Costs of HIV Prevention Among Out-of-Treatment Drug-Using Women: Results of a Randomized Controlled Trial

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SYNOPSIS

Objectives. We developed a micro-costing methodology to estimate the real resource costs consumed by delivery of the National Institute on Drug Abuse (NIDA) Cooperative Agreement Standard Intervention (SI) for human immunodeficiency virus (HIV) prevention, plus two enhanced modules, in a three-arm randomized controlled trial (RCT) among drug-using women. To our knowledge, this is the first micro-costing study of the SI and enhanced modules and the first of its kind targeting drug-using women.

Methods. We conducted a micro-costing study alongside a three-arm RCT to estimate costs of (*1*) the modified NIDA SI; (*2*) the SI and a well woman exam (SI+WWE); and (*3*) the SI, WWE, and four educational sessions (SI+WWE+4ES) to prevent HIV and sexually transmitted diseases in at-risk, drug-using women in St. Louis, Missouri.

Results. The cost of the SI that all 501 participants received was approximately $227 per person. The additional costs for the WWE and 4ES were approximately $145 and $942 per person, respectively. Total program costs for the SI (n=501) were $113,869; additional costs for the SI+WWE (n=342) were $49,403 and for the SI+WWE+4ES (n=170) were $160,189. The main cost component for the SI (64% of total costs) was testing costs, whereas building and facilities costs were the main cost component for the SI+WWE+4ES (75% of total costs).

Conclusions. This study provides accurate estimates of the real costs for standard and enhanced HIV interventions for policy makers seeking to implement targeted HIV-prevention programs with scarce resources.

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Human immunodeficiency virus (HIV) and acquired immunodeficiency syndrome (AIDS) impose a significant health and economic burden to society, yet HIV-prevention programs, which avert hundreds of thousands of HIV infections and save money, are significantly underfunded in the United States[1] and abroad. In many settings, both national and global, resources to combat HIV and AIDS are severely constrained, further bolstering the need for economic analyses to identify the most efficient use of resources. Accurate estimates of the costs of HIV prevention are critical both to place a precise value on such programs as well as to inform efforts to scale up financing to more closely meet public health needs. Cost analyses may also serve an important role in strengthening the political will for greater programmatic investment.

Economic theory offers the theoretical foundation for valuing costs in assessing medical and public health interventions. In a perfectly free market economy, for example, without market failures or distortions, the price of resources can be used as real resource costs—the opportunity costs—of a given intervention or program. Medical and public health programs, however, rarely operate under ideal market conditions; therefore, prices cannot always be used to value resources, and costs must be empirically estimated. While there are two general approaches, micro-costing and gross-costing, for estimating costs that are theoretically grounded in economic principles, micro-costing is preferred for cost estimation for programs in public health and medicine. The Panel on Cost-Effectiveness in Health and Medicine (a nonfederal panel of experts on cost-effectiveness analysis that was convened by the U.S. Public Health Service in 1993) has endorsed this approach.[2] Micro-costing, which allows for the separation of different activities and cost categories, gathers detailed information, directly enumerating and valuing specific resources used in an intervention. Micro-costing measures exact amounts of resources to provide an accurate cost estimate; however, it is labor and resource intensive and, therefore, has had limited use. Although cost studies in HIV prevention exist,[3–5] to our knowledge, micro-costing studies of HIV-prevention programs are inadequate,[6,7] if not entirely absent. This article presents the first full micro-costing study of HIV prevention among drug-using women. It also aims to address gaps in research by offering a standardized and uniform methodology of cost estimation.

We developed a systematic methodology for measuring costs grounded in the theory and process of identifying, estimating, and valuing resource costs, and conducted a micro-costing study alongside a randomized controlled trial (RCT). We estimated and compared the costs of each of the three RCT arms of this study, which we called Women Teaching Women (WTW): (*1*) a modified National Institute on Drug Abuse (NIDA) Cooperative Agreement Standard Intervention (SI); (*2*) the SI and a field-based well woman exam (SI+WWE); and (*3*) the SI, WWE, and four educational sessions (SI+WWE+4ES) among female out-of-treatment crack-cocaine users and injecting drug users in St. Louis, Missouri. The specific aim of the WTW study was to reduce substance use and high-risk sexual behaviors among drug-using women through a holistic, peer-delivered intervention.[8] We estimated total, variable, and fixed costs for the SI and additional costs for the two enhanced interventions (WWE and 4ES). We then compared the breakdown of cost categories across these intervention components. We estimated costs from both the service-provider and societal perspectives. We concluded with a sensitivity analysis of the robustness of these estimates to changes in key cost components.

