
An Overview of the Effectiveness and Efficiency of HIV Prevention Programs

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Synopsis

Because of the enormity of the HIV-AIDS epidemic and the urgency for preventing transmission, HIV

prevention programs are a high priority for careful and timely evaluations. Information on program effectiveness and efficiency is needed for decision-making about future HIV prevention priorities.

General characteristics of successful HIV prevention programs, programs empirically evaluated and found to change (or not change) high-risk behaviors or in need of further empirical study, and economic evaluations of certain programs are described and summarized with attention limited to programs that have a behavioral basis.

HIV prevention programs have an impact on averting or reducing risk behaviors, particularly when they are delivered with sufficient resources, intensity, and cultural competency and are based on a firm foundation of behavioral and social science theory and past research. Economic evaluations have found that some of these behaviorally based programs yield net economic benefits to society, and others are likely cost-effective (even if not cost-saving) relative to other health programs. Still, specific improvements should be made in certain HIV prevention programs.

THE GLOBAL HIV-AIDS EPIDEMIC continues to expand rapidly. In the United States alone, as of December 1993, more than 360,000 persons were reported diagnosed with AIDS. The death toll has been more than 220,000 (1). In 1992, HIV infection became the leading cause of death among men ages 25 to 44 and the fourth leading cause of death among women in the same age group (2). As of 1992, the cumulative costs for treating all persons with HIV infection in the United States were estimated to be \$10.3 billion and were expected to increase to approximately \$15.2 billion by 1995 (3,4). Governmental and nongovernmental organizations, local communities, researchers and advocates, and individual citizens together have responded to the epidemic by designing and implementing numerous programs to help people change behaviors that put them at risk of acquiring or transmitting HIV infection.

HIV prevention programs should be evaluated systematically so that program managers and policy

makers can make program decisions based on empirical findings rather than subjective impressions, and program utility and quality can be ensured (5,6). In 1994, HIV prevention programs underwent a special reexamination. Not only is the role of HIV prevention being discussed within the context of health care reform, but a shift is occurring toward more comprehensive community participation in shared decision making about HIV prevention efforts.

For example, in 1994, the Centers for Disease Control and Prevention (CDC) formally introduced community planning as an essential component of its program support for HIV prevention programs at 65 local, State, and Territorial health department levels. This type of planning requires HIV-AIDS epidemiologic surveillance and other data, ongoing program experience, program evaluations to date, and a comprehensive, objective needs assessment process. It incorporates the perspectives of groups at risk of acquiring or transmitting HIV infection for whom the

programs are intended, providers of HIV prevention services, and scientific experts in the planning process (7,8). In addition, CDC's Advisory Committee on the Prevention of HIV Infection completed an external review of CDC's HIV prevention program and recommended substantial programmatic changes in its five major components (9,10). Community-based, governmental, and other organizations need detailed evaluative information to make sound decisions about future program priorities and strategies.

We attempt to contribute to this special reexamination of HIV prevention programs by addressing three timely questions.

1. What are the general characteristics of HIV prevention programs that have a favorable impact on behavioral outcomes?

2. Which specific HIV prevention programs have been found to have a favorable (or an unfavorable) impact on behavioral outcomes, and which are high priorities for further evaluation? and,

3. Are the financial costs of behaviorally based HIV prevention programs outweighed by the economic benefits, and are these programs cost-effective?

We intend this paper to be a general overview and discussion of these three questions. We believe the HIV prevention literature discussed in this paper accurately and fairly reflects the current state of the field. It is beyond the scope of this paper, however, to include every possible citation. Readers who wish to compile a truly exhaustive bibliography should consult our reference list as well as those in the review papers cited and clearly identified. Neither is this paper a meta-analysis. The limited number of evaluation studies of specific types of HIV prevention interventions, use of different research methods, and diverse intervention designs and implementations render a formal quantitative meta-analysis problematic at this time.

Characteristics of Successful Programs

We reviewed previously published (or readily available) lists of general characteristics of successful, behaviorally based HIV prevention programs (11-28) and extracted several common elements that are briefly described. "Successful" is defined here as averting or reducing HIV-related risk behaviors or favorably modifying their determinants ("effectiveness"), or both, and doing so at a minimal, cost-effective or cost-beneficial level of resource invest-

ment ("efficiency," a broader-than-usual definition of this term).

