The costs and effectiveness of four HIV counseling and testing strategies in Uganda

Nick Menzies[a,b,c], Betty Abang[d], Rhoda Wanyenze[e], Fred Nuwaha[f], Balaam Mugisha[g], Alex Coutinho[h], Rebecca Bunnell[i], Jonathan Mermin[i] and John M. Blandford[a]

Objective: HIV counseling and testing (HCT) is a key intervention for HIV/AIDS control, and new strategies have been developed for expanding coverage in developing countries. We compared costs and outcomes of four HCT strategies in Uganda.

Design: A retrospective cohort of 84 323 individuals received HCT at one of four Ugandan HCT programs between June 2003 and September 2005. HCT strategies assessed were stand-alone HCT; hospital-based HCT; household-member HCT; and door-to-door HCT.

Methods: We collected data on client volume, demographics, prior testing and HIV diagnosis from project monitoring systems, and cost data from project accounts and personnel interviews. Strategies were compared in terms of costs and effectiveness at reaching key population groups.

Results: Household-member and door-to-door HCT strategies reached the largest proportion of previously untested individuals (>90% of all clients). Hospital-based HCT diagnosed the greatest proportion of HIV-infected individuals (27% prevalence), followed by stand-alone HCT (19%). Household-member HCT identified the highest percentage of discordant couples; however, this was a small fraction of total clients (<4%). Costs per client (2007 USD) were $19.26 for stand-alone HCT, $11.68 for hospital-based HCT, $13.85 for household-member HCT, and $8.29 for door-to-door-HCT.

Conclusion: All testing strategies had relatively low per client costs. Hospital-based HCT most readily identified HIV-infected individuals eligible for treatment, whereas home-based strategies more efficiently reached populations with low rates of prior testing and HIV-infected people with higher CD4 cell counts. Multiple HCT strategies with different costs and efficiencies can be used to meet the UNAIDS/WHO call for universal HCT access by 2010.

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Introduction

HIV counseling and testing (HCT) is a key intervention for HIV/AIDS control in developing countries. HCT increases knowledge of HIV status, encourages safer sex, and is an entry point for HIV care and treatment services. Increasing HCT coverage can reduce HIV-associated denial, stigma, and discrimination, and mobilize

[a]US Centers for Disease Control and Prevention (CDC), Global AIDS Program, National Center for HIV, Viral Hepatitis, STD, and TB Prevention, [b]Macro International Inc, Atlanta, Georgia, [c]Harvard University, Cambridge, Massachusetts, USA, [d]CDC-Uganda, Global AIDS Program, National Center for HIV, Viral Hepatitis, STD, and TB Prevention, CDC, and Uganda Virus Research Institute, Entebbe, [e]Mulago-Mbarara Teaching Hospitals' Joint AIDS Program (MJAP), [f]Makerere University, School of Public Health, [g]The AIDS Information Centre (AIC), [h]The AIDS Support Organization (TASO), Kampala, Uganda, and [i]CDC-Kenya, Coordinating Office for Global Health, CDC, Nairobi, Kenya.

Correspondence to Nick Menzies, Harvard University Health Policy Program, 14 Story Street, Cambridge, MA 02138, USA.
Tel: +1 404 217 1076; fax: +1 617 496 2860; e-mail: nmenzies@fas.harvard.edu
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communities to respond to the HIV epidemic [1]. Uganda was the first African country to offer HCT services in 1990, yet population coverage is still low [2].

The traditional HCT strategy is client-initiated testing through free-standing clinics (stand-alone HCT) [3]. This strategy has become relatively standardized as HCT programs have grown in number, size, and maturity. However, evolving epidemic dynamics and increased funding for HIV control have led to expanded service provision and targeting of population groups not reached by existing strategies. At the same time, the advent of HIV rapid test technology has simplified HCT implementation [4]. New HCT strategies have been developed, which differ in their target groups and methods of accessing clients. These strategies include provider-initiated HCT offered to patients at health centers and hospitals, and mobile HCT offered in communities and homes. It is likely that these new strategies will differ in their costs and in their ability to contribute to HIV control objectives, such as expanding knowledge of status, identifying infected individuals to receive HIV treatment, and reducing HIV transmission.