METHODS

Recruitment, design, and sample of the RCT

Community health outreach workers recruited study participants from targeted recruitment zones, employing street-outreach recruitment methods based on prior work.[9] Recruitment and study activities were housed in two sites shared by our project and the St. Louis City Health Department. Centers were located in areas with high rates of drug abuse, crime, and prostitution to enhance screening of potential respondents. Eligibility criteria included: (*1*) being aged 18 years or older; (*2*) reporting sexual activity in the prior four months; (*3*) using cocaine, heroin, amphetamines, or other injection drugs; and (*4*) residing in the St. Louis metropolitan area during the study period (2000–2006).

After obtaining the participant's informed consent, the study interviewer collected urine for drug testing and conducted baseline interviews, which consisted of two sessions. Respondents were remunerated $10 for each of the two baseline interviews (additional remuneration was provided for completion of four- and 12-month follow-up interviews, all of which were considered research costs, as individuals were not remunerated for time spent receiving the intervention conditions). All study participants (n=501) received the SI. They were then randomized to one of three intervention conditions: SI alone (NIDA standard pre- and posttest counseling); SI+WWE; or SI+WWE+4ES. Analysis was based on intention to treat.

Intervention conditions

NIDA SI. Following the first baseline interview, each participant met for approximately 20 minutes with a peer facilitator for HIV pretest counseling, which included collection of blood and administration of the NIDA SI.[10] Two weeks later, a second baseline interview was conducted; participants then met with the peer facilitator to receive HIV posttest counseling, which included receiving test results.

HIV and sexually transmitted disease (STD) testing. Blood collected during the first interview was tested for HIV, hepatitis C (HCV), and syphilis. For HIV, the enzyme-linked immunosorbent assay (ELISA) procedure was used to test serum for HIV 1-2 antibodies; positive ELISA samples underwent confirmatory testing with the Western Blot test.

SI+WWE. Participants randomized to the SI+WWE met with a nurse practitioner (NP) at one of two designated satellite sites. At that time, they were given the choice of either having the WWE immediately following randomization or scheduling an appointment within seven days. The WWE included a breast examination and routine pelvic examination with cervical cytological testing (Pap smear), the results of which could be obtained by phone within 10 days (a follow-up visit was not required). The NP also obtained a short medical history.

SI+WWE+4ES. Women randomly assigned to 4ES, in addition to SI and WWE, had the opportunity to attend four educational sessions. A peer facilitator delivered the educational sessions, which (*1*) were based on the Health Belief Model; (*2*) were focused on increasing knowledge about how to reduce unhealthy behaviors; (*3*) employed a holistic approach focused on health and nutrition, stress and coping, substance abuse, and HIV/AIDS; and (*4*) were interactive and framed by a computer presentation. Meals were provided for participants as well as transportation and babysitting, if needed.

Micro-costing methodology

We developed a methodology of cost estimation employing standard techniques for conducting micro-cost analyses by identifying, measuring, and valuing resources used. While the Panel on Cost-Effectiveness in Health and Medicine has described and endorsed micro-costing,[2] the Panel has provided little guidance on how to implement a micro-costing study in general and no guidance or procedures on how to do so in specific studies. We conducted our analyses from both the provider and societal perspective.[11] Primary data were then collected on the exact number and type of resources consumed.[2,12,13] After measuring resource utilization, we multiplied the quantity of each type of resource consumed by unit costs (the value of those resources) to obtain total component-specific costs and overall costs for SI, WWE, and 4ES. We then divided total and component-specific costs by the number of clients served to determine costs per client.[2] Only costs related to implementation of the intervention were included; study recruitment, development of the survey instrument, and other activities associated with research objectives were excluded. Costs collected were those necessary for reproducing the intervention in a nonresearch setting. The main cost categories included variable costs (materials, tests, incentives, and personnel costs); fixed costs (building and facilities, utilities, transportation, and equipment costs); and societal costs (participants' time).

Variable costs. As shown in Table 1, variable costs—costs that vary with the number of clients served—comprised two broad categories: (*1*) material and testing costs, and (*2*) personnel costs. For material and testing costs, subcategories included condoms, speculums, gloves, lubricant, exam supplies, testing costs, miscellaneous supplies, cleaning supplies, office supplies, incentives and food; these items were obtained from purchase orders. For personnel costs, time spent and wages for peer facilitators, raters, NPs, health professionals, and childcare providers were included. Time spent and personnel employed in research were excluded.

