JAIDS Journal of Acquired Immune Deficiency Syndromes
27:482–491 © 2001 Lippincott Williams & Wilkins, Inc., Philadelphia

Cost-Effectiveness of the Mpowerment Project, a Community-Level Intervention for Young Gay Men

*†James G. Kahn, *Susan M. Kegeles, *Robert Hays, and ‡Nathalie Beltzer

**Center for AIDS Prevention Studies (CAPS) and AIDS Research Institute (ARI); †Institute for Health Policy Studies and Department of Epidemiology and Biostatistics University of California, San Francisco, California, U.S.A.; and ‡INSERM, Marseilles, France*

Objectives: Previous evaluation demonstrated that the Mpowerment Project community-level intervention for young gay men reduces HIV risk behaviors. The current analysis was undertaken to estimate the intervention's health and economic outcomes.
Design/Methods: We conducted a retrospective cost-effectiveness analysis. We estimated HIV infections averted, the gain in quality-adjusted life years (QALYs), cost per infection averted, and net cost. Using a population-level model, we portrayed two epidemic scenarios: the first with stable HIV prevalence and the other with rising HIV prevalence. Inputs included behavior change resulting from the intervention and program cost data. Cost was calculated from three perspectives: societal; societal excluding volunteer time; and that of a community-based organization (CBO). Outcomes were calculated for 1, 5 (baseline), and 20 years.
Results: The Mpowerment Project averted an estimated 2.0 to 2.3 HIV infections in the first year (according to the epidemic scenario), 5.0 to 6.2 over 5 years, and 9.2 to 13.1 over 20 years. The societal cost per HIV infection averted was estimated at between \$14,600 and \$18,300 over 5 years. Costs per infection averted were 28% lower when excluding volunteer time and 35% lower from the CBO perspective. Net savings were \$700,000 to \$900,000 over 5 years from the societal perspective.
Conclusions: The Mpowerment Project is cost-effective compared with many other HIV prevention strategies. The cost per HIV infection prevented is far less than the lifetime medical costs of HIV disease.
Key Words: HIV—Cost-effectiveness—Community—Prevention.

Young gay men are at especially high risk of HIV infection. Between 4% and 8% of gay men aged between 15 and 22 years tested positive for HIV infection in samples in six U.S. cities (1), and self-report data from gay men aged 18 to 29 in four other U.S. cities indicated that 10.5% were HIV-positive (2). A household probability sample of 18- to 29-year-old gay men in San Francisco (CA) found 17.9% to be HIV-infected, with an estimated 2.6% annual incidence (3). A similar survey in Miami (FL) found 17.6% to be HIV positive (4). Annual seroincidence of 2% was found in a cohort of gay men aged 18 to 24 in New York City, with 9% HIV-positive (5). The need for effective HIV prevention in young gay men is critical.

The Mpowerment Project, a community-level HIV prevention program in which young gay and bisexual men are mobilized to consider the issues of HIV prevention, has been shown to reduce rates of unprotected anal intercourse (UAI) (6,7). To our knowledge, this is the only community-level HIV prevention program for young gay men examined in a controlled study. A community-level HIV prevention approach is valuable because it alters the norms, attitudes, and social milieu in which sexual behavior occurs and reaches greater numbers of people than face-to-face

Address correspondence and reprint requests to James G. Kahn, Institute for Health Policy Studies University of California San Francisco, Box 0936 San Francisco CA 94143, U.S.A. Deliveries: 3333 California Street, Suite 265 San Francisco, CA 94118 U.S.A.; e-mail: jgkahn@itsa.ucsf.edu

Dr. Hays is deceased.

Manuscript received October 2, 2000; accepted March 21, 2001.

intervention approaches (8). Encouraging effective community-level HIV prevention is especially important given the heavy emphasis of the U.S. epidemic response on individual and group prevention, rather than on community and environmental strategies (9).

The Mpowerment Project was implemented for 8 months in a mid-sized city (Eugene, OR), with a second mid-sized community (Santa Barbara, CA) as a control (6), and subsequently implemented in the second community (7). The evaluation used longitudinal cohorts of young gay men (18–27 years old) recruited independently of the project, assessing preintervention and postintervention sexual behaviors through mail-back surveys. It demonstrated reductions in the proportion of men reporting UAI in the intervention community compared with findings in the control community.

In addition to effectiveness in changing behavior, another consideration in deciding whether to implement a prevention program is cost-effectiveness. Assessing the economic efficiency of interventions is essential because financial resources for HIV prevention are finite. If resources are used with maximum efficiency, the result will be fewer HIV infections, less HIV disease, and fewer AIDS deaths. Cost-effectiveness analysis is the technique used to assess economic efficiency. So far only a limited range of prevention strategies (as defined by intervention technique, risk group, and local epidemic and economic parameters) have been evaluated for cost-effectiveness, as documented in reviews of the field and recent work (10–13). A few studies have assessed cost-effectiveness of HIV prevention in adolescents (14–16). Just one community level diffusion intervention, for gay men in a small southern U.S. city, has been assessed (17,18). As far as we know, no community intervention specifically for young gay men has been analyzed for cost-effectiveness.

The purpose of the current study is to conduct a retrospective cost-effectiveness analysis of the Mpowerment Project intervention. We tried to answer two questions: What were the health effects, in particular how many HIV infections were averted and how many quality-adjusted life years (QALYs) were gained? What were the economic effects, in particular what was the cost of the intervention per HIV infection averted and what were net costs?

METHODS

We used standard methods of cost-effectiveness analysis (19–21) in combination with a simple epidemic model to evaluate the 8-month Mpowerment Project intervention.

Health and Economic Outcomes

We estimated two health outcomes: HIV infections averted and quality-adjusted life years gained. *HIV infections averted* are defined as the difference in infections expected with and without the intervention. *Quality-adjusted life years (QALYs) gained* represent the expected increase in years of life as well as improved health status.

