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COST SAVINGS THRESHOLD ANALYSIS OF A CAPACITY– BUILDING PROGRAM FOR HIV PREVENTION ORGANIZATIONS

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Abstract

Although the incidence of HIV each year remains steady, prevention funding is increasingly competitive. Programs need to justify costs in terms of evaluation outcomes, including economic ones. Threshold analyses set performance standards to determine program effectiveness relative to that threshold. This method was used to evaluate the potential cost savings of a national capacity–building program for HIV prevention organizations. Program costs were compared with the lifetime treatment costs of HIV, yielding an estimate of the HIV infections that would have to be prevented for the program to be cost saving. The 136 persons who completed the capacity–building program between 2000 and 2003 would have to avert 41 cases of HIV for the program to be considered cost saving. These figures represent less than one tenth of 1% of the 40,000 new HIV infections that occur in the United States annually and suggest a reasonable performance standard. These data underscore the resources needed to prevent HIV.

Although the number of new HIV infections each year remains steady, funding for prevention has become more competitive. Prevention programs need to justify program costs in terms of evaluation outcomes. One such outcome is cost savings. Policy makers also have a need for this information in allocating scarce resources for HIV prevention as illustrated in a report by the Institute of Medicine (2000), which recommended that HIV prevention resources be allocated in such a way as to maximize the number of infections prevented.

Community–based organizations (CBOs) have been the principal front–line providers of HIV/AIDS services and prevention programs since the early days of the epidemic in the United States. CBOs continue to play a key role in the fight against HIV, with their approach to interventions placing a high value on the role of community in defining and solving health

problems (Holtgrave et al., 1995; Kelly, Murphy, Sikkema, & Kalichman, 1993). This community focus is important and necessary in reaching at-risk populations with HIV prevention messages. CBOs have an array of evidence-based interventions to choose from and must evaluate their capacity to implement from an epidemiological as well as a cost savings point of view. One challenge CBOs face is the difficulty of sustaining or expanding their HIV prevention programs once grant funding expires. Some CBOs lack capacity with respect to strategic management and planning in their organizations, as well as the resources and expertise (or access to such expertise) needed to plan, implement, and evaluate targeted prevention interventions. Capacity building, therefore, is integral to strengthening CBOs to ultimately reduce the burden of HIV in communities at risk.

To address the capacity-building needs of HIV prevention CBOs, in 1997 the Centers for Disease Control and Prevention (CDC) contracted with the Association of Schools of Public Health and the University of South Carolina Arnold School of Public Health to assess the possibility of implementing a national curriculum in HIV prevention for CBO program managers in order to build the capacity of CBOs to design and manage more effective HIV prevention programs. Results indicated the need for a national capacity-building curriculum and in 2000, the first cohort of participants in this program began their training (Richter et al., 2000). A complete description of the capacity-building curriculum, called the institute for HIV Prevention Leadership and its evaluation results have been reported on elsewhere (Richter et al., 2006; Richter et al., 2007). After 3 years of development (1997–1999) and 4 years of implementation (2000–2003) and documented capacity increases, an evaluation of its cost savings was conducted. An analysis such as this is appropriate given the length of the causal chain between capacity building targeted at an organization and preventing an HIV infection in the community. Providing economic evaluation information about such programs is useful for conceptualizing a return on public investments that are distal from health outcomes and ensuring the sustainability of capacity-building programs (Holtgrave, 2007).

Economic analyses of the effectiveness of public health interventions typically refer to programs in terms of cost savings or cost effectiveness. An intervention is considered cost saving if the economic benefits of the program outweigh the cost. Cost saving programs represent unquestionably sound societal investments, because money is actually saved in the long run by implementing such programs. Theoretically, society should be willing to fund all cost saving programs. Cost effectiveness refers to an acceptable investment of scarce economic resources by considering the monetary program costs of an intervention in comparison to the intervention's health outcomes (Brownson&Simoes, 1999; Pinkerton&Holtgrave, 1998). When applied to measuring the effectiveness of HIV prevention, these measures of health impact or outcome can include the number of quality life years of life saved or the number of infections averted.

A threshold analysis sets the performance standard at which an intervention might be considered cost saving or cost effective. Such an analysis would indicate the number of HIV infections that would ultimately have to be prevented in order for the investment in a given intervention to be considered cost saving or cost effective. The threshold refers to the cost per HIV infection averted, based on past experience, above which society probably would not be willing to pay (Holtgrave&Qualls, 1995). This approach can be used to calculate how many HIV infections a particular program should avert, at the very least, in order to be cost effective or cost saving relative to other health service programs. This method also allows one to see if the performance standard set by the threshold analysis appears reasonably attainable or not (Holtgrave, 2007). The purpose of this article is to calculate the cost savings threshold for a capacity-building educational program for HIV prevention program managers working in CBOs.

