the male condom, it

seems quite probable that male condom promotion can be highly cost-effective in most parts of the developing world with a significant HIV epidemic.

Female Condom Promotion Among Women at High Risk of HIV Infection

A recent study analyzed the cost-effectiveness of the female condom if supplied to a hypothetical cohort of 1000 SWs in South Africa.⁽⁶⁾ The study's major finding was that this program would generate net savings to the public sector health payer of US\$9,163 or about US\$9 per SW served. Sensitivity analyses indicate that the economic findings are robust across a wide range of values for key inputs. The program generates net savings of US\$5,421 if HIV prevalence in SWs is 25% rather than 50.3% and savings of US\$3,591 if each SW has an average of 10 clients per year rather than 25. A program focusing on non-SWs with only one casual partner would also save money.

Female condoms and male condoms have about equivalent effectiveness in reducing risk of HIV transmission, but as previously noted, female condoms are far more costly. Cost-effectiveness results are therefore sensitive to assumptions made about the rate of substitution between the two types of condoms (ie, the portion of sexual episodes covered by female condoms that would have been covered by male condoms had the female condoms not been available). In the base case modeled in this study--which included HIV prevalence of 50% among the SWs, cost of the female condom of US\$0.66 per unit, and saved life-time HIV treatment costs of US\$2,507 per case averted--the substitution rate was 25%. In other words, 25% of female condoms substitute for male condoms and thus provide no additional benefits. Cost savings are preserved if HIV prevalence is reduced to 25% or the substitution rate is raised to 75%. Under a scenario that includes both high substitution rates (75%) and lower HIV prevalence (25%), the intervention no longer actually saves money but retains its cost-effectiveness (US\$454 per case averted). These results assume no reuse of the female condom.

Improving Blood Supply Safety

As with all HIV prevention strategies, the cost-effectiveness of blood supply safety programs is highly dependent on HIV prevalence in the service area. This is particularly true of programs to prevent HIV infection through contaminated blood products because the cost of testing a unit of blood is the same regardless of whether the blood proves to be infected. Health benefits are achieved only if the blood product is actually infected and if the potential recipient was HIV negative. A 1995 study of the economics of blood supply safety found that it cost US\$172 per HIV infection averted.⁽¹⁷⁾ This result indicates that blood supply interventions can be highly cost-effective. This is particularly true when one considers that the design of this and similar studies may actually be biased toward a less favorable result than is achieved in practice for two reasons: a) only cases of HIV transmitted from blood donor to recipient were considered, whereas transmission to subsequent sex partners was ignored; and b) whereas HIV prevalence among donors was assumed to be 16%, prevalence among recipients was assumed to be 40%, comparable to the highest rates found in sub-Saharan Africa. This means that in only 60% of cases of transfusion of infected blood would it be possible for the recipient to become infected.

Prevention of Mother-to-Child Transmission

The field of prevention of mother-to-child transmission of HIV (PMTCT) has received more attention from cost-effectiveness analysts than any other area of HIV prevention. This may be because of the more easily measured effectiveness of PMTCT interventions compared with behavior change strategies. The result is that the published literature in this area is the most advanced with regard to defining the circumstances under which these interventions make economic sense.

Recent analysis of the cost-effectiveness of PMTCT calculated the financial and mortality outcomes in a hypothetical population of 20,000 pregnant women in a working-class urban South African population.(18) The analysis examined the cost-effectiveness of four different formula-feeding interventions, three antiretroviral (ARV) regimens, and a combined ARV-plus-formula-feeding intervention. The study concluded that "short-course" ARV interventions (a more limited regimen than the current standard of care in the United States) are cost-effective in a wide range of settings with or without formula feeding. The Centers for Disease Control and Prevention (CDC) regimen with formula recommended (but not provided free of charge) would be cost-saving to the health system. The CDC regimen with formula supplied free of charge to the mothers would be cost-effective at a rate of US\$37 per life-year saved.

Another research project, based in the KwaZulu Natal province of South Africa, calculated the cost-effectiveness and affordability of "short-course" AZT plus 4 months of formula feeding.(19) The same analysis was then applied to each of the other South African provinces. Researchers concluded that this intervention would be cost-effective even without the savings in HIV/AIDS care costs associated with the infections averted by the intervention. (At the time, data on the lifetime medical care costs associated with pediatric HIV were unavailable for South Africa or elsewhere in sub-Saharan Africa.) A subsequent multicenter collaborative consensus study of 106 HIV-infected children found that lifetime treatment costs totaled R19,712 (about US\$1,736(*)).(20) The study also found that a program at a scale sufficient to prevent 37% of pediatric HIV infections would cost R3.89 (about US\$0.34(*) per person in South Africa and would be affordable to the health care system.

