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ORIGINAL PAPER

A Cost and Cost–Threshold Analysis of Implementation of an Evidence-Based Intervention for HIV-Serodiscordant Couples

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Abstract
To address gaps in the cost literature by estimating the cost of delivering an evidence-based HIV risk reduction intervention for HIV-serodiscordant, heterosexual, African American couples (Eban II) and calculating the cost-effective thresholds at three participating sites. The cost, cost-saving, and cost-effectiveness thresholds for Eban II were calculated using standard methods. The analytic time period was from July 1 to September 31, 2014. Total costs for 3 months of program implementation were from $13,747 to $25,937, with societal costs ranging from $5632 to $17,008 and program costs ranging from $8115 to $14,122. The costs per participant were from $1621 to $2160; the cost per session (per participant) ranged from $147 to $196. Sites had achievable cost-saving thresholds, which were all less than one for the 3-month costing timeframe.

Keywords Cost–threshold analysis · HIV prevention intervention · Serodiscordant couples

Introduction

Currently, there are 1.1 million people living with HIV in the U.S., and the disease disproportionately impacts African Americans [1]. Heterosexual contact remains the primary route of transmission for African American women and the second most frequent transmission route for African American men [2]. A systematic review of couples-based HIV behavioral interventions suggests that couples-based approaches are successful at promoting safe-sex HIV prevention behaviors [3]. Eban II is an evidence-based HIV risk reduction intervention for HIV-serodiscordant, heterosexual, African American couples [4]. The intervention uses a sexual health model and features a culturally congruent curriculum. The intervention includes testing for HIV and sexually transmitted diseases (STD) and sessions that focus on topic areas such as condom use, communication, knowledge and skills acquisition for HIV prevention, problem-solving, and decision-making. The program also acknowledges racial discrimination and stigma encountered when African Americans seek health-related services, particularly if one partner is living with HIV. A cluster randomized trial of Eban found significant reductions in HIV/STD risk behavior [4].

Cost and cost-threshold analyses of HIV prevention interventions provide important information on the cost of delivering HIV programs and can help policy-makers and

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program planners to make decisions about which HIV prevention programs are affordable and might be considered cost-saving or cost-effective. There is a relative shortage of cost effectiveness studies for behavioral interventions, for interventions focused in the U.S., and for interventions that serve communities most vulnerable for HIV infection [5]. Existing economic evaluation studies suggest that behavioral programs focusing on HIV seronegative individuals are relatively less cost-effective (depending on the epidemiologic context), while behavioral interventions for people living with HIV generally are cost-effective or cost-saving [6]. The purpose of this study was to address these gaps in the cost literature by estimating the cost of delivering the Eban II program and calculating the cost-saving and cost-effective thresholds at three participating sites.

Methods

We estimated the cost, cost-saving, and cost-effectiveness thresholds for Eban II using standard methods of cost and threshold analyses, as recommended by the U.S. panel on cost-effectiveness in Health and Medicine [7], as adapted to HIV/AIDS programs [8]. We conducted the analyses from the societal perspective to account for costs to all parties, to acknowledge the value of competing uses for society's resources, and to maximize comparability with other cost-effectiveness analyses [9]. For the three Eban II sites, data were collected in categories as follows: Step 1: The time period for the analysis; Step 2: A description of the retention services delivered by the program; Step 3: Summary participant data including number of individuals served, number of participant contacts, and costs to the individual for participating in the program; and Step 4: Implementation costs including, staff (including sub-contracts), materials and other consumables. Step 3 was used to calculate the cost of the program from the societal perspective [10–12], which took into consideration the following costs to participants: transportation to and from program services, participants' time for travel and intervention services, and costs incurred by the participant for dependent care. Dependent care included costs associated with child care or elderly care. We used the state minimum wage for each location to estimate the cost of time for participants [9]. In Step 4, data were gathered for all staff and personnel involved in the program on the number of hours spent working on the program, the hourly wage, and the fringe rate. This information was then used to calculate the total staff costs. For this analysis, staff included case managers, trainers, and administrative support staff. In addition, Step 4 was used to assess the per unit and total unit cost of materials and other consumables. Materials and consumable costs included costs for travel, equipment, STD testing services, promotional materials, incentives, risk reduction supplies, office supplies, postage, printing, and rent.

The time period for the analyses was July 1, 2014 to September 31, 2014. All cost data are in 2014 dollars. Steps 1–3 were completed by agency staff using program fidelity forms which tracked the implementation of the study protocol. These records captured data on the number of participants enrolled at each location, the number of contacts per couple, and duration of each contact. Per the Eban II protocol [13], each couple had the opportunity to attend eight sessions. Costs to the participant were estimated based on interview data with program staff. Program costs for Step 4 came from accounting records. Data were then entered into standardized economic analysis spreadsheets [12]. Technical assistance was provided by faculty at Johns Hopkins Bloomberg School of Public Health (JHSPH). For quality control, spreadsheets were reviewed separately by faculty at JHSPH using a standardized form. Any questions were discussed and resolved by faculty and staff at JHSPH, University California Los Angeles (UCLA), and the Eban II sites. Finally, faculty from JHSPH and UCLA reviewed the results of the cost analysis with site-level program staff to improve the validity of findings.