Raising knowledge of status can be achieved through increasing the scale of HCT programs and offering services to traditionally underserved groups such as rural communities. Identifying infected individuals for treatment can be achieved through offering services to groups known to have high HIV prevalence. How HCT may reduce HIV transmission is more contentious. Whereas two randomized control trials of HCT [5,6] have reported strong preventive effects, other studies [7–9] have found little or no impact on risk behavior or HIV incidence, particularly in HIV-negative clients. Several meta-analyses [10–12] have found preventive effects to be strongest among HIV-positive clients and discordant couples, and a similar conclusion was reached by a recent meta-analysis of studies of HCT behavioral outcomes conducted in developing countries [13]. Cohort studies following HIV-discordant couples in the Democratic Republic of Congo, Rwanda, and Zambia have found consistently strong beneficial effects of HCT on condom use and HIV incidence [14–17]. To the extent that HCT reduces HIV transmission, it is likely that prevention effects will be strongest when HCT is provided to infected individuals and discordant couples.

Policy makers must prioritize interventions that maximize impact while staying within budget constraints. Prior studies [18–21] have investigated HCT cost-effectiveness at stand-alone sites in developing countries, reporting per client costs from US$13 to US$36. Little data is available on the costs of HCT outside stand-alone sites, or how strategies differ in their success at reaching key population groups. We investigated the costs, outcomes, and cost-effectiveness of four different HCT strategies currently being used in Uganda.

Methods

HCT strategies were compared in terms of outcomes that reflect three HIV control objectives: expanding knowledge of HIV status, especially to previously untested clients; reducing HIV transmission; and identifying HIV-infected individuals to receive care and treatment services.

Population and setting

We collected data on four HCT projects in Uganda, each utilizing a different HCT strategy. Projects were selected from similar geographic areas to minimize differences in population characteristics and setting. Uganda has a mature generalized HIV epidemic predominantly driven by heterosexual sex, with an HIV prevalence of 7.5 and 5.0% in 15–49-year-old women and men, respectively. HCT coverage is low, and by 2007 only 25% of women and 21% of men reported ever having tested for HIV [2].

HIV counseling and testing strategies

All four HCT strategies follow similar procedures, with HIV testing provided in a single session using a serial HIV rapid test algorithm. Pretest and posttest counseling is provided, covering basic HIV/AIDS information, the testing process, risk-reduction strategies, the interpretation of positive or negative test results, partner communication and disclosure, and voluntary consent. Referral for HIV care and treatment is provided for clients diagnosed HIV-positive. Testing is free, voluntary, and private, and clients are encouraged to test with their partner (couples HCT).

Stand-alone HIV counseling and testing

Stand-alone HCT is the conventional HCT strategy [3], provided through free-standing centers. It is client-initiated, with attendance encouraged through promotional campaigns. Individuals attending the site are provided initial group counseling, with key messages reiterated and consent obtained in private sessions for couples or individuals. Clients diagnosed HIV-positive are referred to local health centers for follow-up.

Hospital-based HIV counseling and testing

Hospital-based HCT is a provider-initiated strategy, offered to all patients with unknown or undocumented HIV status attending hospitals and major health centers regardless of illness presentation, using an opt-out approach [22]. Pretest counseling is provided in a group setting, with key messages reiterated and consent obtained in private sessions. HCT is provided by health providers with HCT-specific training, and counselor-assisted disclosure to sexual partners and family members is provided if requested by the patient. Hospital-based HCT has the potential to identify many HIV-infected individuals, as individuals attending health facilities are more likely to have HIV infection. Linkages to HIV care and treatment can be efficient if services are provided

on-site, although treatment may be less effective if patients have advanced disease.