Basis in real specific needs and community planning. HIV prevention programs must address the real and expressed HIV prevention needs of the community being served, lest the program be rejected by the community as inappropriate, superfluous, and a waste of scarce resources. Needs should be considered at both the community and individual client level. For instance, a needs assessment may uncover a gap in HIV street outreach services for injection drug users (IDUs) in a given community and in the priority given to filling this community-level need. Individual clients receiving outreach services may have quite disparate specific needs, however. For example, some clients may need assistance recognizing their risk for HIV infection, while others may recognize their risk but need assistance obtaining risk-reduction counseling services. Communities and individual clients should not be considered merely respondents to a needs assessment but full partners in a shared decision-making process about which HIV prevention services are most needed (11,23,29).

Cultural competency. To be successful, HIV prevention messages must be tailored to the audience and its needs (11,23,29). Messages, at the very least, must be (a) sensitive to the particular culture of the audience, broadly defined to include age, educational level, sex, geography, race-ethnicity, sexual orientation, values, beliefs, and norms, and other factors; (b) appropriate to the developmental status of the audience, for instance, messages designed for middle-school students are likely to be rejected by high-school students; and, (c) linguistically specific, which goes beyond using the same language as the audience.

Clearly defined audiences, objectives, and interventions. A general principle of program planning and evaluation is that programs should have clear goals, objectives, and strategies (11,23,30). The principle includes a statement of the intended client subpopulation for each HIV prevention service being offered, process (service delivery) and outcome (behavioral or health) objectives, and specific interventions and their components (31). Without these statements, the program's design, implementation, and evaluation will lack direction and focus.

Basis in behavioral and social science theory and research. The large and rapidly expanding literature on behavioral and social science theory and empirical findings relevant to changing HIV-related risk be-

haviors was recently reviewed (11–13,15,21,23,25–28,32–35). Kelly and coworkers (13) reviewed available (true-, quasi-, and non-experimental) studies of the behavioral consequences of HIV prevention interventions. They described three different types of relatively successful interventions—cognitively based, one-on-one interventions, community-level interventions, and community mobilizations. Fisher and Fisher reviewed AIDS risk-reduction interventions from 1980 to 1990 and concluded that conceptually based, group-specific interventions focusing on information, motivation, and behavioral skills were most successful in changing high-risk behaviors (21). Choi and Coates published a population-by-population categorization of evaluation studies of HIV prevention behavioral outcomes (25).

The National Commission on AIDS behavioral and social sciences report described eight factors needed for a person to lower his or her risk of HIV infection (12).

1. strong intention to implement the risk-reduction/avoiding behavior;
2. no environmental barriers blocking the behavior change;
3. necessary skills to execute the behavior change;
4. perceived “pros” of the new behavior greater than the “cons;”
5. perception that peers encourage the behavior change;
6. consistency of one’s self-image with the new behavior;
7. perception that the new behavior is positively reinforced; and,
8. belief that one can actually perform the new behavior.

These factors have been empirically confirmed as important for averting or reducing HIV-related risk behaviors (12). The fifth factor emphasizes the utility of peer-delivered programs for changing group norms, and the seventh factor involves the psychological principle of positive reinforcement for risk-reduction behavior. Positive reinforcement deals with supporting and rewarding successive approximations to the desired behavior change (36). This is a sequential, dynamic process between the person changing his or her behavior and the reinforcer (perhaps a service provider, peer, or family member). Hence, long-term, lasting behavior change with one-time HIV prevention interventions should not be routinely expected (although this will happen for some persons). Intensive and sustained interventions are needed (25).

Quality monitoring and adherence to plans. HIV prevention programs must be subjected to careful process evaluation to ensure that services are delivered according to plan (30). Service quality can be assured by using such measures as client satisfaction and assessment of the content and manner of service delivery. Program costs should be measured or estimated to ensure that the program is on budget and the percentage distribution of the line items is as expected.

Use of evaluation findings and mid-course corrections. Successful HIV prevention programs must be monitored to determine if the stated outcome (behavioral or health) objectives are being approached (11,30). If not, then either the outcome objectives should be rechecked for reasonableness, or mid-course corrections should be made to the program itself to reach its objectives. Because of resource limitations, not every HIV prevention program can be subjected to scientifically rigorous outcome evaluation. This is not necessary, however, if empirical demonstrations exist (perhaps from other settings) that the program can achieve the desired behavioral or health outcomes and the program itself uses careful process evaluation to ensure that services are delivered according to plan (29).