We estimated three economic outcomes. The *cost of the intervention* was calculated from three perspectives: full cost to society (valuing volunteer time); cost to society excluding volunteer time; and cost to a community-based organization. *Cost per HIV infection averted* was defined as the cost of implementing the intervention, divided by the number of HIV infections averted. *Net program costs* was defined as the cost of implementing the intervention minus averted HIV medical care costs.

(We did not, however, calculate cost per QALY gained because this metric yields contradictory results when, as in this analysis, the intervention generates net savings. For example, an increase in QALYs gained, which is desirable, yields a smaller negative ratio (lower savings per QALY gained), which appears undesirable.)

We assessed outcomes over 1, 5, and 20 years, discounting both health and cost components at 3% per year. We conducted sensitivity analyses to assess the effect of uncertainty in inputs.

The steps in our analysis, detailed in the following sections, were: description of the Mpowerment Project; quantification of behavioral effects; adaptation of an existing epidemic model; determination of intervention costs; and calculation of health and economic outcomes.

The Mpowerment Project

There are four guiding principles to the Mpowerment Project. First, social concerns are highly motivating for young gay men, compared with HIV prevention, which is generally not compelling for young men. Therefore, the program adopted a social focus, with HIV-prevention ideas infused into program components rather than being the primary emphasis. Second, the Project used peer influence to support safer sex, because peers and social norms often strongly influence behavior in young gay men. Third, the Project aimed to mobilize and empower the young gay men's community; research indicates that changes are more enduring when people with problems identify and enact their own solutions. Finally, applying the theory of diffusion of innovations (22), the intervention developed a process by which young gay men would encourage and support each other about engaging in safer sex.

Eugene and Santa Barbara were chosen as study communities because each contains a large state university; attracts young people from the surrounding county; is of similar population size; had an AIDS community-based organization (CBO), but had no programs explicitly for young gay men at the time of the study; contains 1 or 2 bars frequented by the gay community, and is 1 or 2 hours away from a larger community. Eugene was randomly assigned to receive the intervention first, with Santa Barbara used for purposes of comparison.

In accordance with principles underlying the program, all Mpowerment Project components, including the name, were designed and implemented by young gay men in the community, with the guidance and supervision of two behavioral intervention researchers. The intervention had three interrelated activities. *Peer outreach* involved formal and informal contacts in which young gay men encouraged their peers to engage in safer sex and recruited additional young gay men into the project. Formal contacts involved an Outreach Team that visited settings frequented by young gay men, such as bars, community events, and the project's Mpowerment Center. Because there were few existing settings where young gay men congregated, an important aspect of formal outreach was the creation of varied social events to attract young gay men, during which safer sex could be promoted. Informal outreach consisted of young men talking to and encouraging friends about safer sex and the project. Second, there were *peer-led M-Groups*, 3-hour meetings of 8 to 10 young gay men. These groups included discussion, exercises, and role-plays on issues relevant to HIV prevention in young men, such as perceptions and attitudes about safer sex and sexual communication. They also included a component to motivate and train men to do informal outreach. A total of 168 men attended M-Groups, representing about 15% of 1,100 estimated young gay men in Eugene. Finally, a small *publicity campaign* used articles, advertisements, outreach materials, and word-of-mouth to increase awareness and acceptance of the program in the gay community.

Behavior Change

The aim of the Mpowerment Project was to encourage the adoption and maintenance of safer sex. The community-based evaluation demonstrated statistically significant reductions in HIV-related sexual risk behaviors (i.e., the prevalence and frequency UAI) compared with a comparison community (6, 7). To minimize bias, the evaluation was separate from the intervention. Study subjects were recruited into a longitudinal cohort by teams of local young gay men who distributed surveys at settings frequented by young gay men and through informal social networks; no formal nonresponse rate was calculated. Annual follow-up used mail-back surveys; loss to follow-up was 45%, comprising 20% no longer living in the communities and the remainder lost to attrition (7). We focused on UAI because it is the most important risk factor for HIV acquisition in gay men. Other risk behaviors (e.g., vaginal sex, needle sharing) were not measured in the behavioral assessment, but they may have followed similar patterns of risk reduction due to the general HIV-risk reduction message of The Mpowerment Project.

For epidemic modeling of HIV *infections* averted, we required as an input the magnitude of risk reduction associated with the intervention. Specifically, we used the relative reduction in the key risk behavior: the difference between the preintervention and postintervention prevalence of unprotected anal intercourse, divided by the preintervention prevalence of this risk behavior. We decreased this difference by 10% to reflect that unprotected episodes are often replaced by protected episodes, and that condoms lower HIV risk by 90% or more (23). To reflect uncertainty in the change in risk, we vary the risk reduction assumption by ± 50%.

Our analysis of the behavioral outcomes is reported in Table 1. In the community that received the intervention (Eugene), 41% of the young gay men (18–27 years old at recruitment) reported UAI before the intervention and 30% reported UAI after the intervention, representing a reduction of 26.8%. In the comparison community, UAI rose slightly: from 38.6% to 39.8%, an increase of 3.1%. The difference in the change between the two cities was 29.9%. Risk reduction was very similar for UAI with specific types of partners: nonprimary partners (27.8% difference in the change between the two cities) and boyfriends (29.6%). The *frequency* of UAI decreased as well, 69% with nonprimary partners and 17% with boyfriends (unpublished data). We used 27% (30% × 90%) as our best estimate of risk reduction. Follow-up assessments at 12 months after intervention completion indicated that risk reduction increased in nonprimary partners to 43% but decreased in boyfriends to 13% (7). We assumed as our best estimate that risk reductions would return in a linear fashion to preintervention levels after 3 years. In the sensitivity analyses, we assessed returns to preintervention behaviors after 1 or 5 years and also modeled the effects of persistent behavior change resulting from program continuation.

Epidemic Model and Inputs

We adapted an epidemic model reported previously (24). This model is based on fundamental principles of HIV epidemic dynamics, such as the relationship of HIV prevalence to HIV incidence and exit rate and portrays risk populations rather than individuals. HIV prevalence is stable in a population (in "steady state") when the number of new HIV infections equals the number of infected individuals leaving the population. If steady-state HIV prevalence and the exit rate (the probability that infected individuals leave the population) are specified, the HIV incidence needed to maintain steady-state prevalence can be calculated, as specified later in this article. HIV prevalence increases or decreases when there are unequal numbers of exiting HIV-positive individuals and new HIV infections. With a constant exit rate, changes in HIV prevalence depend on the number of new HIV infections, which equals HIV incidence times the number of individuals susceptible.