Door-to-door HIV counseling and testing

Door-to-door HCT is a home-based, provider-initiated strategy. Mobile teams offer HCT to clients at home, and community mobilizers ensure all households in a community are offered services [23]. Door-to-door HCT is offered to all adults and to all children aged 0–14 years whose mother is HIV-infected, deceased, or of unknown HIV status. Initial group counseling is provided to family members and peers, followed by private pretest and posttest counseling for individuals and couples deciding to test. Through reducing barriers to testing, this strategy could expand HCT services to previously underserved groups and rural communities, and increase couples testing. HIV-infected individuals are referred to local health centers for follow-up.

Household-member HIV counseling and testing

Household-member HCT is similar to door-to-door HCT, with HCT offered to clients in their own homes. However, this strategy specifically targets the household members of individuals already identified as HIV-infected, reflecting research showing that household members are at higher HIV risk [24]. Households are approached only after voluntary consent by the HIV-positive index client. This strategy is provided in conjunction with existing HIV treatment programs, and mobile teams travel to households of willing program participants, offering HCT to all adults, and to all children aged 0–14 years whose mother is HIV-infected, deceased, or of unknown HIV status. Individuals identified as HIV-infected are offered treatment through the treatment program serving the index patient.

Although relatively new, all three projects providing provider-initiated HCT have reported high levels of acceptance, with more than 84% of eligible individuals agreeing to participate when offered HCT [22–24].

Data collection and analysis

The present study collected de-identified data from project data systems and received ethical approval from the US Centers for Disease Control and Prevention. Projects were evaluated between June 2003 and September 2005, with each project assessed for an evaluation period of 6–12 months coinciding with a period of uninterrupted project operations. Data were collected on a total of 84 323 HCT clients. We adopted a programatic perspective, considering all economic costs incurred to provide HCT but excluding the potential cost-savings that might arise from earlier identification and treatment of HIV-infected individuals and from preventing new infections.

From project accounts and inventories and through interviews with project personnel, we collected data on HCT-specific costs and a portion of shared overheads determined via direct allocation [25]. Input prices of major cost items (equipment, salaries, testing supplies) were standardized across strategies. Buildings and utilities costs were estimated from the equivalent building rental cost, and the costs of other investments (equipment, vehicles, training) were annuitized over the expected useful life with a 3% discount rate [26]. Cost data were collected so as to include the costs of clients who declined services. All costs are reported as 2007 US dollars.

We extracted indicators on the client population and testing results from project data systems. Indicators included total client volume, general demographics (age group, gender), representation of key population groups (previously untested individuals, married or cohabiting couples), HIV diagnosis (including partner's diagnosis for couples testing), and session completion (percentage completing all intervention components). Data on the CD4 cell count distribution of HIV-infected HCT clients were collected for a separate sample of clients conducted by each project.

Cost-effectiveness analyses compared the crude cost per client as well as the costs of reaching key target groups. Average, rather than incremental, cost-effectiveness ratios are reported, as the strategies were judged to be independent programs (not mutually-exclusive) based on the different populations targeted by each strategy [27]. Analyses were conducted using TreeAge Pro 2006 (Williamstown, Massachusetts, USA).

Results

Client population characteristics

Client population characteristics are shown in Table 1. Whereas the age distributions for stand-alone HCT, hospital-based HCT, and door-to-door HCT were similar, the age distribution for household-member HCT was strongly skewed toward younger age groups, with 68% of clients less than 15 years of age. All strategies had relatively equal sex distributions except hospital-based HCT, where more female clients were seen (62% of all clients). All three nontraditional HCT strategies attracted proportionally more first-time clients than stand-alone HCT, especially both home-based strategies. Door-to-door HCT attracted the highest percentage of couples for testing. All strategies reported HCT completion rates above 98.5%.