Sufficient resources. HIV prevention programs require sufficient financial, human, material, and temporal resources to achieve their goals and objectives (11). They must either procure sufficient resources enabling them to reach their desired goals and objectives or restructure their goals and objectives to meet available resources.

Programs to Change Risk Behaviors

We review separately HIV prevention programs designed for persons presently at no or low risk for HIV infection (for example, information and education programs to enhance their knowledge, attitudes, and beliefs regarding HIV and AIDS) and persons who are either HIV infected or HIV seronegative but engaging in high-risk behaviors (for instance, information, education, counseling, and skills training programs to change their drug use and sexual practices). A comprehensive description of the multiple studies (and concomitant methodologies) of behavioral outcomes for each program for each group is not possible. Rather, we describe highlights and reviews of the evaluation literature and refer to more comprehensive reference sources and specific empirical investigations wherever possible.

The references cited were found by multiple, electronic literature searches, reference tracing, and professional networking. Attention is limited to HIV prevention programs with a behavioral basis, as contrasted with purely technological or biomedical interventions, and almost exclusively to domestic studies (contrasted with research in developing countries) and published or readily available sources. The citations include studies with both favorable and unfavorable behavioral outcomes, and most of the studies relied on self-reported behavior, although a few included biological markers as well.

Persons at No or Low Risk for Infection

Information dissemination. Publicly funded information dissemination programs have led to an overall increase in basic HIV knowledge in the general population (24,37–41). Most striking is data from the National Health Interview Survey (NHIS), a probability sample of the United States population, which showed that basic knowledge of modes of HIV transmission increased greatly over the last several years (40,41). For example, among 42,726 adults queried for the 1991 NHIS, 95 percent responded “true” to the statement, “Any person with the AIDS virus can pass it on to someone else through sexual intercourse;” and 94 percent responded “true” to “A pregnant woman who has the AIDS virus can give it to her baby” (40).

In addition, several studies showed that HIV education in the context of comprehensive, school-based health education lead to important knowledge gains among school and college youth (24,42–47). For instance, Walter and Vaughan (47) described a randomized study of an AIDS risk-reduction program for urban high school students given in six class periods. At the 3-month followup, 477 intervention students displayed statistically significant knowledge gains relative to 390 comparison students. They also noted several other studies demonstrating knowledge gains in school-based HIV education programs.

Attitude change. General attitude change messages have been developed relatively recently and delivered with less intensity than information dissemination programs. Perceptions of discrimination and stigmatization have been found to have an unfavorable impact on use of HIV prevention services and are cited as a reason to avoid learning one’s HIV serostatus (40,48,49). Presumably, they also lead to a continued demand for anonymous (rather than confidential) HIV antibody testing in many areas (50). Therefore, HIV prevention messages specifically

designed to address discrimination and stigmatization need expansion and careful evaluation.

Reinforcement of existing no- or low-risk behaviors. Information on the impact of messages reinforcing existing no- or low-risk behaviors on the general adult population is sparse but available for youth in educational settings. Several studies showed that specific HIV prevention programs in educational settings delayed the onset of or reduced high-risk behaviors (43,47,51–54). This was especially true of HIV-AIDS education programs that possessed the following characteristics: (a) inform students how to avoid becoming infected, or if already infected, how to avoid infecting others; (b) develop students’ interpersonal skills to help them avoid, cope with, or leave HIV-risk situations; (c) motivate students through peer presentations and support groups to use their newly acquired, HIV-relevant knowledge and skills; and, (d) allocate sufficient classroom hours (20–25 hours) to influence students’ behaviors (43). These characteristics are consistent with Fisher and Fisher’s conclusion that AIDS risk-reduction programs are most effective if they address information, motivation, and behavioral skills (21).

A comprehensive review paper in this area (53) characterized effective, school-based HIV education programs for adolescents as those that

1. use social learning theories for program development;
2. focus on reducing sexual risk-taking behaviors that may lead to HIV-STD infections or unintended pregnancies;
3. provide accurate, basic information about the risks of and methods for avoiding unprotected intercourse;
4. address social or media influences on sexual behaviors;
5. reinforce clear and appropriate individual and group values against unprotected intercourse; and,
6. model and practice communication and negotiation skills.

