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Analyzing the costs and impact of the TakeMeHome program, a public-private partnership to deliver HIV self-test kits in the United States

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Abstract

Background: HIV testing is as an entry point to access HIV care and prevention services. Building Healthy Online Communities (BHOC) developed a website (TakeMeHome.org) where participants can order HIV home test kits. The purpose of this study was to analyze the costs and impact of the TakeMeHome program.

Methods: We estimated the costs of TakeMeHome across all participating jurisdictions for the first year of the program. We estimated program costs using purchase orders and invoices, contracts, and allocation of staff time, and the costs included website design, participant recruitment, administration and overhead, HIV self-test kits, and shipping and handling. Primary outcomes of the analysis were total program cost, cost per HIV test, and cost per new HIV diagnosis.

Results: TakeMeHome distributed 5,323 HIV self-tests to 4,859 participants over a 12-month period. The total program cost over this period was $314,870. The cost per HIV test delivered was estimated at $59, and the cost per person tested was $65. The program identified 18 (0.6% positivity) confirmed new HIV diagnoses that were verified with surveillance data in 7 health jurisdictions at $169,890. The cost per confirmed new HIV diagnosis was estimated at $9,440.

Conclusions: The TakeMeHome program delivered HIV self-testing at a reasonable cost, and the program may be a cost-effective use of HIV prevention resources. The public-private partnership can be an effective mechanism to validate HIV diagnoses identified with self-testing and provide HIV prevention and linkage to care services.

Keywords

HIV self-testing; home testing; microcosting; cost-effectiveness; online recruitment

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INTRODUCTION

HIV testing is a cornerstone of both the National HIV/AIDS Strategy and the Ending the HIV Epidemic in the U.S. (EHE) initiative.[1,2] For people with undiagnosed HIV, testing is an important first step in accessing HIV treatment services, which can improve health and reduce HIV transmission, and increase testing and treatment for other sexually transmitted infections (STIs).[3,4] For people who do not have a diagnosis of HIV infection, testing provides an opportunity to be connected to HIV prevention services, including pre-exposure prophylaxis (PrEP) and STI services. There was a noticeable decrease in HIV testing during the COVID-19 pandemic, as the traditional, in-person testing services became less accessible.[5,6] HIV self-testing programs offer an innovative mechanism to ensure that HIV testing is simple and accessible for everyone.[3] Furthermore, HIV self-testing can reduce the barriers associated with testing in clinical settings, thereby increasing HIV testing coverage.

In March 2020, Building Healthy Online Communities (BHOC), a consortium of public health organizations, launched an HIV home test kit ordering website (TakeMeHome.org) that was later scaled up nationally through a 2021 national demonstration project funded by the Centers for Disease Control and Prevention (CDC), called “Together TakeMeHome”.[7] Although the TakeMeHome website can be accessed by anyone in a participating location, the self-test kits distribution program targets priority populations by sending in-kind messages through dating apps and other online sites primarily accessed by priority populations most at risk of HIV infection. The centralized systems of distributing rapid HIV self-test kits utilized partnerships with health jurisdictions for funding and private dating apps providers for promotion of the program. The website was developed leveraging relationships that BHOC had built over previous years with major gay dating apps. Previous research has indicated a high demand for HIV home testing among men who have sex with men (MSM) who use dating apps, a substantial portion of whom have never been tested for HIV.[8,9]

Through the TakeMeHome program, individual health jurisdictions may participate and pay for HIV test kits, enabling eligible constituents to order the pre-purchased kits online at no cost to the constituents. The purpose of this study was to analyze the costs and impact of the TakeMeHome program, using program level data from a range of participating health jurisdictions. Our primary cost measures were the cost per HIV test kit delivered and the cost per new HIV diagnosis.

METHODS

Overview of the TakeMeHome program

The TakeMeHome program is described in more detail in the supplemental material and in previous reports.[7,8] Briefly, TakeMeHome was established in March 2020 to facilitate the distribution of rapid HIV self-test kits via an online request platform. The program uses the OraQuick In-Home HIV Test (OraQuick, OraSure Technologies, Inc.), the only HIV self-test currently approved by the United States Food and Drug Administration.

