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A cost analysis of an internet based medication adherence intervention for people living with HIV

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Abstract

The purpose of the study was to document development costs and estimate implementation costs of an internet based medication adherence intervention for people living with HIV in the US. Participants (n=61) were enrolled in the 8 week study in 2011 and entered the intervention website remotely in the setting of their choice. Development costs were obtained from a feasibility and acceptability study of an internet based medication adherence intervention. Implementation costs were estimated based on an 8 week trial period during the feasibility and acceptability study. Results indicated that although developing an internet based medication adherence intervention is expensive, the monthly cost of implementing and delivering the intervention is low. If the efficacy of similar interventions can be established, these results suggest the internet could be an effective method for delivering medication adherence interventions to persons residing in areas with limited access to in-person adherence services.

The introduction and widespread dissemination of combination antiretroviral therapy has dramatically changed the disease trajectory and life expectancy of people living with HIV (PLWH).¹ Consistent adherence to antiretroviral medications can be difficult for patients to achieve, but non-adherence can have major costs to patients and healthcare payers.²⁻⁴ Face-to-face interventions to increase medication adherence are efficacious and cost effective when used by patients with moderate to high levels of non-adherence.^{5,6} Despite their effectiveness, a barrier to widespread implementation of face-to-face interventions to improve medication adherence is their costs.

Computer-based and mobile phone technologies have been used to deliver medication adherence interventions and have been found to improve medication adherence⁷⁻¹¹. A recent review of 36 studies of interventions, which utilized technology to improve HIV patient outcomes, showed interventions are most effective when they include easily usable, individually tailored, multifunctional adherence tools familiar to the patient, which do not alert others as to the purpose of the tool.¹² Patients randomly assigned to a computer-administered adherence support intervention and who remained on protocol (i.e., did not

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discontinue treatment, and had regular exposure to the intervention) during the 18 month study period had greater three-day adherence than patients receiving standard care.¹³ In another study, patients randomized to receive a brief weekly adherence message on their mobile phones had significantly greater adherence at six and twelve months than patients receiving standard care.^{9,14} Online technologies are attractive as intervention delivery mechanisms because they easily blend into patient's everyday lives and are accessible at times and places convenient to them. Once developed, technology-based interventions may be relatively inexpensive to implement and deliver via the internet.

The costs of implementing technology-based interventions to improve antiretroviral medication adherence have received little attention, and we are unaware of any cost analysis of internet-based interventions. The purpose of the study was twofold: to document actual development costs of an internet social support and text message reminder intervention; and to estimate the costs of implementing the intervention from the perspective of an organization or insurance payer who might adopt and implement the intervention. Costs analyses of internet based interventions to improve medication adherence are important. As access to antiretroviral medications increases, studies of interventions to increase patient adherence are needed to ascertain their cost effectiveness, how widely the interventions can be implemented, and how sustainable the interventions might be once implemented.

Methods

Data for this study were derived from a larger study of the feasibility and acceptability of an internet and mobile phone intervention to increase adherence to antiretroviral medications. The intervention was grounded in the Information-Motivation-Behavioral skills model¹⁵ and consisted of three main components: 1) an online interface for participants to interact with each other by posting messages; 2) articles and videos addressing topics related to ART adherence and living with HIV; 3) an online medication adherence self-monitoring system with the option for text-message dose reminders. The website was monitored daily by study staff to detect human subjects concerns and to respond to direct questions about the study from participants. Participants were asked to engage with the intervention interface at least 5 times a week. The 8 week feasibility and acceptability study was conducted between February and April 2011.

Two types of costs were used-development costs and estimated implementation costs. Development costs were obtained by project investigators from monthly expense reports provided by the accountant assigned to the grant project. Estimated implementation costs were derived from the 8 week feasibility and acceptability study. The study considered only the costs associated with delivering the internet based portion of the intervention.*

Development costs associated with the intervention were actual amounts of money paid for research staff salaries and fringe benefits, software development, website design, usability testing, industry consultants, and the costs of conducting a two month trial. Costs during the two month trial were the costs associated with paying for research staff, server hosting, advertising, and technical support. The overhead rate charged by the participating university was 51 percent of direct project costs. These data were obtained from the project.

*The text message feature was optional and was not included in the analysis. The use of text messaging and associated costs are likely to vary across settings. This does not affect the study results greatly for two reasons. First, the internet component was the main focus of the intervention, and only 15 of the 61 participants opted to use the text message feature. Second, the costs of the text messages were small relative to the other components. The text message service costs \$1 per month for the phone number plus \$0.01 for each text message. Among the 15 who opted for the text message service, 2100 texts were sent or received during the 8 week period. This translated into an additional monthly cost among the 61 users of \$0.19.