Recent literature reviews (52,53) found that the discussion of HIV-related issues in schools does not spur the onset of sexual activity among youth.

Since 1986, Switzerland has supported broad-based social marketing of condoms to curb the transmission of HIV infection, particularly among adolescents and young adults (55,56). From 1987 to 1990, this active promotion of condom use neither significantly increased the proportion of adolescents engaging in sexual intercourse nor the average number of sexual

'The preponderance of the empirical evidence reviewed showed that behaviorally based HIV prevention programs have a favorable impact on behavioral outcomes in specific populations, especially when delivered with sufficient resources, intensity, and cultural competency.'

partners, but it did increase reported condom use markedly (56). Among young adults engaging in casual sex, the proportion using condoms every time also significantly increased (55). These results suggest important lessons and research questions for HIV prevention efforts in the United States.

Programs for Risky Behaviors

Clearly, program goals, objectives, and strategies for averting or reducing high-risk behaviors among HIV seronegative and seropositive persons vary. HIV prevention programs often reach them long before their serostatus is known, however. For example, although prevention messages delivered to HIV seronegative and seropositive persons may differ, several modes of message delivery (like street outreach) are common for these two populations. Therefore, our review of behaviorally based HIV prevention programs for these high-risk groups is integrated in this paper.

Counseling, testing, referral, and partner notification (CTRPN). CTRPN programs, which include counseling designed to change HIV-related risk behaviors, have probably undergone more evaluation than any other HIV prevention program. Higgins and colleagues (57) reviewed the literature on behavioral consequences of HIV antibody counseling and testing. They found that counseling and testing tended to reduce HIV-related risk behaviors in specific populations—especially among heterosexual couples discordant in HIV serostatus and (though slightly less obvious from the data) gay men testing HIV seropositive. For instance, researchers in four studies of discordant, heterosexual couples reported substantial increases in their consistent use of condoms after HIV antibody counseling and testing (57).

Research on persons learning their HIV seronegativity in the context of counseling and testing has yielded mixed results (57–64). Several studies found

either little or no effect on high-risk behaviors for those aware of their own serostatus and in counseling (57,58,60,61), or a higher risk for those learning their seronegativity than those unaware or untested (57,59,63). One study found some risk reductions (62). Overall, little evidence supports the notion that HIV antibody counseling and testing for HIV seronegative persons (as implemented in these studies) lead to favorable behavior changes (64). The preponderance of evidence, however, shows the experience is not harmful for them either. For persons testing HIV seronegative, behavioral science theory and research suggest the need to strengthen the duration and intensity of counseling and other preventive services tailored to client-specific needs and the quality and suitability of delivering both counseling and testing services (65,66).

Individual or group information, education, and counseling. Although HIV antibody testing should be delivered in the context of counseling (66), counseling is not always delivered in the context of testing. Sometimes stand alone counseling interventions have been used as comparative conditions to counseling and testing (62). Several studies evaluated one-on-one or small group, risk-reduction counseling interventions completely unlinked to HIV antibody testing (for a comprehensive listing, see 25,53). Many of these studies were randomized, controlled trials examining behavioral outcomes (32,67–85). The preponderance of evidence from these trials suggests that behavioral interventions decreased risky drug- or sex-related activities (32,67,68,70,71,73,74,76–78,80–84).

Community-level. Kelly and coworkers (13,23) pointed to community-level interventions as promising for changing HIV-related risk behaviors. Community-level interventions are those that (a) target the community (often defined by sex, geography, risky behaviors, race-ethnicity, or sexual orientation) rather than a specific individual; (b) involve community members in the actual design and delivery of the intervention; and (c) aim to change community norms about high-risk behaviors (as well as modify individual behaviors). Kelly and colleagues recruited opinion leaders from communities of gay men, trained them in HIV prevention messages and message delivery, and asked them to take these messages back to their communities. Carefully executed, controlled studies showed that this intervention changed community norms and self-reported, risky sexual behaviors (13,23,86,87).