METHODS AND MEASURES

ANALYTIC FRAMEWORK

The analytic framework for this study is a cost savings threshold analysis. We used standard methods to conduct the threshold analysis from both the program funder and societal perspectives (Holtgrave, Pinkerton, & Merson, 2002). In the analysis from the perspective of the program funder, only the costs that this funder (in this case the CDC) pay for the institute are considered. The societal perspective provides a broader interpretation of Institute costs and a more sizable estimate of the number of HIV infections that would ultimately have to be prevented for the investment in the institute to be considered cost saving. The threshold analysis from the societal perspective accounts for the time invested in the institute by the scholars as well as other CDC personnel who devote time to the institute but whose time is not covered directly in the institute's grant (Pinkerton & Holtgrave, 1998). The following paragraphs describe the data that will be used in the two threshold analyses.

COST OF HIV CARE

The cost of care was defined as the medical cost of treating one case of HIV disease. Holtgrave and Pinkerton (1997) calculated this cost to be \$154,402 in 1996 dollars. This represents a conservative estimate because the total cost of treating one case of HIV disease extends beyond medical costs (i.e., lost wages and productivity of an infected individual and their spouse/partner). This figure was adjusted to September 2003 dollars using the Consumer Price Index (CPI) for September 2003 and the mean CPI for 1996 (CPIs retrieved November 3, 2003, from <ftp://ftp.bls.gov/pub/special.requests/cpi/cpiiai.txt>). Cost of care was equal to \$182,055 and was used in both the government/payer and societal perspective analyses. The CPI was used instead of the medical CPI as a conservative measure of the increase in the cost of care. Furthermore, the medical care CPI is largely influenced by hospital care; for persons living with HIV, much of the lifetime costs of treatment come from antiretroviral medications.

INTERVENTION COSTS

Development costs refer to the cost of developing the institute and include research on the preferred topics and formats for training and the development of the institute curriculum. More information on the extensive research that went into the institute's development has been published elsewhere (Richter et al., 2000; Richter et al., 2006). Development costs were derived from the institute's budgets during 1997–1999 and were equal to \$522,106.

Program costs refer to the cost of the institute program itself and can be thought of as the costs needed to replicate the institute. Program costs include personnel, programmatic, and evaluation costs associated with the institute program. These costs include travel for all scholars for 4 weeks of on-site instruction in Atlanta, travel for faculty, on-site food and lodging, facility rental, all instructional materials, and faculty stipends. Additionally, these costs pay for salaries for full and part-time Institute staff and advisers (who mentor program participants during the course of the institute). Evaluation costs include the costs of printing evaluation instruments as well as the staff time necessary to collect, manage, analyze, and report on the data. These costs come from the institute's budgets during 2000–2003 and totaled \$5,163,178 for the entire time period. Development and program costs were used in both the government/payer and societal perspective analyses.

Other intervention costs were calculated as a unit cost per hour of time. These include costs for participants' time and the time spent by federal employees who worked on this project, but were not directly paid off of the project. To account for attrition the average number of scholars attending the institute in a given year (2000–2003) was used in the analyses. This

number is the average of the number of scholars beginning a given Institute year and the number of scholars completing a given Institute year. Data on unit costs per time were used in the threshold analyses from the societal perspective.

Because participants in the institute for HIV Prevention Leadership are representatives of the CBOs they work for, their salaries are expressed per hour away from the job in the final calculations. The costs associated with participants' salaries are expressed as an hourly figure, based on a 40-hour work week. Salaries were estimated using data obtained from the U.S. Department of Labor, Bureau of Labor Statistics (BLS) 2001 National Occupational Employment and Wage Estimates for health educators (<http://www.bls.gov/oes/2001/oes211091.htm>). Although Institute participants represent a variety of different educational backgrounds, the BLS description of the responsibilities of a health educator most closely matched the current job responsibilities of Institute participants. The mean annual wage was used in all calculations and the Federal Employees General Scale-General Increase in Salary (www.opm.gov/oca/payrates/index.asp) was used to calculate yearly adjustments in health educator salary from the 2001 BLS base. Benefits as a percentage of participants' total compensation were also included in our analyses and were estimated at 26.6% using the BLS Employer Cost of Employee Compensation 2003 (www.bls.gov/news.release/ecec.toc.htm, Table 15) for workers in private industry, in the health services, in professional specialty, and in technical positions.