State and local health jurisdictions contract with BHOC and National Alliance of State and Territorial AIDS Directors (NASTAD), BHOC's main partner on this project, to promote and deliver home HIV tests to eligible residents through the TakeMeHome program. Typically, the program is promoted through messages and links on dating apps such as Grindr. These messages direct participants to the TakeMeHome website, where they complete 4 eligibility questions (zip code, sex at birth, age, and time since last HIV test). If eligible, the participant can enter their name, mailing address and email address to order an HIV home test kit. Upon completion of the order, the participant is asked additional demographic and behavioral questions (race, gender identity, number of sex partners in the prior year, and the location of their most recent HIV test site, if any). The order information is then sent to the fulfillment partner, who processes the request and mails the rapid HIV self-test kit with 3 condoms and an insert with additional information about linkage to confirmatory testing, if needed, and resources for STI testing and HIV PrEP.

Participants are offered a follow-up survey 10 days after the mailing of their test kits; no financial incentive for survey response was offered. The anonymous survey asks the participants for demographic information (age, race, gender identity), whether they had taken the test, the test result, and whether they had followed up with additional testing and care if tested positive. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy. CDC's role was to provide technical assistance.[7]

Program impact

We assessed several measures of impact of the TakeMeHome program. We counted the number of participating sites, i.e., health jurisdictions, defined as the geographic areas representing state or local health departments and community-based organizations who agree to pay for rapid HIV self-test kits in their area, and the average length of participation per site in months. We calculated the total number of site-years of participation as the sum of months of participation across all sites, divided by 12.

We calculated a range of self-testing outcomes, including number of HIV test kits delivered, number of people tested, number of reported new HIV diagnoses, and number of confirmed new HIV diagnoses (for applicable sites with this information). Participating locations were invited and encouraged to participate in case matching, in which they would match the data for all mailed tests against the health department HIV case surveillance data to identify any new positive cases that did not have a previous record of a positive HIV test result before their TakeMeHome test. These self-testing outcomes were calculated in terms of the overall number across sites and the average number per site.

Some of the program impact measures we calculated were previously reported, by sociodemographic factors such as age and race/ethnicity.[7] We included these previously reported outcome measures in this study because these measures are needed for estimating the cost per HIV test kit delivered and the cost per new HIV diagnosis.

Program costs

We estimated the total annual costs of the TakeMeHome program across all participating sites using data obtained for the period from March 31, 2020 through March 31, 2021. Cost analysis was conducted from the TakeMeHome program's perspective.[10,11] We estimated program cost based primarily on purchase orders and invoices, contracts, and estimates of allocation of staff time.

We assessed the start-up costs separately from the recurrent costs to account for additional staff time and resources required to establish the program. Start-up costs included the costs of the project director who was responsible for all project activities, including program administration, data management, and other logistics. Additional activities at the start-up included building and supporting the TakeMeHome internet platform, designing online ads, and purchasing computer equipment. We annuitized these start-up costs using a 3% discount rate, assuming a useful life of 5 years for the internet platform and 3 years for the computer equipment. Beyond those periods, we assumed that the internet platform would require a major redesign or building a new platform and the computer equipment would be replaced. Recurrent costs included the costs of the project director, internet technology support (IT) services, office space and utilities, cell phone service, and office supplies.

These start-up and recurrent costs were considered fixed costs, meaning they did not vary based on the number of HIV tests delivered or number of participating jurisdictions. The HIV test costs, however, were considered variable costs, as these costs depended on the number of HIV tests delivered. These variable costs included the costs of the HIV test kit, shipping and handling, NASTAD administration fee, recruitment costs (advertising), and educational materials and condoms.

We first estimated fixed costs on an annual basis. Data on the variable costs were collected from all sites (March 31, 2020–March 31, 2021) regardless of the length of time the site participated in the TakeMeHome program. We calculated the total program cost per site-year to illustrate the average cost of program participation for one year. We also calculated the variable program cost per site-year to illustrate the average cost of adding an additional site to the TakeMeHome program for one year.

All costs are reported in 2020 U.S. dollars. The supplement contains additional details of the cost analysis.

Average costs

By combining the measures of cost and program impact, we calculated the cost per test delivered, the cost per person tested, the cost per reported new HIV diagnosis, and the cost per confirmed new HIV diagnosis. Our analysis of the cost per confirmed new HIV diagnosis was limited to sites that matched kit orders to HIV case surveillance and confirmed the new HIV diagnoses. In calculating the cost per confirmed new HIV diagnosis, we assumed that the cost per HIV test delivered in the subset of applicable sites was the same as for all participating sites.