For example, Kelly and coworkers (86) assessed

the impact of using trained community members to endorse openly the importance and acceptability of changing sex-related risk behaviors among male patrons of gay bars in three southern communities. In one of the three communities, 295 gay men completed the pre- (intervention) surveys and 348 the post-intervention surveys. After introducing popular, behavior-change endorsers into this community of gay men, the mean percentage of gay men reporting unprotected anal intercourse during the preceding 2 months decreased by 24 percent from mean baseline levels, self-reported use of condoms for all anal intercourse occasions increased by 15 percent, and the number of gay men reporting more than one sex partner decreased by 6 percent (86).

Another large-scale, community-level intervention, the AIDS Community Demonstration Projects, operated in several American cities—Dallas, Denver, Long Beach, New York City, and Seattle—and addressed five priority populations—(a) men having sex with men, but not self-identifying as gay; (b) out-of-treatment IDUs; (c) female sex partners of IDUs; (d) female prostitutes; and (e) youth in high-risk situations (youth neither at home nor in school) (17). In all cases, the projects used actual success stories of behavior change by one or more community members, translated these stories into HIV prevention messages, trained community members in message delivery, and asked them to relay these messages to others.

The projects pioneered the adaptation of Prochaska's stage of behavior change model (88) to HIV prevention (17). This model posits that persons cycle (and relapse) through these stages of behavior change:

1. pre-contemplation (unaware of own risk or do not intend to change the risk behavior "problem" in the near future);
2. contemplation (seriously consider overcoming the "problem," but make no commitment toward action);
3. preparation (intend to take effective action in the very near future);
4. action (modify behavior, environment, or experience to overcome the "problem"); and
5. maintenance (stabilize the new behavior and avoid relapsing to the "problem") (88).

The community members' success stories (already noted) were combined with the stage of behavior change framework (and other theoretical constructs) to craft messages specifically designed for community members at particular stages of behavior change,

which was seen as central to maximizing the success of this intervention. Preliminary data analyses from the projects indicate greater movement toward consistent use of bleach for cleaning injection equipment or use of condoms during sexual intercourse for persons exposed to this intervention than those not exposed (89).

Outreach. Outreach programs aim to encounter clients in their own community who are unlikely to be receiving important HIV prevention services (90). They generally fall into two broad categories—those that refer clients to HIV prevention services offered in other settings or those that provide HIV prevention services in street or other nontraditional settings. Outreach programs encountering IDU clients have been intensively evaluated by the National AIDS Demonstration Research (NADR) Project (91) and are described in the ensuing section. CDC launched a family of studies at eight sites to assess enhancements to existing street outreach services for IDUs and youth in high-risk situations. These studies have yielded interesting process evaluation and service delivery data, and the outcome evaluation phase began in 1993 (90).

Drug treatment and other, related activities. The point of contact with IDUs (and their sex partners) has generally been as inpatients in a drug detoxification and rehabilitation program, outpatients in a drug treatment center, or out-of-treatment IDUs. Through a variety of information, education, and counseling sessions, HIV prevention programs have attempted to get IDUs to stop using and injecting drugs, stop using unclean needles and syringes, and stop engaging in high-risk sexual behaviors (35,67–69,74,75,79,80,85,92–100). Whether offered early or late in the treatment process or as standard (short, one-time) or enhanced (longer, multiple) versions, these sessions generally reduced IDUs' risky drug behaviors (especially those needle-related). Their impact on modifying sex-related risk behaviors such as casual partners or exchanging sex for drugs or money was less obvious and requires further study (67–69,74,75,79,80,85,93,95,99,100).

The NADR Project assessed longitudinal data from 28 sites delivering street outreach services to a total of 13,475 IDUs and 1,637 sex partners of IDUs (91,93). Study participants were randomly assigned to standard or enhanced AIDS education and counseling sessions. At the 6-month followup, a clinically meaningful and statistically significant reduction was found for the following high-risk behaviors of IDUs for both intervention assignments: frequency of injecting drugs, use of noninjected drugs, use of borrowed injection equipment, and number of sex

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partners. Twenty-eight percent fewer of the total IDU sample reported injecting daily at followup than at baseline (42 percent versus 70 percent). Twenty-four percent fewer reported borrowing needles at followup than at baseline (24 percent versus 48 percent) and 8 percent fewer reported having two or more sex partners during the preceding 6 months (36 percent versus 44 percent).