Participants' time investment in the institute was calculated as the number of hours spent in on-site instruction (62.5 hours per week of on-site instruction $\times$ 4 weeks) plus the estimated number of hours (60) spent on the Integrated Learning Experience, a take-home assignment completed between on-site training weeks. Table 1 outlines participants' unit cost per hour of time invested in Institute work over each year of the institute. The amount of time that participants spent traveling to the institute as well as the costs associated with that time were also calculated based on conversations with the institute's implementation team and travel staff. The same figures were used for hourly salary. The number of hours spent on travel was determined to be 12 hours per on-site Institute week ($\times$ 4 weeks = 48 hours) for two thirds of the scholar cohort (66.7%), and 20 hours per on-site Institute week ($\times$ 4 weeks = 80 hours) for the one third (33.3%) of the scholar cohort that required travel either a day before or after the instructional sessions because of distance. As indicated by the amount of time scholars spend in capacity-building activities for each on-site week of instruction, the institute uses a comprehensive and intensive capacity-building curriculum. More details on the institute's curriculum can be found in Richter et al. (2006). Table 1 illustrates the time and cost investment owing to scholars' Institute travel.

The costs associated with the time devoted to the institute by other federal personnel whose salaries are not covered directly by the institute's grant were also calculated. Salaries were estimated using data obtained from the Office of Personnel Management General Schedule Salary Tables (www.opm.gov/oca/payrates/index.asp). Because federal employees working with the institute for HIV Prevention Leadership work for the Centers for Disease Control and Prevention, which is based in Atlanta, Locality Pay Tables for the Atlanta region were used. Estimates were calculated by averaging the first and last step for each federal employees Grade (grades 11–13, number of employees at each grade varied by year) per year of the project 2000–2003. Federal employees' benefits as a percent of their total compensation were estimated using the BLS Employer Cost of Employee Compensation 2003 (www.bls.gov/news.release/ecec.toc.htm, Table 1) for all civilian white-collar workers. The time per year spent by federal employees on the institute varied by their role on the project. An estimate of the project officer's time per year was obtained per conversation with the person holding that position. This person is at the Grade 13 level and spends approximately 85% of his or her time on the institute. The salary estimate for this

person was calculated by averaging the first and last step for a Grade 13 employee per year of the project 2000–2003; benefits were calculated at 27.2% and figured into the total salary. The 2000–2003 cumulative salary for this person is \$317,706.30.

CDC employs one to two other federal employees at the Grade 11 and/or 12 level per year who spend time on-site at the institute as well as spend time advising participants throughout the course of the institute. Estimates of time spent advising included two hours of staff meeting time and 10.5 hours of time working with Institute participants (average of 7 participants per advisor 1.5 hours each per week) for each of four Institute weeks. Estimates of hours spent advising off-site were based on an average of seven scholars per adviser and includes 2 hours per take-home assignment $\times$ four assignments $\times$ two drafts of each assignment; four conference calls of 1 hour each; three chat sessions of 1 hour each; two advisors phone calls of 1 hour each; and 12 hours of direct assistance to scholars (phone and e-mail). The hourly salary (calculated based on a 40-hour work week) estimates for these persons also were calculated by averaging the first and last step of their grade per year of the project 2000–2003; benefits were calculated at 27.2% and figured into the total hourly rate. In the years 2000, 2002, and 2003, the CDC employed one person at each Grade level 11 and 12 to work on this project. In 2001 one person was employed to fulfill this role; however, that person's grade level is not known, and as a result an average of Grades 11 and 12 are used. It was estimated that each of these individuals spends 72 hours per week of the institute working ($\times$ 4 weeks = 288 hours) and 133 hours advising scholars outside of the institute, for a total of 421 hours of time per year on this project. Because of the intensity of the institute's curriculum, CDC personnel, like Institute scholars and staff, work numerous hours over the typical 40-hour work week during the institute's 4 weeks of on-site instruction. Table 2 details the unit cost per time investment attributable to other CDC staff time.