We conducted one-way and multi-way sensitivity analyses to assess how the estimated cost per person tested would change under different assumptions about the program costs and outcomes. In the one-way analyses, we varied one cost input at a time (test kit cost, shipping and handling cost, all fixed costs, and advertisement/recruitment cost) while holding all other inputs at their base case values. In doing so, the given cost input was varied ±50% of its base case value. In the multi-way analyses, we simultaneously varied two inputs (test kit cost and all fixed costs) or three inputs (test kit cost, all fixed costs, and shipping cost).

RESULTS

Program impact

A total of 17 sites (local and state health jurisdictions) from 9 U.S. states participated in the HIV home testing program from March 31, 2020–March 31, 2021. The average length of participation in the program per site was 7 months (range across the sites, 1–12 months) as jurisdictions learned about the program, signed up, and completed their contracts throughout the first year. The total program length was estimated to be 10 site-years.

The program distributed a total of 5,323 home test kits ordered by 4,859 people (Table 1). The average number of test kits distributed per site was 313 and ranged from 21 to 1,093 across sites. The average number of people tested per site was 286 (range: 19–1,047). Across all sites, the program identified 31 HIV diagnoses based on participant self-report, and the average number of HIV diagnoses per site was 1.8 (range: 0–12). In the 7 sites with case matching to confirm new HIV diagnoses, the program distributed 2,872 home test kits to 2,826 people and identified 28 self-reported HIV diagnoses of which 18 (0.6%) were confirmed new HIV diagnoses. The average number of confirmed new HIV diagnoses was 2.6 (range: 0–7) per site.

Program costs

We estimated the total program cost at $314,870 over the 12-month duration of program participation across all sites (Table 2). Program fixed costs were estimated at $56,980 per year. Program variable costs were estimated at $257,890 across sites. The program staff cost was the largest component of the fixed costs, followed by IT support and website design and development (Table 2). Purchase of In-Home HIV Test kits was the largest component of variable costs, followed by the test kit shipping and handling costs.

Average total costs

Across all sites, we estimated the cost per test delivered at $59 and the cost per person tested at $65 (Table 1). We estimated the cost per reported HIV diagnosis at $10,160 across all sites ($6,070 across 7 sites). We estimated the cost per confirmed new HIV diagnosis at $9,440 across the 7 sites with case matching to confirm new HIV diagnoses.

In the one-way sensitivity analyses, the estimated cost per person tested was most sensitive to assumptions regarding the test kit cost and the shipping and handling costs (Figure 1). In multi-way sensitivity analyses, the cost per confirmed new HIV diagnosis ranged from

$5,520 to $13,360 when simultaneously varying the test kit costs, shipping and handling costs, and all fixed costs.

DISCUSSION

The collaborative TakeMeHome HIV home testing program provided direct access to HIV self-testing in 17 jurisdictions across 9 states, and the program identified 18 (0.6% positivity) confirmed new HIV diagnoses that were verified with HIV surveillance data. The cost per test delivered was estimated at $59, and the cost per person tested was $65; the cost per confirmed new HIV diagnosis was estimated to be $9,440.

Our cost estimates are within the range reported in a recent cost-effectiveness analysis of a self-testing intervention based on the randomized controlled trial (RCT) of HIV self-testing among MSM (eSTAMP).[12] The self-testing RCT reported the cost per test at $68 and cost per new HIV diagnoses at $10,480 (all costs in 2020 US$); the costs included incentives to participants for reporting test results.

This analysis was not intended to be a formal cost-effectiveness analysis of the costs and health consequences of an HIV testing program. However, formal cost-effectiveness studies have reported that the cost per new HIV diagnosis could be as much as $31,600 (much higher than our estimate of $9,440 for the TakeMeHome pgoram) for a testing program to be cost-saving and $87,100 for a program to be considered cost-effective in the United States (2020 US$).[12,13] In addition, our analysis provides cost estimates based on real-world implementation of self-testing, without offering any incentive to the participants who tested, thus reflecting a more realistic cost-effectiveness scenarios for scaling up self-testing nationally.