In this model, HIV incidence is assumed to be proportional to the frequency of risk behaviors and to HIV prevalence. Thus, if risk behaviors decrease by a specified percentage whereas HIV prevalence remains constant, HIV incidence drops by the same percentage. This approach reflects the relationship of risk behaviors and HIV incidence in populations with low HIV incidence, such as young gay men in Eugene. Most mathematical models of HIV transmission assume that each exposure to HIV confers an equal and relatively small (generally <0.5%) risk of HIV transmission. When HIV incidence is low (e.g., less than 10%), cumulative risk is nearly linearly proportional to the number of risky episodes, and reducing risky episodes proportionally reduces cumulative risk (25).

Infections are calculated in annual intervals by applying the calculated value for HIV incidence to the number of susceptibles at the beginning of each year. We conducted analyses for 1 year, 5 years (base case), and 20 years. We chose these time frames to represent a wide range of epidemic horizons. Shorter time frames yield more certain estimates for that time period, but miss important long-term epidemic dynamics. Longer time frames capture more epidemic dynamics but require more assumptions (and thus uncertainty) about how the epidemic will evolve. Use of multiple time frames helps indicate the accumulation of benefits over time, particularly for a intensifying epidemic. We discounted all future HIV infections to the year of the intervention at 3% per year as recommended by the U.S. Panel on Cost-Effectiveness in Health and Medicine (19). Discounting is a stan-

TABLE 1. *Prevalence of and change in unprotected anal intercourse, Mpowerment intervention community versus comparison community*

	Preintervention	Postintervention	Relative decrease from preintervention	Decrease associated with intervention[a]
Intervention community	41.0	30.0	−26.8	−29.9
Comparison community	38.6	39.8	3.1	—

[a] The decrease associated with the intervention is the decrease observed in the intervention community minus the decrease observed in the control community.

dard economic technique to reflect the lower value individuals place on future events (both health status and costs), in proportion to how far into the future those events are expected to occur. We varied the discount rate from 0 to 5% in a sensitivity analysis.

We described two possible epidemic scenarios for the young gay men in Eugene: stable HIV prevalence ("steady state") and rising HIV prevalence ("presteady state"). Steady state, as already noted, is when the number of new HIV infections equals the number of infected individuals exiting the population. Presteady state is when new HIV infections exceed exiting HIV-positives, such that HIV prevalence rises over time.

In the steady-state scenario, we assume that the self-reported HIV prevalence of 5.5% in young gay men in Eugene (14 of the 251 study subjects who reported being tested) represents steady-state HIV prevalence. The HIV incidence required to maintain this steady state HIV prevalence depends on the exit rate. We estimated the exit rate as 0.12 per year. This is the combined probability of two independent factors, adjusted for overlap of probabilities: participants aging beyond the 18 to 29 age range (one twelfth per year = 0.0833) and the risk of dying or becoming sexually inactive due to HIV disease (conservatively, one twenty-fifth per year, or 0.04). Thus, HIV incidence is calculated to be 0.007. This is equal to (exit rate × HIV prevalence) divided by (1 − HIV prevalence). In this scenario, the estimated discounted number of HIV infections in the community of young gay men in Eugene ($n = 1{,}100$) is 7 for 1 year, 32 for 5 years, and 99 for 20 years.

In the presteady-state scenario, we assume that HIV prevalence in young gay men in Eugene was rising toward a steady-state HIV prevalence of 20%. We selected 20% as a high-end estimate based on HIV prevalence in young gay men in San Francisco (18%). HIV incidence at this steady state is 0.030, for the same exit rate as already given. Because HIV prevalence at the time of the intervention was only 5.5% (0.275 of 20%), the model assumes that HIV incidence at that time would also be 0.275 of steady state HIV incidence, or 0.00825. This estimate of presteady-state incidence is based on the assumption that for a given population, with a defined level of risk behavior, incidence approximates a linear function of HIV prevalence in the population. In this scenario, the estimated discounted number of HIV infections is 8 for 1 year, 40 for 5 years, and 137 for 20 years. We varied the steady state prevalence ± 50% in the sensitivity analyses.

Decreases in risk behavior are assumed to translate to equal relative decreases in HIV incidence. If risk behaviors decrease by 20%, HIV incidence decreases by 20%. Thus, any intervention-induced reduction in risk behaviors lowers HIV incidence, leading to fewer new infections. The resulting lower HIV prevalence in turn contributes to a decrease in new HIV infections even if HIV risk behaviors return to preintervention levels.

Intervention Cost

We estimated intervention costs retrospectively, abstracting cost data from the project ledgers and interviewing project staff. Only costs associated with implementing the intervention were included; costs for evaluating effectiveness were excluded. The major categories of the budget included personnel, consultation, computer equipment, supplies, outreach materials and publicity, travel, and space rental. The personnel category was divided into supervisor, intervention expert, project coordinators, and volunteers. Supplies included computer software, telephones, office supplies and furniture, and logistic support for meetings. Expenditures for the promotion of the Mpowerment Center, such as T-shirts, buttons, condoms, and lubricants were included in "outreach materials and publicity."

Costs were initially estimated in 1991 U.S. dollars (all amounts given in this article are expressed in U.S. dollars), when incurred, and inflated to year 2000 dollars using the appropriate price indices for inflation. Wages were inflated (adjustment 1991–2000 = 1.35) based on average hourly earnings in constant dollars for private service-producing workers (U.S. Bureau of Labor Statistics) adjusted to nominal dollars using the overall Consumer Price Index (CPI). Other budget items were inflated using the overall CPI (adjustment 1991–2000 = 1.25), with the exception of items that have remained constant or decreasing in price (computers, computer software, long-distance telephone).