Fixed costs. As shown in Table 2, fixed costs—costs that do not necessarily increase with the number of clients served—comprised three broad categories: (*1*) building and facilities, (*2*) transportation, and (*3*) equipment. Building and facilities costs included rental building space and utilities, and were obtained from rental, utility, and insurance billing information. Space utilized for interventions was assessed based on the proportion of time and overall square footage used. Transport costs included travel costs for clients (including mileage to and from intervention site), provided on an as-needed basis. They were also obtained from travel records and mileage claims. Equipment costs comprised equipment for the WWE and included exam chair, table, stool, microscope, lamp, small refrigerator, and small cooler; costs were obtained from purchase orders.

Societal costs. To estimate the opportunity costs of participants' time, we included session time and travel time. Session time for participants was the same as the personnel time obtained from study records. Transport time was estimated to be 15 minutes per trip per person and was cumulated over the number of sessions

Table 1. Variable costs incurred (service-provider perspective), Women Teaching Women Study

					SI (n=501)		*WWE[b] (n=342)*		*4ES[b] (n=170)*	
Description of items	*Group[a]*	*Cost/unit*	*Total units*	*Total costs*	*No. of units*	*Total costs*	*No. of units*	*Total costs*	*No. of units*	*Total costs*
Materials and testing costs										
Condoms[c]										
Male condoms	A	$80.25/1,000	5,000	$401.25	5,000	$401.25				
Female condoms	A	$1,000.00/1,000	1,000	$1,000.00	1,000	$1,000.00				
Demonstrator condoms	A	$80.25/1,000	500	$40.13	500	$40.13				
Speculums										
Speculums for WWE	B	$23.00/25	342	$314.64			342	$314.64		
Gloves[c]										
Latex gloves	A, B	$4.59/100	2,350	$107.87	2,000	$91.80	350	$16.07		
Nitrile gloves	A, B	$9.71/100	350	$33.99	300	$29.13	50	$4.86		
Lubricant										
Protection lubricant	A	$165.00/1,000	1,000	$165.00	1,000	$165.00				
Exam supplies										
23-gauge butterfly needles	A	$35.50/50	25	$17.75	25	$17.75				
Alcohol preps[c]	A	$1.28/200	826	$5.29	826	$5.29				
Ammonia inhalants	A	$18.29/100	50	$9.15	50	$9.15				
Bandages	A	$1.97/100	550	$10.84	550	$10.84				
Gauze pads[c]	A	$2.01/100	413	$8.30	413	$8.30				
IV Vacutainer® set[c]	A	$37.23/50	59	$43.93	59	$43.93				
Penis model	A	$12.00/model	3	$36.00	3	$36.00				
10% KOH solution	B	$12.00/bottle	2	$24.00			2	$24.00		
9% NaCl solution	B	$3.50/bottle	2	$7.00			2	$7.00		
Bottle and dropper set	B	$161.71/144	144	$161.71			144	$161.71		
Disposable exam sheets	B	$19.00/100	342	$64.98			342	$64.98		
Disposable pipettes	B	$128.17/case	1	$128.17			1	$128.17		
Exam capes	B	$12.68/50	350	$88.76			350	$88.76		
Exam table paper	B	$3.00/roll	6	$18.00			6	$18.00		
Lens paper	B	$7.55/12 books	12	$7.55			12	$7.55		
Pap-smearing fixative	B	$13.00/12	24	$26.00			24	$26.00		
Safetex™ cytology fixative	B	$25.60/12	12	$25.60			12	$25.60		
Test-tube holding tray	B	$30.55/tray	1	$30.55			1	$30.55		
Testing costs										
HIV-negative	A	$139/test	501	$69,639.00	501	$69,639.00				
HIV-Western blot	A	$206/test	13	$2,678.00	13	$2,678.00				
Pap smear test kit	B	$62/kit + test	342	$21,204.00			342	$21,204.00		

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Table 1 (continued). Variable costs incurred (service-provider perspective), Women Teaching Women Study