Furthermore, favorable behavior changes were found for use of new needles, bleach to clean injection equipment between uses, and condoms. Among the 13,475 IDUs, 21 percent more reported always using new needles at followup than at baseline (40 percent versus 19 percent), and 9 percent more reported always using condoms (19 percent versus 10 percent). Several factors contributed to the favorable impact of street outreach services, including using outreach workers from the community (often ex-addicts), providing bleach and condoms and demonstrating their correct use, and offering training in sexual negotiation and refusal skills (91).

Wiebel and colleagues (101) argued that their NADR program had a favorable impact on HIV sero-incidence in three Chicago communities. They followed 641 out-of-treatment, initially HIV seronegative IDUs over a 4-year period. Without the street-based outreach program, the expected number of new HIV infections among these IDUs was 172; however, only 90 HIV conversions were estimated to have occurred largely because the percentage of IDUs engaging in risky drug behaviors (primarily sharing needles, syringes, and other injection equipment) decreased from 100 percent to 14 percent during the study period (101).

Further research is needed to understand better (a) the culture(s) of drug users in our society (their beliefs, practices, and perceptions of risk) to know which specific HIV prevention programs could be most effective and efficient in affecting favorable drug- and sex-related behavior changes (93,100, 102,103); (b) the various sub-groups among IDUs

defined by characteristics such as drug preference, ethnicity, and sex who likely require different types of drug treatment as well as HIV information, education, and counseling sessions in terms of content, duration, and format (91,99,100); and (c) the long-term impact of information, education, and counseling efforts on IDUs' HIV-related risk behaviors (91,100).

In addition, future research should determine the relative benefits of HIV information, education, and counseling sessions as well as the contribution drug treatment itself makes to HIV prevention. For instance, by reducing the frequency of drug use, methadone maintenance programs contribute to HIV prevention directly.

Needle and syringe exchange. Presently, there are at least 37 needle and syringe exchange programs (NEPs) in the United States, with the first established in 1988 (104,105). NEPs primarily focus on reducing IDUs' drug use through referral to drug treatment and such high-risk drug behaviors as frequency of injection (often with the same needle), needle or syringe sharing, and use of unclean injection equipment. Furthermore, attention is often devoted to reducing risky sexual behaviors such as number of sex partners, proportion of sex partners who are also IDUs, HIV prevalence in those partners selected, and unprotected intercourse (104,105). A recent study emphasized the continued need for available, sterile needles and syringes (106). Among 466 IDUs interviewed, researchers found that 49.6 percent purchased needles and syringes on the street, 63.7 percent possessed fewer than three sets of needles and syringes, and 88.6 percent reused needles and syringes (69.6 percent used a single set for three or more injections). Asked if they would use an NEP, 88.2 percent of those interviewed responded affirmatively (106).

Empirical evidence of the impact of domestic NEPs on IDUs' HIV-related risk behaviors is relatively scarce, although more data are becoming available (35,107). A recent comprehensive review reported that only 9 of 26 studies assessing the impact of NEPs on IDUs' high-risk drug and sexual behaviors were based in the United States (105). With respect to the 16 "higher quality" studies, most of these studies found reductions in the frequency of injection (3 out of 8 studies), frequency of needle or syringe sharing (10 out of 14), and likelihood of giving away used needles (3 out of 5). Three out of four studies showed an increase in needle cleaning. Whether NEPs had an impact on IDUs' number and choice of sex partners and use of condoms was less obvious (105).

Further research is needed to describe more fully (a) the social context and patterns of drug use in general and needle and syringe sharing in particular (including the "kinetics" of needles and syringes as they circulate through a group of IDUs) (102,105); (b) the long-term impact of NEPs on IDUs' HIV-related risk behaviors (108); and (c) alternative methods for dispensing new, sterile needles and syringes to IDUs such as using local pharmacies (105). In addition, future research should evaluate the effect of any changes in drug paraphernalia and prescription laws on needle-sharing behaviors.

Economic Evaluations of Programs

There has been a renewal of the debate over whether prevention efforts save society money, or whether persons spared preventable illnesses accrue greater health costs given their extended lifetimes (109–111). One might question whether HIV and other disease prevention programs should be held accountable to the standard that a program's economic benefits to society should outweigh its financial costs. Whether or not one accepts this standard, applications of economic evaluation techniques are as appropriate to behaviorally based HIV prevention programs as they are to other health programs. Even if an HIV prevention program does not actually save society money, it is possible the program is still cost-effective relative to other health programs.