Two cost elements warrant discussion. First, volunteer time in the Mpowerment Project has ambiguous economic value, particularly as to whether it should be considered a direct program cost. Because the Mpowerment Project is a community mobilizing project that focuses on facilitating the empowerment of young gay men, young men are encouraged to volunteer for project activities (e.g., setting up events, developing safer sex materials, and joining the Outreach Team) primarily as a means to foster the intervention. Through their work on the project, volunteers are exposed to social norms supporting safer sex, and they build their social networks through which these norms are then diffused. By volunteering and having influence about the course of the project, volunteers also gain a sense of ownership in the project and its mission of reducing risk behavior and strengthening the community of young gay men. They are motivated to volunteer not only to help their community, but also because in so doing they participate in a trendy activity and meet other young gay men. In effect, volunteers are also clients of the intervention. This is in contrast to volunteers in other types of programs (e.g., needle exchanges), who are not intended beneficiaries. Thus, the usual justifications for including the economic value of contributed effort in the direct cost of the intervention may not apply. These justifications are that volunteer effort would otherwise need to be purchased to obtain a needed service, or alternatively that volunteer time should be valued as an "opportunity cost," that is, based on the economically valuable work and home activities individuals would do if not volunteering. However, in The Mpowerment Project it is the act of volunteering rather than the associated economic productivity that is critical; the proximate economic product (a social event) has far less value than the volunteering itself. In fact, it was often discussed within the project that the outcome (staging the social event, outreach materials) was secondary to the process of achieving the outcome. Even if a paid coordinator could stage the event or develop outreach materials more efficiently by himself than by working with volunteers, doing so would be considered a failure since it would not facilitate the empowerment of volunteers who would then feel ownership of the project and the project's message, and then take the HIV prevention message to their peers. In production terms, volunteering is the intermediate outcome between purchased inputs and the desired final outcome of behavior change. Because of the unclear economic status of volunteering, we repeated the analysis with and without assigning a value to volunteer time.

Second, for the two societal cost perspectives, we incorporated costs associated with the need for expertise in conducting the intervention. The Mpowerment Project in Eugene was a novel application of diffusion theory, theories about empowerment and community organizing, and social marketing methods. As such, it required regular involvement by individuals with a thorough understanding of the theoretical underpinnings of these approaches, involvement that would be less necessary once the program elements were well established and accessible by manuals and videotapes. The second and third authors played this role and also supervised staff, so their time is divided into the two personnel categories of supervisor (the time typically needed by a local program supervisor) and intervention expert (time which is not necessarily found locally). Since the supervision expertise was not local, we included inter-city travel costs. If a CBO attempted to replicate this project, it is not likely that intercity travel costs for expert supervisors would be necessary. Thus, to reflect the costs experienced by a CBO's implementing an intervention like the Mpowerment Project using replication training materials, we did a third cost analysis from the CBO perspective, excluding the personnel, travel, and telephone costs of direct expert involvement.

HIV Medical Care Costs and QALYs

We estimated the averted costs of medical care for HIV/AIDS by combining a published cost model with recent data on treatment patterns. The model (26) estimates lifetime HIV/AIDS medical costs for treatment scenarios, including intermediate antiretroviral (ARV) use and cost consistent with published recommendations, and low ARV use and cost representing zidovudine monotherapy initiated at CD4 <500. Our analyses of patterns of ARV use in Medicaid in four states in 1998 suggest that about one half of clinically ill individuals are receiving recommended triple ARV therapy, with the remainder receiving fewer or no ARVs (Kahn et al., unpublished data); this may reflect high rates of actual treatment failure (27), as well as other factors. Thus, we used the mean of the low and intermediate cost hypotheses, inflated with the medical component of the consumer price index (adjustment 1996–2000, 1.13), and discounted at 3% per year, or $159,330. Other data suggest that optimal ARV therapy results in substantially lower inpatient costs (28–30), so in a sensitivity analysis we used the low-cost hypothesis, or $98,361. We also varied the discount rate from 0 to 5% in a sensitivity analysis.

QALYs gained represent the expected increase in years of life as well as improved health status. A QALY represents a year of life in perfect health. Thus, QALYs are calculated as years of life times the "utility" of a person's health state measured on a 0 to 1 scale (19). In this analysis, QALYs are calculated by multiplying the number of HIV infections averted by the QALYs gained per HIV infection averted, which has been estimated for HIV infections averted at age 26 using the model already cited (26). As with costs, we used the mean of the low and intermediate scenarios, or 12.2 QALYs gained per HIV infection averted, at a 3% discount rate. We adjusted this to 12.7 to reflect the 2 added years of life expectancy for our younger population (these 2 years have a present value of 0.5 years, discounted at 3% over 40 years). We conducted sensitivity analyses on the scenarios and discount rate, as above.

RESULTS

Health Outcomes

HIV Infections Averted

The estimated number of HIV infections averted due to the Mpowerment Project is 2.0 in the first year after project implementation, 5.0 over 5 years, and 9.2 over 20 years, for the steady state analysis (Table 2). The increase in infections averted with longer time frames is the result of two factors. First, behavioral risk reductions are assumed to continue beyond a year after the end of the project, with behaviors returning to preintervention levels over 3 years if no intervention activities are maintained. In addition, the spread of HIV is slowed by the persistent decrease in HIV prevalence resulting from initial risk reduction.

TABLE 2. *Number of HIV infections averted and quality-adjusted life years (QALYs) gained, Mpowerment Project, baseline assumptions*

	1 year	5 years	20 years
Steady state			
HIV infections averted	2.0	5.0	9.2
QALYs gained	24.9	63.0	116.6
Presteady state			
HIV infections averted	2.3	6.2	13.1
QALYs gained	29.4	79.1	166.4

In the presteady state, which has higher HIV incidence, more infections are estimated to be averted: 2.3 in 1 year, 6.2 over 5 years, and 13.1 over 20 years. This is consistent with the higher HIV incidence in the presteady-state hypothesis. Also of note, the ratio of infections averted in presteady state to steady state increases from 1.18 in the first year to 1.43 for 20 years, reflecting the importance of delayed benefit when HIV prevalence is rising. That is, infections averted in the short term, when HIV prevalence is low, delay onset of higher HIV prevalence with its associated higher risk.