					SI (n=*501*)		*WWE*[b] (n=*342*)		*4ES*[b] (n=*170*)	
Description of items	*Group*[a]	*Cost/unit*	*Total units*	*Total costs*	*No. of units*	*Total costs*	*No. of units*	*Total costs*	*No. of units*	*Total costs*
Miscellaneous/cleaning supplies										
Air freshener	A, B, C	$3.21/each	4	$12.84	2	$6.42	1	$3.21	1	$3.21
Bleach	A, B, C	$1.84/bottle	3	$5.52	1	$1.84	1	$1.84	1	$1.84
Empty spray bottles	A, B, C	$6.79/3 bottles	3	$6.79	1	$2.26	1	$2.26	1	$2.26
Paper towels	A, B, C	$18.60/12 rolls	12	$18.60	6	$9.30	4	$6.20	2	$3.10
Soap	A, B, C	$4.09/bottle	4	$16.36	2	$8.18	1	$4.09	1	$4.09
Tissues	C	$1.89/box	9	$17.01					9	$17.01
Disolv® germicidal cleaner	B	$13.25/12 cans	12	$13.25			12	$13.25		
Sanitary pads	B	$3.24/48 pads	48	$3.24			48	$3.24		
Sterile cotton tips	B	$1.88/500	500	$1.88			500	$1.88		
Tampons	B	$3.88/40	40	$3.88			40	$3.88		
Office supplies										
Felt-tipped markers	A, B, C	$5.99/8	16	$11.98	8	$5.99	5	$3.74	3	$2.25
Folders	A, B, C	$1.09/folder	12	$13.08	6	$6.54	4	$4.36	2	$2.18
Lightbulbs	A, B, C	$13.63/24	24	$13.63	12	$6.82	8	$4.54	4	$2.27
Pens	A, B, C	$5.99/50	50	$5.99	25	$2.99	17	$2.04	8	$0.96
Cassette tapes	C	$100.00/pack	1	$100.00					1	$100.00
Paper	A, C	$11.62/ream	9	$104.58	7	$81.34			2	$23.24
Pencils	A, C	$1.20/12 pencils	24	$2.40	18	$1.80			6	$0.60
Tape	A, C	$21.22/6 rolls	6	$21.22	4	$14.15			2	$7.07
Binders	C	$1.09/each	4	$4.36					4	$4.36
Dry-erase markers	C	$4.29/4 markers	4	$4.29					4	$4.29
Easel cling-pad	C	$16.12/pad	1	$16.12					1	$16.12
Plastic cups, plates, utensils	C			$14.07						$14.07
Incentives										
Monetary remuneration	A, B, C	$20.00/person	501	$10,020.00	159	$3,180.00	172	$3,440.00	170	$3,400.00
Certificates	C	$3.49/25	170	$23.73					170	$23.73
Frames	C	$2.00/frame	170	$340.00					170	$340.00
Ivory embossed cards	C	$18.78/100	200	$37.56					200	$37.56
Votives	C	$42.50/170	170	$42.50					170	$42.50
Food[c]										
Respondent meals	C			$1,961.02						$1,961.02
Subtotal (materials and testing costs)						$77,503.20		$25,616.42		$6,013.73

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Table 1 (continued). Variable costs incurred (service-provider perspective), Women Teaching Women Study

					SI (n=501)		*WWE[b] (n=342)*		*4ES[b] (n=170)*	
Description of items	*Group[a]*	*Cost/unit*	*Total units*	*Total costs*	*No. of units*	*Total costs*	*No. of units*	*Total costs*	*No. of units*	*Total costs*
Personnel costs										
Standard Intervention										
Peer facilitator										
SI I: 30 min/person; 501 people[d]	A	$15/hour	250.50	$3,757.50	250.50	$3,757.50				
SI I lab delivery: 15 min each, 400 trips	A	$15/hour	100	$1,500.00	100	$1,500.00				
SI II: 30 min/person; 501 people[d]	A	$15/hour	250.50	$3,757.50	250.50	$3,757.50				
Rater										
Reminder calls: 10 min/person; 501 people	C	$15/hour	83.50	$1,252.50					83.50	$1,252.50
Well woman exam										
Nurse practitioner										
WWE: 30 min/person, 342 people[e]	B	$25/hour	171	$4,275.00			171	$4,275.00		
4 educational sessions										
Peer facilitator										
Educational sessions: 2 hours 10 min each, 213 sessions	C	$15/hour	461.50	$6,922.50					461.50	$6,922.50
Health professional										
Educational sessions: 2 hours each, 213 sessions	C	$25/hour	426	$10,650.00					426	$10,650.00
Childcare provider										
Educational sessions: 2 hours each, 213 sessions	C	$10/hour	426	$4,260.00					426	$4,260.00
Subtotal (personnel costs)						$9,015.00		$4,275.00		$23,085.00
Total variable costs						$86,518.20		$29,891.42		$29,098.73
Variable costs per participant						$172.69		$87.40		$171.17

NOTE: Allocation of costs to intervention arms are population weighted in some cases.