Furthermore, the cost of rapid HIV testing in outreach settings using mobile vans, which provide more access to HIV testing in communities who are medically underserved, ranged from $181–$323 per test and from $21,600–$27,300 per new HIV diagnosis.[14] Although the testing cost may be lower ($22–$62/test) in health care settings, e.g., emergency departments and STI clinics,[15–17] individuals are required to travel to the clinics for testing and receipt of results, which requires additional effort and associated costs to patients, which can be a barrier to testing.

The cost of the rapid HIV self-test kits was a major cost driver. Although the unit cost of the self-test kit is largely stable in the private market, costing approximately $45 per kit in most community pharmacies ($45.99, OraQuick In-Home HIV Test, https://www.cvs.com/, accessed 7/1/2022), the TakeMeHome program obtained an average price per test kit of $23.45. This price is about 25% higher than that of the self-test kit used in eSTAMP trial ($18.65/test), where the price was negotiated between the project contractor and manufacturer, OraSure Technologies, Inc., and nearly half of the test kits (SURE CHECK HIV ½ Assay) were used under Investigational Device Exemption from the Food and Drug Administration.[12] When we reduced the self-test kit cost to the TakeMeHome program by 50% from the base case, the cost per test and per new diagnosis was reduced to $47 and $7,580, respectively. Should additional HIV self-tests be approved by the FDA, cost per test

would likely drop due to increased competition, thereby enabling an increase in the number of tests each jurisdiction would be able to provide in their area.

Shipping and handling of the test kits was another cost driver, accounting for 25% of the total program cost. Exploring other lower-cost options for fulfilling test kit orders, e.g., mailing multiple test kits, as in programs run by the eSTAMP trial,[18] or mailing the test kits directly by the manufacturer to participants, as in Baltimore City Health Department and Public Health Institute at Denver Health,[19,20] could have a notable effect on the cost-effectiveness of the program.

Another important component of the self-testing program was recruitment of the participants by displaying appropriate ads on the networks of publisher websites and dating apps. This process often takes experience and proper selection of the websites and apps to reach prioritized populations, and the costs and effectiveness may vary substantially.[12,19,21,22] In our analysis, we used market price as an opportunity cost of posting the ads ($15 per 1000 impressions), although the program was able to secure in-kind contributions for posting ads and messages through the dating apps, based on the BHOC's relationship with the partners providing the apps, built over many years.

Our cost analysis provides early estimates of the program costs since the TakeMeHome program was launched in March 2020, and some jurisdictions were implementing the self-testing program only for a few months. As the program continues, the health jurisdictions may find better ways to implement the program and potentially improve efficiency and reduce costs. One limitation of this analysis was that we did not include health jurisdictions' costs, aside from their contractual payments for the test kits. However, these costs would likely be very low, as the program was designed to be low burden for health jurisdictions, with BHOC taking on the promotion, ordering, shipping and other fulfillment logistics, and data gathering for health jurisdictions. The main additional cost to the jurisdictions, other than the contract itself, would be the time spent on the contracting process and, for those with the capacity, surveillance case matching. The public-private partnership was critical in TakeMeHome for matching HIV diagnoses with the cases already reported in the health department HIV surveillance data and determine if those were newly diagnosed HIV cases. This type of partnership or a similar arrangement can help ensure an accurate accounting of all new HIV diagnoses and could promote linkage to HIV treatment.[7]

An important feature of TakeMeHome is that the HIV test kits can be made available to constituents in specific zip codes, thereby allowing program resources to be directed to areas most at need. Furthermore, the test kits and subsequent services were provided free of charge to the recipient, which could support improving access to HIV testing among disproportionately affected groups. This program was scaled up through CDC's 2021 national demonstration project, called "Together TakeMeHome," which was a national initiative to promote the distribution of free HIV self-tests within the most affected populations.[7] A large number of EHE jurisdictions are covered in the TakeMeHome program, and these locations were prioritized for promotion within the Together TakeMeHome project.[23]

Our analysis is based on data from a real-world implementation of rapid HIV self-testing in 17 jurisdictions. We accounted for all relevant costs, including test kits, supplies, shipping and handling, recruitment ads, administrative overhead, and building an interactive internet site. However, our analysis considered only the costs incurred during the first year of the program. Although we annuitized the substantial start-up costs over a five-year period, we still might have overestimated these costs in the long term if only relatively minor maintenance costs are required in future years (and not major start-up costs every five years as we assumed).