Holtgrave and co-workers (112,113) recently completed a thorough review of the economic evaluation literature relating to HIV prevention and treatment programs. Among 47 studies meeting their inclusion criteria, they found that most of these studies dealt with treatment and mandatory rather than voluntary prevention programs (especially certain screening strategies). We describe some of the major cost-benefit and cost-effectiveness analyses from this review, along with other, more recently presented or published analyses. These descriptions serve to illustrate the current state-of-the-art of applying economic evaluation techniques to HIV prevention and the need for collecting program-specific cost and benefit (or effectiveness) data. Because the underlying assumptions and methods used by researchers are not entirely common across studies, care should be exercised when comparing reported cost-benefit and cost-effectiveness results from different citations.

Cost-benefit analyses. Holtgrave and co-workers conducted a cost-benefit analysis of publicly funded HIV CTRPN programs (64). It was assumed that

CTPRN would not be provided without public funding and at least 20 new HIV infections were averted for every 100 HIV seropositive persons identified and reached by CTRPN (as described and justified in much greater detail in their article [64]). They estimated this program's direct and indirect costs, number of persons served, approximate number of HIV infections averted, monetary benefits to society for each HIV infection averted, and benefit-cost ratios. Under base-case assumptions, the benefit-cost ratio was slightly more than 20 (every dollar invested in HIV CTRPN yielded a \$20 gain), and greater than one for all cases considered (64).

The parameter of greatest uncertainty in the HIV CTRPN cost-benefit analysis was the quantitative effectiveness of service delivery in preventing HIV infection. Although the exact value of this parameter might be questioned, the threshold (or "break-even") analysis showed that (under base-case assumptions) even if only 1 in 100 persons testing HIV seropositive and receiving the associated counseling and referral services changed his or her behavior and averted transmission to one other person, the economic benefits of the program equalled the financial costs (64). Although it is difficult to state precisely the exact effect of an HIV prevention program on numerous outcome variables, it is relatively easy to demonstrate that, even if the favorable impact is quite small, the program can yield net economic benefits to society. Such analyses lend economic support to the concept that HIV prevention efforts need not change the behavior of every client in order to be worthwhile (114).

Cost-effectiveness analyses. Owens and co-workers (115) recently evaluated the cost-effectiveness of CDC's recommendation to screen for HIV infection in acute care settings where the seroprevalence of HIV infection is 1 percent or more. When measuring only the costs and benefits associated with the person screened, the cost-effectiveness of screening was \$60,000 per life year saved at 1 percent seroprevalence, and ranged from \$71,000 to \$55,000 per life year saved at 0.5 to 2 percent seroprevalence (115). This cost per life year saved is near the cutoff usually considered cost-effective for screening strategies (116). These cost-effectiveness ratios appear less favorable than the cost-saving results for publicly funded HIV CTRPN (as described previously) because of the lower HIV seroprevalence of the acute-care settings relative to the CTRPN sites and perhaps different study assumptions and methods (for other recent papers about HIV screening, see 117).

As part of an assessment of the public health

HIV-AIDS Literature Review

To represent the evaluation literature in a given topic area accurately and fairly, at least one scientific expert (not a co-author) for each area at the Centers for Disease Control and Prevention (CDC) and some at outside institutions reviewed an earlier draft (or sections thereof) of this paper.

Paul Farnham and Robin Gorsky read the section describing economic evaluations of HIV prevention programs, and T. Stephen Jones reviewed the drug-related sections. They are all with the Office of the Associate Director for HIV-AIDS, Office of the Director.

Janet Collins of the Division of Adolescent and School Health, National Center for Chronic Disease Prevention and Health Promotion, read the section describing school-based HIV-AIDS education.

Ron Wilson with the Office of Analysis, Epidemiology, and Health Promotion, National Center for Health Statistics, reviewed the information dissemination section.

Donna Higgins, Division of STD-HIV Prevention, National Center for Prevention Services, read the section describing counseling, testing, referral, and partner notification, and Daniel Schnell, of the same division, read the section on community-level interventions.

Wanda Jones and Laura Leviton, Office of the Associate Director for HIV-AIDS, Lynda Doll of the Division of HIV-AIDS, National Center for Infectious Diseases, and Sevgi Aral, Division of STD-HIV Prevention, reviewed multiple sections of the manuscript.