[a]A = SI; B = WWE; C = 4ES

[b]Incremental costs

[c]The costs of these items used for this study were divided by 60%, as the items were shared with another National Institutes of Health study.

[d]30 min/person = 20 min SI and 10 min cleanup/transition/paperwork.

[e]30 min/person = 20 min WWE and 10 min cleanup/transition/paperwork.

SI = National Institute on Drug Abuse Standard Intervention for HIV prevention

WWE = well woman exam

4ES = four educational sessions

IV = intravenous

KOH = potassium hydroxide

NaCl = sodium chloride

HIV = human immunodeficiency virus

min = minutes

Table 2. Fixed costs incurred (service-provider perspective), Women Teaching Women Study

Description of items	*Group*[a]	*Cost per unit*	*Total units*	*Total costs*	*SI (n=501)*	*WWE*[b] *(n=342)*	*4ES*[b] *(n=170)*
Building and facilities costs							
Rental building space							
HS North location (excluding utilities)[c]	A, B, C	$1,900.00/month	34 months	$38,760.00	$19,169.56	$13,085.80	$6,504.64
Suite 4 KH location (including utilities)[d]	C	$6,620.00/month	34 months	$112,540.00			$112,540.00
Subtotal					$19,169.56	$13,085.80	$119,044.64
Utilities (HS North location)[c]							
Phone service	A, B, C	$157.00/month	34 months	$3,202.80	$1,584.01	$1,081.30	$537.49
Gas	A, B, C	$166.00/month	34 months	$3,386.40	$1,674.81	$1,143.29	$568.30
Water service	A, B, C		34 months	$335.81	$166.08	$113.37	$56.35
Electricity	A, B, C	$73.75/month	34 months	$1,504.47	$744.07	$507.93	$252.48
Janitorial/cleaning service	A, B, C	$83.47/month	34 months	$1,702.84	$842.17	$574.90	$285.77
Security system	A, B, C		34 months	$324.00	$160.24	$109.39	$54.37
Subtotal					$5,171.38	$3,530.18	$1,754.76
Transport costs							
Client transportation[e]							
Van rental and gas[f]	C		16 days	$988.90			$988.90
Cab fares	C			$498.15			$498.15
Transporting participants by car	C		3,080 miles	$924.00			$924.00
Subtotal					$0.00	$0.00	$2,411.05
Equipment							
Exam chair/table/stool	B		1	$1,200.00		$1,200.00	
Microscope	B		1	$250.00		$250.00	
Lamp	B		1	$75.00		$75.00	
Small refrigerator	B		1	$40.00		$40.00	
Small cooler	B		1	$10.00		$10.00	
Subtotal					$0.00	$1,575.00	$0.00
Total fixed costs					$24,340.94	$18,190.98	$123,210.45
Fixed costs per participant					$48.59	$53.19	$724.77

NOTE: Allocation of costs to intervention arms are population weighted in some cases.

[a]A = SI; B = WWE; C = 4ES

[b]Incremental costs

[c]Utilities and rental costs for the HS North location @ $12 per square foot used for this study have been multiplied by 60%, because the total costs of using the facility were shared with another study and include a time period of 34 months.

[d]This study used the Kings Highway (KH) suite (331 square feet @ $20/square foot) 2.5 days per week. The building and facilities costs of this location have been divided by half to get the total cost for this study ($112,540.00).

[e]Transportation for clients was provided on an as-needed basis. Some transportation costs incurred directly by participants were not included. Client transport costs were obtained from aggregate of receipts and purchase orders by year (different from fiscal year). These costs have also been multiplied by 60%, because transportation was shared with another study.

[f]Daily costs may include additional fees, and total van rental costs included gas as well as daily rental.

SI = National Institute on Drug Abuse Standard Intervention for HIV prevention

WWE = well woman exam

4ES = four educational sessions

attended. In general, the best approximation of the opportunity cost of time for drug-abusing women is to base the wage rate on women with the same employment record and educational status in the labor force.[2] The participants' time was valued at the minimum wage rate of $5.15 for Missouri as obtained from the National Bureau of Labor Statistics at the time of the study.[14] While participants' time costs have frequently been omitted from previous studies, time, like any other resource, is in limited supply, and its consumption should be reflected in cost analyses.[15,16]

Research costs. Research costs—which included the costs of follow-up HIV, HCV, and syphilis tests; participant costs for completing the interviews; and booster sessions to evaluate the effectiveness of the SI, WWE, and 4ES—were not reported as intervention costs.[2] However, for reference purposes, costs of HIV and STD follow-up tests were $704 per person ($352,704 in total for 501 participants) and personnel costs for follow-up sessions were $5,168, assuming an hourly wage of $15.