QALYs Gained

The estimated number of QALYs gained by the Mpowerment Project is 25 in the first year after project implementation, 63 in 5 years, and 117 in 20 years, for the steady-state analysis (Table 2). In the presteady state, with more HIV infections averted, more QALYs are gained.

Economic Outcomes

Intervention Cost

The Mpowerment Project cost $90,913 from the comprehensive societal perspective (counting volunteer time), $64,762 without volunteer time, and $58,865 considering only CBO costs (year 2000 dollars; full budget in given in the Appendix). The largest expenditure was for personnel, representing 71% of total cost if counting volunteer time and 59% if excluding it. The cost per young gay man participating in the M-group component of the program (n = 168) was $541 for comprehensive societal costs, $385 without volunteer time, and $350 from the CBO perspective. The cost per young gay man in the community and in our epidemic model (n = 1,100) was $83 for comprehensive societal costs, $59 without volunteer time, and $54 from the CBO perspective.

Cost per HIV Infection Averted

The estimated cost per HIV infection averted under the comprehensive societal perspective is $46,400 in year one for steady state and $39,300 for presteady state (Table 3). With longer time frames, the cost per infection averted decreases substantially. Over 5 years, the cost per HIV infection averted decreases by 60%, to $18,300 for steady state and $14,600 for presteady state, respectively; for 20 years, the decrease is about 80%. This decrease reflects the accumulating numbers of infections averted, as presented in Table 2, as well as that costs are incurred only in the first year.

When volunteer time is not valued, the estimated cost per HIV infection averted is 28% lower: for 5 years, $13,000 for steady state and $10,400 for presteady state. From the perspective of a CBO, the cost per HIV infection is 35% lower than the comprehensive societal perspective, or $11,900 for steady state and $9,500 for presteady state for five years.

Net Program Costs

The program eliminates more in HIV medical costs than it costs to implement, thus showing net savings. For the 1-year analysis, for societal costs including volunteer time, estimated net savings are $212,000 for steady state and $267,000 for presteady state (Table 4). Savings rise steeply in the longer time frames, to nearly $2 million presteady state for 20 years. Net savings vary little in terms of program costs (1% – 15%), because differences in program costs are far smaller than savings from HIV medical costs averted. For example, at 5 years presteady state, the CBO perspective has estimated net savings of $934,000, compared with $902,000 for societal costs with volunteer time (data not shown).

Sensitivity Analyses

We report sensitivity analyses for seven key inputs, for the presteady-state scenario over 5 years, valuing volunteer time (Table 5). We present results for the presteady state scenario because variation in steady-state HIV prevalence is an issue only for this scenario; sensitivity to input uncertainty was similar for the steady state scenario.

TABLE 3. *Program cost per HIV infection averted, Mpowerment Project, unadjusted for HIV medical costs averted, baseline assumptions*

	1 year	5 years	20 years
Societal perspective: volunteer time assigned economic value			
Steady state	46,400	18,300	9,900
Presteady state	39,300	14,600	6,900
Societal perspective: volunteer time not assigned economic value			
Steady state	33,000	13,000	7,100
Presteady state	28,000	10,400	4,900
Perspective of community-based organization (excluding expert consultation)			
Steady state	30,000	11,900	6,400
Presteady state	25,400	9,500	4,500

Amounts shown in U.S. dollars, 2000.

TABLE 4. *Net program savings, Mpowerment Project, adjusted for HIV medical costs averted. Societal perspective, volunteer time assigned economic value, baseline assumptions*

	1 year	5 years	20 years
Steady state	212,000	700,000	1,371,000
Presteady state	267,000	902,000	1,996,000

Amounts shown in U.S. dollars, 2000.

Two factors are uncertain in our estimate of the reduction in risk behaviors: magnitude and duration. Over a ±50% range for the magnitude of risk reduction, HIV infections and the cost per infection averted also vary by ±50%. These results are also presented in Figure 1, for both epidemic scenarios. For the conservative assumption that risk reduction ends after 1 year, 46% fewer infections are averted; if risk reduction decreases linearly to 5 years, 39% more infections are averted.

Two important epidemiologic factors are uncertain. Over a ±50% range around reported HIV prevalence, HIV infections averted, and cost per infection averted vary over the range from −47% to +44%. If eventual steady-state prevalence is really 10% (instead of 20%), HIV infections averted decrease by 15%; if steady state prevalence is 30%, HIV infections increase by 21%.

Two costs inputs may vary from baseline. The lifetime cost of HIV/AIDS care may be lower than our base-case estimate, as a result of savings inpatient costs with optimal ARV therapy. Using the low-cost hypothesis of $98,361, net savings decrease from $902,000 to $522,000 (data not shown in table; HIV infections averted and cost per infection averted are unchanged). The cost of the intervention may deviate from our estimate; variation by ±25% yields cost per infection averted of $11,000 to $18,300 (data not shown in table; HIV infections are unaffected).

The discount rate, 3% at baseline, is by convention tested in sensitivity analyses at 0 and 5%. There is only minor variation in the number of HIV infections averted, because they occur mainly in the first 3 years and are thus little affected by discounting. The cost per HIV infection averted is lower when the discount rate is low, simply because more HIV infections are averted (program costs, all in year 1, are unchanged by discounting). Discounting at 0 results in substantially more QALYs gained than at 3% (169 versus 79) and greater net savings ($1.4 versus $0.9 million), by placing greater value on health status and medical costs that occur far in the future; discounting at 5% results in fewer QALYs (47) *and lower net savings ($0.68 million) (data not shown in table).*

The Mpowerment Project was a one-time intervention in Eugene, as implemented by the expert staff/researchers.