Implementation costs were estimated to represent costs in a community health center or costs to a health insurance payer who might implement the intervention. The most likely setting for implementation would be in a developed country, where the population has access to computers and the government, either as a single payer insurer or a funder of research grants, has the resources to cover initial development costs. Project investigators estimated the intervention, if implemented in a real world setting, would require one coordinator for 20 hours per week, a computer server to host the project, advertising, and technical support. The hourly wage rate of the coordinator was estimated at \$33 per hour, including fringe benefits. This was the amount paid to the coordinator during the 8 week trial period and therefore represents a reasonable estimate of what a coordinator would cost if the intervention were implemented by a community organization. The cost for technical support was estimated at 5 hours per week at \$80 per hour for external staff, and \$45 per hour if provided by internal staff. Server hosting costs were \$25 per month. Advertising expenses to recruit participants were assumed to be \$85 per month. Advertising costs were estimated based on actual expenses incurred during the feasibility and acceptability study. During the 18 month development and recruitment process, a total of \$1,525 was spent on advertising, yielding a monthly cost of \$85. A total of \$5,720 was paid to project consultants to aid in the development of the intervention and design of the 8 week trial.

The cost data were then used to compute monthly per user costs. Weekly estimates of required hours for the coordinator and technical support were converted into monthly equivalent values of \$2,860 and \$1,733, respectively. Then, monthly costs for the coordinator, technical support, server hosting and advertising were summed to obtain a monthly total cost. This monthly total cost was then divided by the assumed number of users to obtain per user monthly costs. Two values were used for the number of users- the 61 study participants who completed the baseline survey and the 55 study participants who used the intervention and completed both baseline and 3 month follow up survey as part of the feasibility and acceptability study.* These were the estimates produced by the 8 week trial, but it is possible that such interventions could be delivered on a larger scale. The initial analysis assumed the cost of \$80 per hour for technical support. Forty five dollars per hour was assumed in the sensitivity analysis.

Results

Total development costs associated with the intervention were \$519,555, with \$340,288 in direct project costs and \$173,547 in indirect overhead costs. The majority of direct project costs were for personnel, with investigators and research staff during the development period accounting for \$272,884. An additional \$18,144 was spent on research staff during the project's 8 week trial period. Together these research staff costs amounted to 84.1 percent of direct project costs. Costs associated with software development were \$40,000, representing 11.6 percent of direct project costs. Website design, usability testing, server hosting, advertising, and technical support accounted for the remaining 2.7 percent of direct project costs. Overhead costs, calculated as 51 percent of the \$340,288 direct project costs, as required by the participating University, totaled \$173,547 (Table 1).

Once developed, costs associated with maintaining the intervention were estimated as a coordinator, computer hosting server, advertising, and technical support. These were \$2,860, \$25, \$85, and \$1,733, respectively, for a monthly total of \$4,703 (Table 1). Monthly per user

*The 61 participants consisted of gay ($n=58$) and bisexually ($n=3$) identified men. Of the 61 participants, 35 were non-Hispanic white, 19 were African American, 6 were Hispanic-white, and 1 was American Indian/Native Alaskan. Participants were screened on the basis of having reported less than 100 percent adherence to their antiretroviral therapy medications in the past 30 days. The mean baseline adherence level for the intervention group was 85.1 percent.

cost for maintaining the intervention was of \$77.10, assuming 61 users, and \$85.51, assuming 55 users. A more robust hosting server was estimated to cost \$100 per month. Using \$100 for the cost of the server, instead of the assumed \$25, yielded a monthly per user cost of \$78.32, assuming 61 users, and \$86.8, assuming 55 users. The \$80 per hour cost of technical support assumed that support was being performed by external contracted staff. If internal staff could provide technical support at \$45 per hour, the monthly per user cost would be \$64.67 assuming 61 users and \$71.73 assuming 55 users (Table 2).

Discussion

This study documented the development costs and estimated the implementation costs of an online social support and text message reminder intervention designed to improve antiretroviral medication adherence among PLWH. While development costs were large, the estimated monthly cost of implementing the intervention by a healthcare provider or insurance payer was much lower. The largest development cost was for research staff and overhead costs, which is typical of academic research studies. The study found that monthly per user costs were sensitive to the hourly rate paid for technical support. Future implementation efforts should therefore focus on finding low cost sources of technical support to reduce per user costs and increase the feasibility of implementation. Per user costs also declined as the number of users increased.