Sensitivity analyses

Sensitivity analyses were conducted to analyze the variation in total costs according to uncertainties in key cost categories, such as percent participation, building and facilities, and testing.

Future cost savings

Future cost savings associated with preventing HIV and AIDS cannot be micro-costed in the context of a clinical trial with a four- or 12-month follow-up time horizon. Rather, these estimates are either gross-costed, from hospital and medical records, or are derived from the literature. Standard estimates of the value of preventing an HIV transmission, using the net present value of lifetime treatment costs for HIV, adjusted to June 2003 U.S. dollars using the medical care component of the consumer price index, are roughly $200,655 if HIV is prevented completely[1,17,18] and $19,566[19] per year in the case of a delay in the onset of HIV. A 2006 study, however, projected the lifetime costs of medical care for HIV-infected adults employing current antiretroviral therapy (ART) standards and found the discounted lifetime costs to be $385,200.[20] This suggests that effective ART regimens have further increased both the survival prospects and lifetime costs of HIV-related medical care in the U.S. In either case, the potential cost savings from averting HIV infections are high and increasing.

RESULTS

Variable costs

As shown in Table 1, in comparing the two major variable cost categories (materials and testing, and personnel), materials and testing comprised the majority of variable costs for the SI (totaling $77,503) and WWE (totaling $25,616), whereas personnel comprised the majority of variable costs for the 4ES ($23,085). Indeed materials and testing costs for both SI and WWE were eight and six times the costs for personnel, respectively, whereas personnel costs for 4ES were nearly four times the costs for material and testing. The 4ES were considerably more labor intensive as compared with the SI and WWE. While one would expect the total variable costs for SI to be significantly more than for WWE and 4ES due to the greater number of clients served, the per-person variable costs amounted to $173. The addition of the 4ES nearly doubled the per-person variable costs, with an average per-person variable cost of $171, whereas the additional cost for the WWE, above and beyond the SI, was $87. Consistent with other studies,[21] the variable cost per client for the SI was driven significantly by testing costs.

Fixed costs

Table 2 presents results of the fixed costs analysis. Total fixed costs were significantly higher for the 4ES (totaling $123,211) compared with both the SI (totaling $24,341) and WWE (totaling $18,191) by roughly a five- and nearly seven-fold difference, respectively. The significantly higher building and facilities costs for the 4ES as compared with both SI and WWE resulted from the need to hold the 4ES in a separate building for blinding purposes, although the rent was significantly higher in this context. Transport and equipment costs were fairly modest within this scope, but it is worth noting the necessary investment in equipment costs (e.g., exam chair, table, stool, microscope, lamp, refrigerator, and cooler) to conduct the WWE (totaling $1,575). As a result, the total fixed costs per person were considerably higher for 4ES, totaling $49 (SI), $53 (WWE), and $725 (4ES).

Societal costs

Societal costs comprised participants' time in sessions and in travel. As shown in Table 3, participants' additional time spent in 4ES (total $7,004) was considerably greater than that spent in SI ($1,720) or WWE ($881). This difference was driven more by the number of sessions than any other parameter, especially as fewer individuals participated in the 4ES as compared with the SI or WWE. The total travel time costs were greater

for the SI ($1,290) as compared with WWE ($440) and 4ES ($876). This would be expected, however, given the fewer number of individuals in the 4ES and WWE compared with the SI. In total, societal costs per person were greater for 4ES ($46) as compared with WWE ($4) and SI ($6) by a factor of 11 and seven times, respectively, although social costs were a relatively small part of the total cost equation.

Total program costs and costs per person

Table 4 incorporates all three types of costs—variable, fixed, and societal. The total costs of the SI, WWE, and 4ES were $113,869; $49,403; and $160,189, respectively. This translates to a cost per person of $227, $145, and $942, respectively. The difference in the number of people in each highlights the significant difference in costs—a greater than fourfold difference in additional costs for 4ES above and beyond the SI. The costs per person are important for comparisons in this analysis due to the fact that while all 501 trial participants received SI, 342 received the additional WWE, and 170 received SI, WWE, and 4ES.