TABLE 5. *Sensitivity analyses for HIV infections averted and cost per HIV infection averted, Mpowerment Project, for presteady state situation over 5 years, societal perspective with volunteer time included*

Model input changed	Value range (baseline)	HIV infections averted	Cost per HIV infection averted
Baseline estimates	—	6.2	$14,600
Reduction in risk behaviors			
Magnitude	14%–41% (27%)	3.1–9.3	$28,900–$9,800
Return to preintervention	1 year–5 years (3 years)	3.4–8.6	$26,900–$10,500
Epidemiologic parameters			
HIV prevalence	2.75%–8.25% (5.5%)	3.3–8.9	$27,700–$10,300
Steady state HIV prevalence	10%–30% (20%)	5.3–7.5	$17,100–$12,100
Discount rate	0%–5% (3%)	6.7–6.0	$13,600–$15,200
Program continuation[a]	Cost 50% of year 1, risk reduction stable	13.0	$19,700

[a] See text for further description.
Amounts shown in U.S. dollars.

If the program were continued at a cost of 50% of initial year costs and with a resulting stable reduction in HIV risk behaviors, there would be a doubling of HIV infections averted over 5 years. The overall cost per infection averted from the comprehensive societal perspective would be $19,700. The marginal cost per infection averted (the increase in cost divided by the increase in infections averted) would be $24,300.

DISCUSSION

This analysis suggests that the Mpowerment Project, a community-level HIV prevention strategy, averted approximately five to six HIV infections in young gay men over 5 years, at a societal cost of $18,000 or less per infection averted. Different time frames, epidemic scenarios, cost perspectives, and modeling inputs led to a range in estimated HIV infections averted of 2 to 13 and in cost per infection averted of $4,500 to $46,400. All estimates of cost per infection averted are far less than the discounted lifetime direct medical costs of HIV disease, estimated before protease inhibitors at $56,000 (31,32), more recently for recommended triple ARV therapy at $195,000 (26), and in this study for a realistic mix of ARV patterns at $159,330.

The Mpowerment Project appears to be among the most cost-effective of HIV prevention strategies assessed for cost-effectiveness, especially for gay men. A popular opinion leader prevention intervention in gay men in Biloxi (MS) costs $12,000 to $65,000 per HIV infection averted, based on two analyzes (17,18). This intervention is economically efficient for the same reason as the Mpowerment Project, by changing community norms through intensive intervention with only a few men who then spread safer sex attitudes. Small group interventions have often cost more per HIV infection averted than we

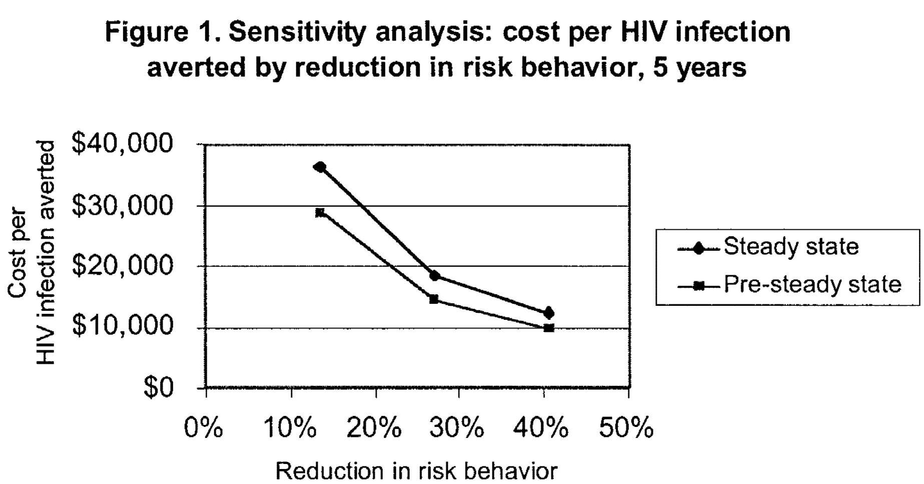

FIG. 1. The cost per HIV infection averted (unadjusted for averted medical care costs, 5-year time frame) varies from $10,000 to $40,000 across epidemic scenarios and risk-behavior reductions. These results are far lower than the estimated $159,000 lifetime cost of medical care per HIV infection, leading to net savings for the program (see text and Table 4 for details).

found for the Mpowerment Project, depending on the number of sessions: for gay men receiving a one-session skills training $4,150 per HIV infection averted (33), for gay men receiving 12 risk reduction sessions $50,000 per HIV infection averted (34), and for at-risk urban women in a primary health care clinic for a 5-session intervention $126,000 per HIV infection averted (35). Needle exchange programs and other prevention strategies in injection drug users have estimated cost per HIV infection averted of $3,000 to $90,000, mostly in the range of $4,000 to $30,000 (12).

The Mpowerment Project's cost-effectiveness findings may provide an indication of the cost-effectiveness of community mobilization/diffusion interventions in other populations. We believe that the findings are most directly relevant to other "second tier" cities, with low prevalence in the gay population and in young gay in particular. Replicating the Mpowerment Project with young gay men in other cities may be predicted to be slightly more cost-effective, if effectiveness improves or if costs are lowered (e.g., due to streamlined intervention procedures or cost-saving strategies such as greater reliance on volunteers or shared offices). However, local characteristics such as HIV prevalence and previous exposure to prevention efforts can result in substantial differences in effectiveness and cost-effectiveness. Predictions of the cost-effectiveness of mobilization/diffusion interventions in other risk groups, such as injecting drug users or ethnically identified populations, must consider several factors. For example, higher costs would result from more difficulty in identifying or recruiting members of a group. Effectiveness (HIV infections averted) could be compromised by fragmented social networks that impede the spread of safe behavior (even though a mobilization strengthens those networks) or by already low risk behaviors due to previously successful prevention, or enhanced by higher HIV risk.

The policy implications of our findings are twofold. First, CBOs have a community-level intervention available to them for young gay men that is effective and is likely to be cost-effective, even considering factors that vary by setting as noted above. Second, for CBOs and HIV-prevention planning groups, successful use of a preexisting epidemic model suggests that cost-effectiveness can be estimated without creating new epidemic models. The model used here should work for any intervention that has been evaluated for behavioral effectiveness and that yields its HIV prevention benefits primarily within any given risk community (i.e., the benefits are not due to avoiding HIV spread to other risk groups). For any specific analysis, other epidemic models may be adaptable as well.