The cost analysis determined the costs incurred through delivering the programs, expressed as the total cost (C) for the 3-month time period, the cost per participant served, and the cost per intervention session per participant. Given an estimate of the discounted lifetime treatment costs for HIV (T), the cost-saving threshold analysis estimated the number of transmissions that would need to be averted (A) such that the total program costs would be exceeded by the total discounted savings ($C < AT$). Based on the literature, we assumed lifetime cost of HIV treatment of $330,000 (2011 USD), and this estimate of T takes into account varying treatment costs at different stages of infection [14]. We adjusted "T" to 2014 dollars (U.S. Department of Labor's Consumer Price Index http://data.bls.gov/pdq/SurveyOutputServlet) (Price index for all urban costumers (not seasonally adjusted, U.S. city average, medical care) ($435.292/400.258 \times 330{,}000$). The value of "T" during program data collection was $358,884 USD. Program costs, C, were calculated for each site using information from Steps 3, 4, and 5 described above. Specifically, the total costs to the participant were added to the implementation costs times one plus the overhead rate (C = total participant cost + (implementation costs × (1 + overhead rate))). For each site, the number of infections that would need to be averted per year to reach the cost-saving threshold was given by the ratio C/T, or the cost of the program per year over the discounted lifetime cost for HIV care. The cost-effectiveness threshold for the number of quality adjusted life years that would have to be saved for the intervention to be considered cost effective was calculated using the formula C/$100,000

(where $100,000 is one conservative estimate of the price society is willing to pay for a quality adjusted life-year) [14, 15]. We note that Eban II could yield a benefit of quality adjusted life years by either (or both) preventing new HIV infections among HIV seronegative partners and/or improving the quality of life of partners living with HIV.

Results

Total costs for three months of program implementation were from $13,747 to $25,937, with societal costs ranging from $5632 to $17,008 and program costs ranging from $8115 to $14,122 (Table 1).

Eban II sites served from 8 to 16 individuals (4–8 couples). Couples retained at post-test completed an average of 7.3 sessions (SD = 1.97); couples retained at 3-month follow up completed an average of eight sessions. The costs per participant were from $1621 to $2160 and the cost per session (per participant) ranged from $147 to $196. The cost-saving and cost-effectiveness thresholds were well below one for the time period of the analysis. To be cost-saving, every 5 years, the programs would need to avert from one to two HIV infections (Site A, 0.8 HIV infections averted (0.04 × 4×5); Site B, 1.4 HIV infections averted (0.07 × 4×5); Site C, 1.6 HIV infections averted (0.08 × 4×5)).

Discussion

Eban II is an evidence-based HIV risk reduction intervention designed for HIV-serodiscordant African American couples. Many current HIV care and HIV prevention models focus on individual behavior and not on the behavior of the patient and their partner. This study sought to better understand the cost of implementing an intervention that serves individuals *and* their partners, in contrast to other approaches that focus on individuals regardless of their relationship status. Program costs for Eban ranged from $13,747 to $25,937 and all the programs had cost-saving thresholds of all less than one for the 3-month costing timeframe. To be cost-saving, every 5 years, the programs would need to avert from one to two HIV infections.

This analysis is subject to limitations. First, the sites self-reported the costs associated with program delivery based on program records, interviews with program staff, and accounting records. Second, the study did not take into consideration other benefits to the study participants such as quality-adjusted life-year saved through receipt of comprehensive HIV medical services or the prevention of HIV infection. Finally, the data to estimate the number of HIV transmissions that were averted by the program were not available so we were only able to estimate their costs and the corresponding cost-effectiveness and cost-saving thresholds. Furthermore, the thresholds reported in this manuscript are dependent on the effect size of the intervention and the sustainability of the intervention effects beyond the 3 month intervention period.

Many HIV prevention interventions are heavily influenced by a medical model of delivery rather than a sexual health model. The sexual health model focuses on the dynamics of two individuals in a sexual relationship and recognizes the importance of having the burdens related to heath care distributed equally among both partners [4]. Eban II reduces risks and provides information about lowering the level of risk by interacting with both partners at the same time. As a result, the communication burden is shifted from the female partner to both partners.

The value of offering interventions that acknowledge the interconnectedness of relationships and family within the context of HIV prevention remains important within African American culture and is often overlooked. The number of people living with HIV is increasing due to life-saving medications. As funding remains stable or decreases, program

Table 1 Cost analysis of Eban II—quarterly costs

	Site A	Site B	Site C
Total program costs (societal costs + program costs)	$13,747	$21,602	$25,937
Societal costs	$5632	$7480	$17,008
Program costs	$8115	$14,122	$8929
Number of participants served	8	10	16
Cost per participant	$1718	$2160	$1621
Cost per participant per session	$156	$196	$147
Cost-saving threshold[a]	0.04 HIV infections averted	0.07 HIV infections averted	0.08 HIV infections averted
Cost-effective threshold[b]	0.14 QALYs saved	0.22 QALYs saved	0.26 QALYs saved

[a]Total program costs from the societal perspective/$358,884

[b]Total program costs from the societal perspective/$100,000

planners and policy-makers face difficult decisions about resource allocation. This study aids program planners to better understand how to budget for serodiscordant couples-based HIV behavioral prevention interventions. These findings offer additional evidence of the cost of addressing the HIV testing and treatment needs of couples, who may also be concurrently receiving pre-exposure prophylaxis (PrEP) or post-exposure prophylaxis (PEP).

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