Cost breakdown

Micro-costing this study enabled us to estimate detailed breakdowns of costs by cost category (Figure). As the Figure demonstrates, the main cost components of the SI were testing (64%) and building and facilities

Table 3. Societal costs incurred, Women Teaching Women Study

							SI (n=501)		*WWE (n=342)*		*4ES (n=170)*	
Description of items	*Group*[a]	*Time spent per activity*	*No. of people*	*Total units in hours*	*Cost per unit*[b]	*Total costs*	*No. of units*	*Total costs*	*No. of units*	*Total costs*	*No. of units*	*Total costs*
Participant's time												
Session time												
Standard Intervention												
SI I	A	20 min	501	167.00	$5.15	$860.05	167.00	$860.05				
SI II	A	20 min	501	167.00	$5.15	$860.05	167.00	$860.05				
Well Woman Exam												
WWE	B	30 min	342	171.00	$5.15	$880.65			171.00	$880.65		
Educational Sessions												
4ES	C	2 hours, 4 sessions	170	1,360.00	$5.15	$7,004.00					1,360.00	$7,004.00
Subtotal								$1,720.10		$880.65		$7,004.00
Travel time												
Standard Intervention	A	15 min/ session, 2 sessions	501	250.50	$5.15	$1,290.08	250.50	$1,290.08				
Well Woman Exam	B	15 min roundtrip/ session	342	85.50	$5.15	$440.33			85.50	$440.33		
Educational Sessions	C	15 min/ session, 4 sessions	170	170.00	$5.15	$875.50					170.00	$875.50
Subtotal								$1,290.08		$440.33		$875.50
Total societal costs								$3,010.18		$1,320.98		$7,879.50
Societal cost per participant								$6.01		$3.86		$46.35

NOTE: Total costs = number of people × time spent per session × number of sessions × wage

[a]A = SI; B = WWE; C = 4ES

[b]Cost per unit is the minimum wage for Missouri from the U.S. Bureau of Labor Statistics, August 2005.

SI = National Institute on Drug Abuse Standard Intervention for HIV prevention

WWE = well woman exam

4ES = four educational sessions

min = minutes

Table 4. Total costs incurred, Women Teaching Women Study

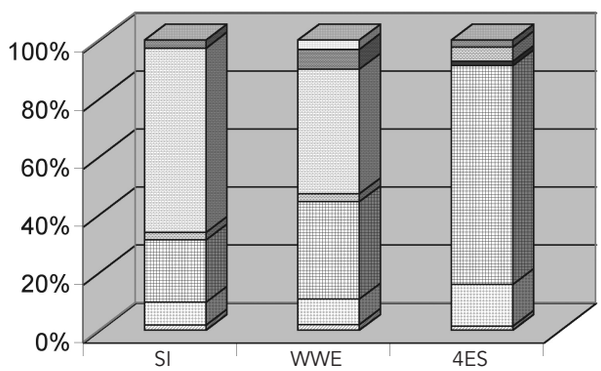
Description of items	*SI (n=501) Total costs*	*WWE (n=342) Total costs*	*4ES (n=170) Total costs*
Total variable costs	$86,518.20	$29,891.42	$29,098.73
Variable cost per client	$172.69	$87.40	$171.17
Total fixed costs	$24,340.94	$18,190.98	$123,210.45
Fixed cost per client	$48.59	$53.19	$724.77
Total societal costs	$3,010.18	$1,320.98	$7,879.50
Societal cost per client	$6.01	$3.86	$46.35
Total cost	$113,869.32	$49,403.38	$160,188.68
Total cost per client	$227.28	$144.45	$942.30

SI = National Institute on Drug Abuse Standard Intervention for HIV prevention

WWE = well woman exam

4ES = four educational sessions

Figure. Cost breakdown of SI, WWE, and 4ES by cost category, Women Teaching Women Study



	SI	WWE	4ES
Equipment	0.0%	3.2%	0.0%
Incentives	2.8%	6.9%	2.4%
Testing	63.5%	42.9%	0.0%
Societal costs	2.6%	2.7%	4.9%
Transportation	0.0%	0.0%	1.5%
Buildings and facilities[a]	21.4%	33.6%	75.4%
Personnel	7.9%	8.7%	14.4%
Materials	1.8%	2.0%	1.4%

[a]Includes utilities

SI = National Institute on Drug Abuse Standard Intervention for HIV prevention

WWE = well woman exam

4ES = four educational sessions

(21%), followed by personnel (8%). This pattern of cost distribution was similar for WWE, where testing comprised 43%, building and facilities 34%, and personnel 9%, although the magnitude of the difference between testing and building and facilities was much smaller for WWE as compared with SI. For the 4ES, the main cost component was building and facilities (75%) by a large margin, with personnel (14%) a significantly lower secondary cost category.