Nevirapine Study

PMTCT in developing countries has been revolutionized with the dissemination of findings from the HIVNET 012 trial.(21) This study's regimen consisted of a single dose of nevirapine administered to the mother at onset of labor and to the child within 72 hours of birth. It has two crucial advantages over alternative interventions. First, at US\$4 per mother-child pair, the ARV costs are far lower than in other regimens.(#) Second, because dosing is easy and can be administered so late in the pregnancy, more women might have access to it than to alternatives that require prenatal care.

These factors, combined with an efficacy of about 50%, make nevirapine regimens more cost-effective over a wider range of settings than any of the alternative regimens.(22) It

also confers greater public health impact in the many developing country settings where only a small proportion of women visit a clinic early in pregnancy. In areas with 15% prevalence, the nevirapine regimen has a cost-effectiveness ratio of US\$19 per DALY or US\$506 per case of pediatric HIV averted. In areas with a higher prevalence (30%), the cost-effectiveness is still greater-US\$11 per DALY or US\$298 per case averted.

Given the low cost of nevirapine, it is the VCT costs rather than drug costs that drive the numerator of the cost-effectiveness ratio. Further progress in increasing the efficiency of PMTCT intervention lies in finding ways to reduce the cost of VCT while keeping its quality at an acceptable level.

Alternatively, in a somewhat controversial suggestion, researchers have noted a large potential increase in cost-effectiveness of the HIVNET 012 regimen by eliminating the VCT component altogether in high prevalence areas, and instead providing nevirapine to all willing pregnant women. Because of reduced stigma in accepting treatment under these circumstances, uptake rates, and therefore public health impact, may be enhanced with this approach. However, this analysis did not quantify the potential benefits of VCT in reducing adult-to-adult HIV transmission. Nevertheless, as a temporary measure where the infrastructure for VCT is unlikely to be established in the near term, distribution of nevirapine to all consenting pregnant women, even those who have not been tested or who may refuse testing, may be an option to consider.

Intervening With Injection Drug Users

HIV is readily transmitted via shared, unsterilized syringes. Injection drug users (IDUs) (or those receiving injection drugs in substandard medical settings) are therefore at high risk of HIV infection and can be an important factor in spreading HIV to non-drug-users through sexual transmission. A number of studies, most from the United States, have demonstrated the cost-effectiveness of various strategies for reducing the spread of HIV among IDUs. These strategies, often provided in combination, include:

- counseling and testing, partner notification
- provision of clean needles to addicts with or without return of used needles
- bleach distribution to enable users to maintain clean needles if they do reuse them
- substance abuse treatment, typically methadone maintenance

Based on data from Baltimore, Maryland, individual programs of HIV counseling and testing, partner notification, or bleach distribution have a cost-effectiveness ranging from US\$3,500 per case averted to US\$32,000 per case averted, assuming an annual HIV incidence of 4% among IDUs. This is highly cost-effective for industrial country settings, where the lifetime medical costs for treating HIV typically average about US\$195,000.(23)

Drug treatment emphasizing methadone maintenance is also cost-effective at US\$4,000 per HIV case averted and has added crime and unemployment reduction benefits not included in these figures. Cost-effectiveness of needle exchange programs varies widely,

from US\$3,000 to US\$90,000 per case averted, depending on HIV incidence in the area and the efficiency of the program. Most estimates cluster in the range of US\$12,000 to US\$45,000 per case averted.(23)

It is not clear, however, whether similarly high levels of cost-effectiveness can be attained in Eastern Europe and the countries of the former Soviet Union, but there is reason to believe this is possible: Although savings in medical costs are lower in these areas (because available treatment is much more limited), so too are wages for the personnel needed to deliver the services. Indeed, a study of the effectiveness and cost-effectiveness of an intervention program with injection drug users in Svetlogorsk, Belarus, found that such interventions can be extraordinarily cost-effective.(24) The intervention evaluated in this study emphasized a comprehensive approach that included the exchange of used-for-sterile syringes, safe sex counseling, condom promotion, bleach distribution, and referral for STD services. The average cost per HIV infection averted was projected at only about US\$68 (estimate range: US\$54 to US\$100), and reflects the uncertainty of some of the inputs used to calculate averted HIV infections. If the cost of the associated mass media campaign were included, the cost per HIV infection averted rises to the US\$240 to US\$442 range, still notably cost-effective. The importance of these findings is underscored by the explosive HIV epidemic--a significant portion of it fueled by injection drug use--now under way in many parts of the former Soviet Union and Eastern Europe(25).