Further, we note that if the TakeMeHome program was expanded to more jurisdictions or scaled up nationally, the relative importance of the fixed costs would decrease, as would the cost per HIV test delivered. Of note, a key feature of the TakeMeHome program is that participating jurisdictions do not bear the fixed costs, thereby preventing a possible barrier to participation. In fact, as the program finished its second year, it increased the number of kits distributed from around 5,300 kits in year 1 to 9,000 kits in year 2. However, we did not include data from year 2 in this analysis of the HIV testing component of the TakeMeHome program because there were additional costs of the program in year 2 to offer full lab-based HIV and STI testing and Spanish translation of the materials. Based on the lessons learned from TMH, the CDC funded “Together TakeMeHome”, a national scale demonstration project, with the goal of distributing up to 1 million free HIV self-tests over five years.

CONCLUSIONS

The collaborative TakeMeHome HIV home testing program provides direct access to HIV self-testing at a relatively low cost. The program can be scaled up regionally or even nationally to support the Ending the HIV Epidemic in the U.S initiative. The data we present show that the program can deliver HIV testing at a fairly low cost, comparable with or below HIV testing in other health care and non-health care settings. The public-private collaboration can be a viable mechanism to deliver self-tests to persons who might not seek or access HIV testing otherwise. By collaborating with health jurisdictions, persons with a diagnosed HIV infection can be linked to HIV care, and those without a diagnosed infection can be connected to HIV prevention services, including PrEP and STI services.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Conflicts of Interest:

Jennifer Hecht reports institutional funding from Gilead Sciences, and no other potential conflicts of interests were disclosed.

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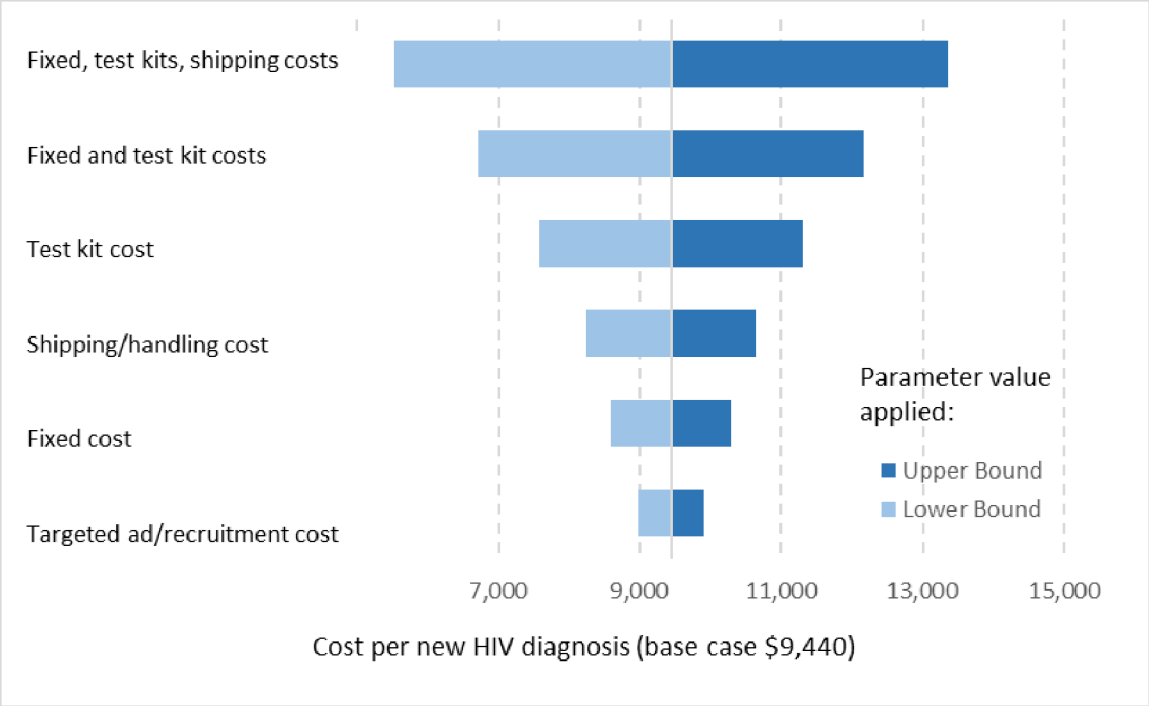

FIGURE 1.
Sensitivity analyses: Cost per new confirmed HIV diagnosis when varying one or more cost input assumptions

TABLE 1.