The purpose of the paper was to provide estimates of implementing an internet-based intervention, not to test the efficacy of an intervention. A previous study estimated that the costs of in-person adherence interventions ranged from \$470 to \$1,560 per person per month depending on the type of intervention and frequency of contact.⁵ The monthly cost of the internet-based intervention in the current study was substantially lower, which suggests future research to develop and assess the efficacy of internet-based interventions is warranted. Comparisons of the cost effectiveness of internet-based versus in-person interventions are also needed.

A cost benefit analysis is needed to evaluate whether an internet based intervention designed to improve medication adherence among PLWH could result in an overall cost savings among those who use the intervention or could be a more cost-effective treatment than face-to-face interventions. If found to be effective, improved medication adherence resulting from using the intervention could result in lower total healthcare costs, which may partially or fully offset the costs of implementation. Future studies should collect healthcare cost and effectiveness measures in order to determine whether the cost savings from improved adherence outweigh the costs of the intervention or provide more cost-effective treatment than face to face interventions.

Several assumptions were made in the analysis. The development was conducted as part of an academic study. It is possible that private companies could achieve lower development costs through reduced overhead rates. The initial study was of feasibility and acceptability. Establishing the efficacy of the intervention will result in future added development costs. The analysis assumed the number of users to be the same as the number that participated in the feasibility and acceptability study. It is possible that the intervention could support more users than were recruited, which would result in lower per user costs. Future studies should determine the optimal scale of delivery of internet based interventions. Even with an estimate of 55 users, the \$85.51 cost per month is a small percentage of the \$2,100 per month estimated lifetime cost of HIV care.¹⁴ The shelf lives of internet based interventions have not yet been determined. Future studies should determine how often internet based interventions need to be updated, changed, or replaced.

As online social support adherence interventions are developed, there will be trade-offs between utilizing existing online social websites (e.g. *Facebook*) and developing a similar, but separate, online social environment. Advantages of using an existing platform include reduced development time, user familiarity, and potentially fewer resources that would be required to sustain the intervention. Alternatively, developing a similar, but separate, platform may provide added privacy assurances and offer greater flexibility to customize features. Additional research is needed to identify the delivery platform that will offer best uptake of a social support ART adherence intervention among PLWH.

The high development costs and relatively low implementation cost for the internet social support and text message reminder intervention have implications for health policy. First, public funding, most likely from government funding agencies, will probably be necessary to cover the research and development costs of internet-based programs, such as adherence interventions. Community health providers or private insurance payers are unlikely able or willing to pay the high cost for developing online interventions to increase adherence to antiretroviral medications. Second, because the costs of implementation are low relative to in-person interventions, online interventions to increase medication adherence could be disseminated widely and their costs potentially covered by government or private insurers if an intervention is shown to save them money through healthcare cost savings. Domestically, internet based interventions could be a cost effective way to provide adherence programs to rural areas with limited access to face-to-face healthcare.

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Table 1

Costs associated with the design, development, and implementation of an internet based intervention to promote medication adherence among PLWH in the United States

Research and Development Costs	Total Cost	Intervention Costs	Cost per Month
Research Staff During Development	\$272,884	Coordinator	\$2,860
		Server Hosting	\$25
Research Staff During 8 Week Trial	\$18,144	Advertising	\$85
		Technical Support	\$1,733
Software Development	\$40,000		
Website Design	\$1,000		
Usability Testing	\$350		
Server Hosting	\$325		
Advertising	\$1,525		
Technical Support	\$6,000		
Consultants	\$5,720		
Overhead Costs	\$173,547		
Total	\$519,555	Total	\$4,703

Notes: Costs data were obtained from project personnel.

Table 2

Per user cost sensitivity analysis

Total Monthly Costs				Per User Costs			
	Total Cost	Coordinator	Server	Advertising	Technical Support	61 Users	55 Users
Actual	\$4,703	\$2,860	\$25	\$85	\$1,733	\$77.10	\$85.51
Advanced Server	\$4,778	\$2,860	\$100	\$85	\$1,733	\$78.33	\$86.87
Internal Technical Support	\$3,945	\$2,860	\$25	\$85	\$975	\$64.67	\$71.73
Advanced Server & Technical Support	\$4,020	\$2,860	\$100	\$85	\$975	\$65.90	\$73.09

Notes: Cost data were obtained from project personnel. The advanced server would cost \$100 per month instead of \$25. Internal technical support would cost \$975 per month instead of \$1,733.