Antiretroviral Drugs: A New Frontier for Prevention?

Recent findings from Uganda indicate that the risk of transmission within discordant couples is highly correlated with the level of HIV found in the blood (viral load).(26) This raises hope that the risk of transmission from HIV-infected individuals with viral loads suppressed by ARV therapy may be lower than the risk of transmission from those who are not receiving therapy. If this is true, then ARV therapy not only controls the progression of HIV to AIDS and death, but may also slow the spread of the disease in the population. In short, ARV therapy might be a potent prevention option.

However, more research must be carried out before this hope can be transformed into practice. First, it is possible that viral load suppressed by ARV therapies is associated with a higher risk of transmission than is the same viral load occurring in ARV-naive patients. Second, because those on ARVs may engage in more risky behavior and because they are likely to live longer, the benefits from lower per-episode transmission probabilities could be overwhelmed by increased risky behavior, especially over time.(27) A theoretical model testing the interaction of these and other relevant variables in San Francisco suggests that the potential prevention benefits of ARV therapy are overwhelmed by increases in risky behavior.(28) Unfortunately, it appears that these dangers are not simply theoretical: San Francisco has recently witnessed evidence of increases in HIV incidence that may well be linked, at least in part, to misconceptions that ARV therapy is equivalent to a cure and that it eliminates transmission risk by those with ARV-associated viral load reductions.(29)

No information is yet available regarding the ways these dynamics might operate in developing countries. Nevertheless, the introduction of ARV therapies must be accompanied by vigorous education and counseling programs for the recipients to reduce further transmission from them to others (often referred to as "positive prevention").

Directions for Future Research

Much is known about prevention of HIV in the developing world. A recent review of the cost-effectiveness of 10 prevention options in the developing world found that they ranged from actually saving the health system money to costing US\$18 per DALY gained.⁽³⁰⁾ Most estimates cluster in the range of US\$5 to US\$18 per DALY (see Table 1).

Most of these studies are based on models that incorporate data where available but are based predominantly on constructions of the likely range of values of key inputs. Nevertheless, they can provide important general lessons about strategies to limit the spread of HIV. For example, some studies have concluded that the benefit of prevention is highest if the program is introduced when HIV prevalence is still low, and that the success and cost-effectiveness of targeted prevention interventions depend on the level of heterogeneity in risk activity and risk-group mixing patterns.⁽³¹⁾ Almost all of these studies emphasize the superior efficiency of targeted over nontargeted interventions.

The extant body of work also has severe limitations. It consists of evaluations of stand-alone programs at one "snapshot" point in their development. Program data have been used to calculate average cost-effectiveness ratios, with little effort to examine marginal cost-effectiveness or the relationship between cost-effectiveness and program scale. In addition, the literature contains few studies that formally compare multiple options. Most analyses are also restricted to the perspective of the health care payer and do not include the broader societal perspective. Finally, good cost-effectiveness data are extremely sparse or missing for some important prevention strategies. These include condom social marketing, school-based education programs, mass media campaigns, and programs for migrant populations. The next generation of economic evaluations should address these types of interventions. It should also address the effect of scale, phase of the epidemic, and program combinations on costs and cost-effectiveness.

Conclusion

Cost-effectiveness analysis offers a critically important perspective for decision-makers seeking the largest health impact for limited HIV prevention dollars. There is also ample evidence of the cost-effectiveness of a wide range of HIV prevention interventions. New spending on these interventions, particularly if targeted to high-risk groups and implemented as early as possible in the local development of the epidemic, is capable of producing dramatic reductions in HIV incidence. These programs achieve important health benefits and in some cases even save money, which may be used for other aspects of HIV prevention and care. These findings should be carefully considered and

incorporated into the HIV prevention planning process and program priority setting of each affected country.

Even with optimistic estimates of increases in global funding for HIV/AIDS, the task of controlling the epidemic remains daunting. Regardless of the infusion of new resources, little gain will be realized if they are used inefficiently. Thus, it is imperative that available funds be spent for interventions that are cost-effective and that information on cost-effectiveness help guide resource allocation as funding is scaled up to more closely match real needs.

Notes

* Currency conversion on 3/30/02.

Nevirapine cost has subsequently been reduced to zero by the manufacturer for developing countries planning a national program to prevent MTCT.

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