Only outcomes regarding HIV prevention have been discussed and valued in these analyses. However, other benefits to which we have not assigned economic values are also likely to result from this intervention approach. For example, other sexually transmitted diseases may have been prevented due to increased condom use. More broadly, this community mobilization approach became, in essence, a community-building program for young gay men. Specific benefits of the program that we did not consider and are difficult to quantify economically include decreased social isolation and increased self-esteem by having a better sense of community and increased social networks. In addition, having an alternative social setting to gay bars may have resulted in reduced alcohol use.

Our analysis has several limitations. Most importantly, effectiveness (HIV infections averted) was modeled rather than measured empirically, as is true for most HIV prevention cost-effectiveness analyses. In particular, our findings depend on the assumption that HIV incidence is proportional to the prevalence of unprotected anal intercourse. Epidemic models often rely on similar assumptions, by summing the risk from multiple independent low-risk exposures to HIV. Also, the risk behavior data collected to evaluate the Mpowerment Project were selected without anticipating a cost-effectiveness model. Data on heterosexual and injection-drug-use risks would have created a fuller picture, and perhaps indicated additional HIV prevention benefits. As with the uncertainties explored in the sensitivity analyses, these methodologic limitations are unlikely to change the conclusion that cost per HIV infection averted is far lower than the cost of treating HIV disease.

Our cost analysis was retrospective, which posed some challenges. We were able to determine financial outlays only by reviewing voluminous accounting records, we had to systematically review project activities to estimate volunteer effort, and we had to distinguish time spent by S. Kegeles and R. Hays on program implementation rather than evaluation. We recommend that future behavioral evaluations consider prospectively tracking resources needed for program implementation if cost or cost-effectiveness analyzes are contemplated.

We believe that our estimates of the impact and cost-effectiveness of the Mpowerment Project confirm the value of community-level interventions for HIV prevention. Individual-level interventions such as counseling and testing remain important in HIV prevention. However, interventions to change community behaviors by mobilizing an entire group have the demonstrated ability to effectively reduce risk behaviors, and to do so very efficiently.

Acknowledgments: The authors thank Larry Osborn for his extraction of project expenditures from financial records, Thomas J. Coates for his encouragement and review, and anonymous journal reviewers for excellent comments and suggestions. This work was supported by U.S. National Institute of Mental Health grants nos. MH46816 and MH41459 (the Center for AIDS Prevention Studies, UCSF) and by NIDA grant no. DA09531 (through the Societal Institute for the Mathematical Sciences).

REFERENCES

1. Valleroy LA, MacKellar D, Janssen R, et al. The 1994–1996 Young Men's Survey. HIV infection and risk behavior prevalence among young men who have sex with men sampled in six urban counties in the U.S.A. [abstract C.2407]. XI International Conference on AIDS, Vancouver, British Columbia, Canada, July 7–12, 1996.
2. Catania J, Stall R, Osmond D, et al. HIV seroprevalence rates among men who have sex with men in the Urban Men's Health Study. American Public Health Association Conference, Washington D.C., November 15–18, 1998.
3. Osmond DH, Page K, Wiley J, et al. HIV infection in homosexual and bisexual men 18 to 29 years of age: The San Francisco Young Men's Health Study. *Am J Public Health* 1994;84:1933–7.
4. Webster RD, Darrow WW, Stempel RR, et al. Second wave of HIV infection washes ashore: South Beach health survey of young gay men [abstract C.1416]. *XI International Conference on AIDS.* Vancouver, British Columbia, Canada, July 7–12, 1996.
5. Dean L, Meyer I. HIV prevalence and sexual behavior in a cohort of New York City gay men (aged 18–24). *J Acquired Immune Deficiency Syndr Human Retrovirol* 1995;8:208–11.
6. Kegeles SM, Hays RB, Coates TJ. The Mpowerment Project: A community-level HIV prevention intervention for young gay men. *Am J Public Health*. 1996;86:1129–36.
7. Kegeles SM, Hays RB, Pollack LM, et al. Mobilizing Young Gay and Bisexual Men for HIV Prevention: A Two-Community Study. *AIDS* 1999;13:1753–62.
8. Kelly J. Community-level interventions are needed to prevent new HIV infections. *Am J Public Health* 1999;89:299–301.
9. Wohlfeiler, D. Structural and environmental HIV prevention for gay and bisexual men. *AIDS* 2000;14(Suppl 1):S52–6.
10. Holtgrave DR, Qualls NL, Graham JD. Economic evaluation of HIV prevention programs. *Annu Rev Public Health* 1996;17: 467–88.
11. Holtgrave DR. The cost-effectiveness of small group and community-level interventions; and The cost-effectiveness of the components of a comprehensive HIV prevention program: a road map of the literature. In Holtgrave DR, ed. *Handbook of HIV prevention policy analysis* New York: Plenum, 1998:119–34.
12. Kahn JG. Economic evaluation of primary HIV prevention in injection drug users. In Holtgrave DR, ed. *Handbook of HIV prevention policy analysis*. New York: Plenum, 1998:45–62.
13. Johnson-Masotti AP, Pinkerton SD, Kelly JA, et al. Cost-effectiveness of an HIV risk reduction intervention for adults with severe mental illness. *AIDS Care* 2000;12:321–2.
14. Rotheram-Borus MJ, Lee M, Gwadz M. Cost-effectiveness of an intervention for runaway youth [abstract 14272]. XII World Conference on AIDS, Geneva, Switzerland, June 28–July 3, 1998.
15. Tao G, Remafedi G. Economic evaluation of an HIV prevention intervention for gay and bisexual male adolescents. *J Acquir Immune Defic Syndr Hum Retrovirol* 1998;17:83–90.
16. Wang LY, Davis M, Robin L, et al. Economic evaluation of safer choices: a school-based human immunodeficiency virus, other sexually transmitted diseases, and pregnancy prevention program. *Arch Pediatr Adolesc Med.* 2000;154:1017–24.
17. Kahn JG, Haynes Sanstad K. The role of cost-effectiveness analysis in assessing HIV prevention. *AIDS Publ Policy J* 1997;12: 21–30.
18. Pinkerton SD, Holtgrave DR, DiFranceisco WJ, et al. Cost-effectiveness of a community-level HIV risk reduction intervention. *Am J Public Health* 1998;88:1239–42.
19. Gold MR, Siegel JE, Russell LB, eds. *Cost-effectiveness in health and medicine.* New York: Oxford University Press, 1996.
20. Drummond MF, O'Brien B, Stoddart GL, et al. *Methods for the economic evaluation of health care programs,* 2nd ed. New York: Oxford University Press, 1997.
21. Haddix AC, Teutsch SM, Shaffer PA, et al. *Prevention effectiveness: a guide to decision analysis and economic evaluation* New York: Oxford University Press, 1996.
22. Rogers EM. *Diffusion of innovations.* New York: Free Press, 1983.
23. Pinkerton SD, Abramson PR. Effectiveness of condoms in preventing HIV transmission. *Soc Sci Med* 1997;44:1303–12.
24. Kahn JG. The cost-effectiveness of HIV prevention targeting: How much more bang for the buck? *Am J Public Health* 1996;86: 1709–12.
25. Pinkerton SD, Abramson PR. Occasional condom use and HIV risk reduction. *J Acquir Immune Defic Syndr Hum Retrovirol* 1996;13: 456–60.
26. Holtgrave DR, Pinkerton SD. Updates of cost of illness and quality of life estimates for use in economic evaluations of HIV prevention programs. *J Acquir Immune Defic Syndr Hum Retrovirol* 1997;16: 54–62.
27. Lucas GM, Chaisson RE, Moore RD. Highly active antiretroviral therapy in a large urban clinic: risk factors for virologic failure and adverse drug reactions. *Ann Intern Med.* 1999;131:81–7.
28. Torres RA, Barr M. Impact of combination therapy for HIV infection on inpatient census [letter]. *N Engl J Med* 1997;336: 1531–2.
29. Rahman A, Deyton LR, Goetz MB, et al. Inversion of inpatient/outpatient HIV service utilization: Impact of improved therapies, clinician education and case management in the US department of veterans affairs [abstract 433/42429]. In XII World Conference on AIDS, June 28–July 3, 1998, Geneva, Switzerland.
30. Rawlings JE, Holmes J, Belton B, et al. Changes in HIV/AIDS patterns of care and estimated costs at an urban medical center during the era of HAART [abstract 4442/42430]. In XII World Conference on AIDS, June 28–July 3, 1998, Geneva, Switzerland.
31. Hellinger FJ. The lifetime cost of treating a person with HIV. *JAMA* 1993;270:474–8.
32. Guinan ME, Farnham PG, Holtgrave DR. Estimating the value of preventing a human immunodeficiency virus infection. *Am J Preventive Med* 1994;10:1–4.
33. Pinkerton SD, Holtgrave DR, Valdiserri RO. Cost-effectiveness of HIV prevention skills training for men who have sex with men. *AIDS* 1997;11:347–57.
34. Holtgrave DR, Kelly JA. Cost-effectiveness of an HIV/AIDS prevention intervention for gay men. *AIDS Behav* 1997;1:173–80.
35. Holtgrave DR, Kelly JA. Preventing HIV/AIDS among high-risk urban women: the cost-effectiveness of a behavioral group intervention. *Am J Public Health* 1996;86:1442–5.