Costs and impact of the TakeMeHome HIV home testing program, March 2020–March 2021

	All sites	Case matching sites (with confirmed new HIV diagnoses)
No. of sites (local and state health jurisdictions)	17	7
Average length of program participation per site, months	6.9	NE
No. of site-years of program participation	9.8	NE
No. of HIV tests distributed (average per site)[a]	5,323 (313)	2,872 (410)
No. of people tested (average per site)[a]	4,859 (286)	2,826 (404)
Number of reported HIV diagnoses (average per site)[b]	31 (1.8)	28 (4.0)
Number of confirmed new HIV diagnoses (average per site)	NE	18 (2.6)
Program cost (average per site)[c]	$314,870 ($18,520)	$169,890 ($24,270)
Total program cost per site year	$32,300	NE
Variable program cost per site year	$26,450	NE
Cost per test delivered[b]	$59	$59
Cost per person tested[c]	$65	$60
Cost per reported HIV diagnosis[c]	$10,160	$6,070
Cost per confirmed new HIV diagnosis[c]	NE	$9,440

[a]The results for test kits distributed and persons tested differ slightly from that of Hecht et al. (2021),[7] due to differences in data cleaning processes across the two studies.

[b]HIV diagnoses based on self-report (n=855) and case matching in those sites with confirmed new HIV diagnoses.

[c]The total costs in the final column (Case matching sites, n=7) were calculated by assuming the same cost per test under each program activity across all sites. First, we calculated the average cost of each program activity listed in Table 2, then applied the average costs to calculate the total activity costs for the case matching sites, which sum to the total program cost.

Costs are reported in 2020 US dollars; costs above $100 are rounded to the nearest $10.

Sites are health jurisdictions, defined as the geographic areas representing state or local health departments and community-based organizations. NE = not estimated.

TABLE 2.

Estimated fixed costs (start-up and recurrent costs) and variable costs of the TakeMeHome HIV home testing program, in 2020 US dollars

	Start-up costs, (annual)[a]	Recurrent costs (annual)	Total costs (annual)
Fixed costs			
Program staff	5,300	22,500	27,800
Website design and development	7,420	0	7,420
Design of online advertisements	500	0	500
Internet technology (IT) support	320	14,000	14,320
Computer and equipment	520	0	520
Internet services[b]	0	58	58
Cell phone	0	360	360
Office supplies[c]	0	20	20
Utilities	0	410	410
Office space	0	5,580	5,580
Subtotal	14,050	42,930	56,980
Variable costs [d]			
Text messaging from apps for recruitment	NE	NE	30,500
In-Home HIV Test kit ($23.45/kit on average)	NE	NE	124,820
Shipping and handling ($15/kit)	NE	NE	79,850
NASTAD administrative fee (10% of test kit cost)	NE	NE	20,470
Educational materials and condoms	NE	NE	2,250
Subtotal	NE	NE	257,890
Total program cost	14,050	42,930	314,870

See supplement for details on cost estimates. Costs above $100 are rounded to the nearest $10, hence the numbers may not add up to the totals.

[a] Before annuitizing, the actual start-up costs were estimated as follows: $25,000 for program staff, $35,000 for website design, $500 for design of online advertisements, $1,500 for internet technology (IT) support, and $1,500 for computer and related equipment. With two exceptions, these costs were annuitized over 5 years. The two exceptions were the computer cost (annuitized over 3 years) and the online advertisement cost (not annuitized; we assumed this cost could be incurred in each additional year of the program as new sites are added or as updates are needed for other reasons). To annuitize over 5 years and 3 years, we divided the cost by 4.72 and 2.91, respectively, according to standard formulas for annuitization assuming amount due at the end of the year, and assuming a 3% annual discount rate and no residual value left at the end of the discounted years (Haddix et al. 2003).[10]

[b] Internet services costs reflect internet access costs not included elsewhere and were pro-rated to the share of the costs incurred by TakeMeHome program personnel.

[c] As noted in the supplement, virtually all office-related activities were performed electronically, such that practically no costs were incurred for office supplies.

[d] The variable costs were estimated from the time frame of March 2020 through March 2021.

NE = Not estimated; NASTAD = National Alliance of State and Territorial AIDS Directors