RESULTS

PROGRAM FUNDER PERSPECTIVE

As mentioned previously, the program funder perspective allows for a less conservative estimate of the number of HIV infections that would ultimately have to be prevented in order for the investment in the institute to be considered cost saving. In this analysis, only the costs that the program's funder (in this case the CDC, which is funded by the federal government) pays for the institute will be considered. To get an indication of the number of HIV infections that would ultimately have to be prevented for the investment in the institute to be considered cost saving, the development and program costs of the institute were added together and then divided by the cost of care as illustrated in Table 3. The number of HIV infections that would have to be averted by all Institute participants over the course of 4 years of the program in order for the costs put into the program by the government to be offset by the medical costs saved is approximately 32.

SOCIETAL PERSPECTIVE

The threshold analysis from the societal perspective accounts for the time invested in the institute by the scholars as well as other CDC personnel who devote time to the institute, but whose time is not covered directly in the institute's grant. This allows for a broader interpretation of Institute costs and a more sizable estimate of the number of HIV infections that would ultimately have to be prevented for the investment in the institute to be considered cost saving. The same development, program, and care costs as used in the governmental perspective analysis were also used in this analysis. Here, the development and program costs were added together along with the total costs for scholar time, scholar travel, the CDC project officer, and other CDC personnel time and then divided by the cost of care in order to get an indication of the number of HIV infections that would ultimately

have to be prevented for the investment in the institute to be considered cost saving or cost effective from the society's perspective, as indicated in Table 4. During the 4 years of the program, 41 HIV infections would have to be averted among all Institute participants for the real dollars put into the program by the funder plus the costs associated with the investment of time to be offset by the medical costs saved.

DISCUSSION

The above numbers representing the cost savings threshold indicate the break-even point, or threshold, at which the benefits of the institute outweigh its costs. In other words, the cost savings threshold represents the lowest number of HIV infections a particular program should avert for program costs to be completely offset by the medical costs saved. Put into a national perspective, these figures indicate that the organizations of the 136 persons who have completed the institute during the years 2000–2003 need to avert 32 additional HIV infections total for the institute to be cost saving for the government (the program's funder) and 41 additional HIV infections for the institute to be cost saving to society. This represents an additional 0.24–0.30 infections averted per person who attended the institute between 2000 and 2003 because of increased capacity. Put another way, this represents less than one tenth of 1% of the 40,000 new HIV infections in the United States each year.

Although we don't know how many infections are prevented by the programs of participating CBOs, this method allows one to see if the performance standard set by the threshold analysis appears feasible or not. Because the institute targets prevention program managers located in CBOs around the nation, each with varying target populations and impact evaluation capabilities, it is impossible to link Institute-related capacity outcomes with distal disease outcomes in the communities served by the participant CBOs. However, given the small number of cases that would need to be averted nationally, over the 2000–2003 time period it is seemingly feasible that the institute can be considered cost saving to both government and society.

This feasibility is supported in the literature. A cost effectiveness evaluation of the Safer Choices program, a school-based educational program to reduce HIV, sexually transmitted diseases, and pregnancy among high school students, found that among 20 schools in two states, 0.12 HIV infections were averted (Wang et al., 2000). Similarly, another small-group cognitive-behavioral risk reduction intervention was estimated to prevent between 2.06 and 7.41 infections (Pinkerton et al., 2002). A study of eight AIDS demonstration research prevention interventions found that the interventions prevented 129 infections among 6629 participants (Pinkerton et al., 2000). Another study found that nine already existing interventions had the potential to prevent over 20,000 infections nationwide through a combination of intensive interventions in high prevalence populations and inexpensive, large-scale interventions in low-prevalence populations (Cohen, Wu, & Farley, 2005). Additional research by Pinkerton, Johnson-Masotti, Holtrae, and Farnham (2001) also found several small group and peer led interventions to be economically efficient. Taking the numbers of infections averted in small settings and extrapolating them to a national level far exceeds the cost savings threshold of the institute. In general, the most economically efficient interventions reach a large number of persons, do not have substantial costs per participant, and exist in high-prevalence areas. These are similar to the interventions planned and implemented by Institute participants in their communities. In addition, showing how these 136 HIV prevention program managers were able to impact the communities they serve is an area for future research.

Recently, it has been noted in the literature that total costs associated with HIV infection vary among demographic groups and include additional costs beyond medical costs. In

Hutchinson et al., (2006) analysis of data from the HIV/AIDS Reporting System of the CDC revealed that direct medical costs per case (in 2002 dollars) were highest for Whites (\$180,900) and lowest for Blacks (\$160,400) and demonstrated that productivity losses per case for Whites was lowest (\$661,100) and highest for Hispanics (\$838,000). Another recent study indicates a much higher lifetime cost of medical treatment for HIV; in 2004 dollars the discounted lifetime cost of HIV treatment is estimated at \$303,000 (Schackman et al., 2006). The analysis presented here utilized only an inflation-adjusted total medical cost figure (in 2003 dollars) and did not include addition costs, such as lost productivity. Analyses that use a higher cost of HIV infection will yield a lower threshold of averted HIV infections, making the benefit of these interventions to society greater. It should also be noted that cost savings is a high standard; most public health interventions are only held to a cost effectiveness standard (Holtgrave, 1998, 2007). Using cost effectiveness standards would also serve to lower the number of infections that would need to be averted.