Sensitivity analyses

We conducted sensitivity analyses to examine the variation in our total cost estimates as a result of variation in key parameters. We were most interested in examining the effects of uncertainties in key cost categories: the testing costs for SI, and the building and facilities costs for 4ES. As shown in Table 5, for SI, we varied the testing costs to a 25% decrease in HIV testing and to the substitution of a rapid HIV test for the enzyme immunoassay (EIA) test. For both variations, the total costs per client were reduced, most significantly for the substitution of the rapid HIV tests. For SI, if rapid HIV tests were used, there could be significant cost savings (a difference in costs of roughly $129 as rapid tests cost as little as $10), assuming three test series of simple rapid test kits[22] repeated in duplicate, with similar specificity and sensitivity as that of the EIA. Even though SI was required for the study, for hypothetical purposes, we also varied the participation rate in SI from 100% to 80% and calculated the total costs per participant on that basis. As one might expect, variation in this parameter increased the total cost per client, although not by a large amount (about $8 per person). For 4ES, reducing the building and facilities costs by 25% reduced the total cost per person by roughly the same proportion; reducing that cost by 50% similarly reduced the total cost per person by

Table 5. Sensitivity analysis, Women Teaching Women Study

Intervention arm	*Uncertainties examined*	*Total cost per client*
Standard Intervention	Base case (with fixed costs)	$227
	25% decrease with cost of enzyme immunoassay test	$193
	Rapid tests used instead of enzyme immunoassay test	$98
	Participation at 80% of current level	$235
Four educational sessions	Base case (with fixed costs)	$942
	25% decrease in building rental/utilities	$777
	50% decrease in building rental/utilities	$549
	If each session has three people	$1,233
	If each session has five people	$759

the same proportion. Finally, decreasing the number of people in each session from an average of four to three (a 25% decrease) increased the total cost per person by about 25%. Similarly, increasing the average number of people in each session from four to five (25% increase) decreased the total cost per person by a slightly lower proportion (20%).

DISCUSSION

The number of new annual HIV infections in the U.S. has dropped significantly from 160,000 in the mid-1980s to 40,000 in the 1990s. Despite this drop, however, the number of new annual HIV infections has remained steady at 40,000 for the past several years. While there are numerous explanations for this inactivity, two of the most cited include an estimated $300 million annual shortfall in HIV-prevention spending and underutilization of preventative programs nationwide.[23] Members of racial/ethnic and gender groups are disproportionately impacted and at risk as a result of these policy decisions. This study's aim was to measure and report the costs of a gender-specific, peer-delivered HIV-prevention intervention for drug-using women and to provide accurate cost estimates for targeted program planning for HIV prevention. We found the total cost per participant of the NIDA SI for HIV prevention ($227) and additional costs for an enhanced WWE module ($145) to be relatively modest. Enhancing the SI further by adding the 4ES cost less than an additional $1,000 per person. Together the costs of the SI and enhanced interventions compared favorably to economic evaluations of other HIV-prevention and treatment programs.[19,24]

In our study, we developed a micro-costing methodology to provide accurate estimates of resource utilization and costs. The method offered here systematically applies the micro-costing framework recommended by the Panel on Cost-Effectiveness in Health and Medicine in 1996,[25] but extends it through operationalizing costing techniques, in this case for a standardized and enhanced HIV-prevention program alongside a field-based RCT. This methodology can be used, with modifications, to estimate the costs of similar behavioral interventions, especially those that rely heavily on different and varied cost components and cost categories. Studies of the cost of enhanced HIV prevention have not employed this methodology.[7]

Micro-costing has several strengths: its systematic nature, standardization across cost components, reliability and validity resulting from cost collection alongside actual program delivery, and ability to account for the most significant inputs. Two limitations of this methodology, however, include the method's reliance on self-observation by providers and study personnel, which may be prone to error, and the significant burden of detailed cost collection placed on the research team and intervention personnel. Good record keeping, such as that employed in this study, will make the task of estimating costs easier.

CONCLUSIONS

The detailed cost information that our micro-costing method collected is essential for understanding the levels and types of resources necessary for effective implementation of targeted HIV-prevention programs. As an input to cost-effectiveness and cost-benefit analyses, micro-costing enables benefits to be weighed accurately against costs to facilitate rational allocation decisions. Moreover, such cost analyses can serve an important role in generating the political will to scale up HIV prevention in efforts to stem the AIDS epidemic both nationally and worldwide.[26]

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