APPENDIX

Mpowerment Project budget (8 months)

Resources	Role in project	Quantity	Unit cost (1991 $)	Total cost (2000 $)[a]
Personnel				64,282
Paid personnel				38,131
Supervisor	Overall management of intervention implementation	318 hours	14.42/hr	6,191
Intervention expert	Training, oversight, problem solving	24 hours	38.46/hr	1,246
4 Coordinators	Liaison, coordinating and facilitating groups, overseeing outreach team and outreach material	2,842 hours (50% each)	$8/hr	30,694
Volunteers				26,151
Community Advisory Board	Expertise and training	160 hours	14.42/hr	3,115
Volunteers	Outreach to bars/outreach events/office work/meeting coordination	2,133 hours	$8/hr	23,036
Consultation	Training of peer group facilitators			864
Computer equipment	To generate outreach materials and mailings; administrative tasks	1		2,500
Supplies				5,997
Computer software	Word processing, data base, graphics			400
Telephone/answering machine and installation	Communication with clients and collaborators	1		313
General	Office supplies. Project administration			940
Furniture	Sofas, chairs, desks, bookcases . . . to furnish office			924
Dildos	Condom demonstration in M-group	8		138
Logistic support for meetings	M-group food/drinks, materials (condoms, lubricants); CAB/Core group			3,283
Outreach materials and publicity				9,071
Events	Materials for costumes, space rental, sound system			4,060
T-shirts	For volunteers, with project name and logo	30		188
Buttons	With logo, distributed to groups			188
Condoms/lubricants				
In office	Accessible at the center			704
In community	Gift packages distributed to friends, as part of outreach and outreach events			736
Pamphlets-various	Promote safer sex and advertise existence of the program			289
Invitation cards	For social events			238
Copying	Cover all outreach materials			1,526
Logo design contest	For Mpowerment logo	1		155
Publicity	Newspaper advertisements (coordinator recruitment, inviting young men to participate, reminders of safer sex norm)			989
Travel	Plane fare, lodging for intervention experts/supervisors to intervention city	13 trips San Francisco, CA to Eugene, OR, U.S.A.		3,911
Space				3,436
Rent/utilities	Mpowerment Center: meetings, project offices. Gas, electric, water, garbage			3,281
Deposit/cleaning fees				155
Communication				852
Telephone charges	Local, long distance (to San Francisco)			740
Postage	Mailings			112
Totals				
Total with volunteer time				90,913
Total without volunteer time				64,762
Total without direct expert involvement				58,865

[a] Total cost is adjusted from 1991 to 2000 dollars using a U.S. consumer or wage price index (see text).
All amounts shown in U.S. dollars.