Our calculations indicate that a national capacity-building training program for HIV prevention program managers is a cost effective approach to strengthening CBOs' abilities to provide high-quality HIV prevention programs to their communities, ultimately reducing HIV infections. The benefits of this national training program exceed its costs if only 41 or more additional HIV infections are averted by the higher quality programs participants' provided as a result of their increased capacity. Evaluation results of the institute indicate that participants have significantly increased their capacity in HIV prevention programming and strategic planning and management (Richter et al., 2007). Given that 136 HIV prevention program managers increased their capacity during the 4 years of this analysis and these program managers supervise numerous interventions reaching many members of their communities, it is feasible that at least 41 HIV infections were averted; although as discussed above, the exact number of averted HIV infections directly resulting from participating in the intervention is impossible to quantify. Continued investment in capacity is needed for organizations to sustain increases in capacity and get the most benefit from the money spent on prevention programs. Although these additional inputs may incur additional costs, they are needed to be sure an averted case of HIV stays averted. As demonstrated, even larger investments in capacity building require few cases of HIV, relative to the entire yearly HIV incidence, to be averted in order to offset the high cost of HIV treatment.

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TABLE 1**Participants' Unit Cost Per Time Investment in the Institute**

	Year 2000	Year 2001	Year 2002	Year 2003
Hourly salary including benefits (Dollars/Hour)	\$22.53	\$23.15	\$23.98	\$24.73
Time investment in the institute (Hours/Year)	310	310	310	310
Average number of Participants in the Institute	37.5	27	42	41.5
Subtotalled costs for participant time (hourly salary $\times$ time in hours $\times$ number of scholars)	\$261,889	\$193,792	\$312,267	\$318,155
Travel-Related Scholar Time				
Number of scholars traveling 12 hours/week	25.01	18.01	28.01	27.68
Number of scholars traveling 20 hours/week	12.49	8.99	13.99	13.82
Subtotalled costs for scholar time for traveling 12 hours/week (hourly salary $\times$ time in hours $\times$ number of scholars)	\$27,047	\$20,014	\$32,250	\$32,858
Subtotalled costs for scholar time for traveling 20 hours/week (hourly salary $\times$ time in hours $\times$ number of scholars)	\$22,506	\$16,654	\$26,835	\$27,341
Total costs for participants' institute time	\$1,086,103			
Total costs for travel-related scholar time	\$205,505			

TABLE 2

Other CDC Employees' Unit Cost Per Time Associated with the Institute

	Year 2000	Year 2001	Year 2002	Year 2003
Grade 11 hourly salary including benefits (dollars/hour)	\$29.66	\$30.75	\$32.17	\$33.50
Grade 12 hourly salary including benefits (dollars/hour)	\$35.55	\$36.85	\$38.56	\$40.15
Number of CDC Personnel at Grades 11 and 12	2	1	2	2
Time investment in the institute (hours/year)	421	421	421	421
Subtotaled costs for other CDC personnel time (hourly salary $\times$ hours $\times$ number of personnel)	\$27,455	\$14,229	\$29,775	\$31,010
Total costs for other CDC personnel time	\$102,470			

TABLE 3

Program Funder Perspective Threshold Analysis

Total Development Costs 1997–2003	Total Program Costs 2000–2003	Cost of Care September 2003 Dollars	Cost-saving Threshold (Number of additional HIV infections that would need to be averted)
\$522,106	\$5,163,178	\$182,055	31.23

TABLE 4

Societal Perspective Threshold Analysis

	Total Development Costs 1998-2003	Total Program Costs 2000-2003	Total Costs for Scholars' Institute Time	Total Costs for Travel-related Scholar Time	Total Costs for CDC Project Officer Time	Total Costs for Other CDC Personnel Time	Cost of Care September 2003 Dollars	Cost-saving Threshold (Number of additional HIV infections that would need to be averted)
	\$522,106	\$5,163,178	\$1,086,103	\$205,505	\$317,706	\$102,470	\$182,055	40.63