James Kahn with the Institute for Health Policy Studies, University of California at San Francisco, and Mary Utne-O'Brien of the School of Public Health, University of Illinois at Chicago, read the specific sections describing their respective work with IDUs.

Finally, Richard Needle with the Community Research Branch, National Institute on Drug Abuse, provided extensive background materials for the drug-related sections.

impact of NEPs in the United States, researchers determined the cost-effectiveness of NEPs in preventing HIV infection. Using a simplified version of the New Haven needle circulation model, they estimated that in four hypothetical cities with varying organizational, program, and HIV-risk parameters, the cost per HIV infection averted among NEP clients ranged from \$12,000 to almost \$100,000 (118). Using a different model of HIV transmission and a synthesis of NEP behavior-change evaluations for only one of

the four cities, the cost per HIV infection averted was about \$4,000 (118). Other cost-effectiveness measures derived to assess the productivity of NEPs included cost per client contact (ranging from \$6 to \$41 for 7 NEPs reporting), cost per syringe distributed (ranging from \$0.26 to \$6.81 for 16 NEPs), and cost per (service) hour open (ranging from \$4 to \$550 for 16 NEPs) (119).

Another study estimated the cost-effectiveness of these five HIV prevention interventions for IDUs: counseling and testing, extended counseling and education (after counseling and testing), partner notification, bleach distribution, and treatment of drug dependency (120). For each intervention, the cost per adult HIV infection averted was calculated using only the direct costs associated with implementing the intervention in two sample cities in the eastern United States with moderate-to-high HIV risk levels. Cost per adult HIV infection averted for the first four interventions ranged from about \$3,000 to \$32,000 in City A and \$4,000 to \$66,000 in City B, with partner notification being the most expensive. Treatment of drug dependency provided additional HIV-related benefits of \$5,000 to \$7,000 per treatment slot per year (120).

Wiebel and colleagues (101) concluded that street-based outreach services (and use of indigenous outreach workers) were cost-effective alternative interventions for preventing HIV infection among IDUs. They estimated that a street outreach program in the Chicago area prevented 82 new HIV infections among 641 IDUs over a 4-year period, which would have cost more than \$9.7 million to treat from infection to death. Under this program, the cost per individual IDU contact was \$30, and the cost per HIV infection prevented ranged from \$150 to \$300 (101).

Summary

The preponderance of the empirical evidence reviewed showed that behaviorally based HIV prevention programs have a favorable impact on behavioral outcomes in specific populations, especially when delivered with sufficient resources, intensity, and cultural competency. In addition, of the programs examined by cost-benefit analysis, HIV prevention efforts need have only a small favorable impact on behavioral outcomes for the program's economic benefits to outweigh the financial costs. Although the relative cost-effectiveness of HIV prevention efforts is just now receiving attention, analyses to date indicate favorable results. Thus, there should be a strong, continued commitment of private

and public funds to behaviorally based HIV prevention programs.

This overview (and good program management principles) suggests, however, that specific areas for HIV prevention program improvement include the following:

1. modifying programs to meet as many of the general characteristics of successful programs as possible,

2. emphasizing programs receiving favorable evaluations in future community planning priority settings for HIV prevention,

3. redesigning or discontinuing programs receiving unfavorable evaluations, and

4. devoting attention to programs needing high priority evaluative study (especially those serving populations disproportionately affected by the HIV epidemic).

Other challenges remain in answering the following policy-related questions:

1. What is the optimal amount of funding to expend on HIV prevention relative to other health programs?

2. In terms of number of HIV infections averted, what is the optimal expenditure of HIV prevention funds for each subpopulation (for example, persons at no or low risk for HIV infection, high-risk but HIV seronegative, and HIV infected) and the programs associated with each?

3. What are the optimal methods for delivering and supporting HIV prevention services?

4. What is the optimal mix of various HIV prevention interventions and services that results in a comprehensive HIV prevention program? and,

5. How readily transferable are the behavioral outcomes of successful HIV prevention programs from one subpopulation or setting to another?

Although answering this set of policy-related questions will provide difficult challenges in the future, the empirical evidence to date indicates that behaviorally based HIV prevention programs have a favorable impact on behavioral and economic outcomes. Now is the time for a renewed commitment to HIV prevention efforts designed to change behaviors putting one at risk of acquiring or transmitting HIV infection.

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