HIV prevalence in HIV counseling and testing client groups

The HIV prevalence in HCT clients and subgroups is shown in Table 2. Both stand-alone HCT and hospital-based HCT reported high client HIV prevalence, at 19.1 and 27.2%, respectively. In contrast, the two home-based

Table 1. HIV counseling and testing client characteristics.

	Stand-alone HCT	Hospital-based HCT	Household-member HCT	Door-to-door HCT
Characteristics of HCT clients (% of total, *N*)				
Total HCT clients:	9604	23 238	2011	49 470
Age groups: 0–4 years	0.0% (0)	5.3% (1243)	13.9% (280)	0.4% (174)
Age groups: 5–14 years	0.2% (20)	4.3% (999)	54.0% (1085)	2.9% (1418)
Age groups: 15–24 years	27.6% (2651)	25.8% (5984)	16.3% (327)	31.9% (15761)
Age groups: 25–34 years	37.5% (3598)	31.4% (7297)	4.1% (82)	28.0% (13835)
Age groups: 35–44 years	22.3% (2141)	17.9% (4157)	3.5% (70)	17.4% (8623)
Age groups: >45 years	12.4% (1194)	15.3% (3558)	8.3% (167)	19.5% (9659)
Sex: female	48.7% (4681)	62.4% (14491)	51.9% (1043)	50.9% (25187)
First-time testers	64.8% (6227)	79.3% (18428)	95.3% (1916)	90.0% (44523)
Completed all HCT components[a]	99.9% (9592/9604)	98.6% (22287/22598)	99.6% (1980/1987)	99.7% (49331/49470)
Couples HCT (% of total, *N*/Denominator)				
Tested as couple (of all clients)	12.4% (1188/9604)	3.2% (745/23238)	7.5% (150/2011)	21.6% (10671/49470)
Married or cohabiting (of all clients)	42.7% (4102/9604)	50.8% (11794/23238)	11.6% (234/2011)	60.1% (29721/49470)
Tested as couple (of all married or cohabiting clients)	29.0% (1188/4102)	6.3% (745/11794)	64.1% (150/234)	35.9% (10671/29721)

Due to occasional missing data, denominators may not match exactly in all parts of the table. HCT, HIV counseling and testing.
[a]Includes enrollment, pretest counseling, sample collection and HIV test, receipt of results, and posttest counseling.

strategies reported relatively low client HIV prevalence. For household-member HCT, the low prevalence reflected a higher proportion of clients in the 5–14-year-old age group, which had a 2.4% HIV prevalence, compared with 17.0% prevalence in those more than 24-year-old. For door-to-door HCT, the low average HIV prevalence reflected a low HIV prevalence across all age groups. Across all strategies, the peak HIV prevalence was found in the 35–44-year-old age group. Women and first-time clients also exhibited higher HIV rates. A substantial percentage (>30%) of all HIV-infected clients had advanced immunosuppression (defined as CD4 cell count below 200 cells/μl) regardless of testing strategy, and almost one-quarter of HIV-infected clients identified by hospital-based HCT had a CD4 cell count below 50 cells/μl. The door-to-door strategy identified the highest proportion (69.3%) of HIV-infected clients with a CD4 cell count above 200 cells/μl.

Couples HIV counseling and testing

Although no strategy reported more than 25% of clients testing as part of a couple, many clients who tested as individuals were married or part of a cohabiting couple. There was wide variation in the percentage of clients who were married or part of a cohabiting couple who actually undertook couples HCT, ranging from 6.3 (hospital-based HCT) to 64.1% (household-member HCT). Married or cohabiting couples in hospital-based HCT

Table 2. HIV testing results in HIV counseling and testing clients.

	Stand-alone HCT	Hospital-based HCT	Household-member HCT	Door-to-door HCT
HIV prevalence in client groups (% of total, *N*/Denominator[a])				
All clients	19.1% (1834/9579)	27.2% (6108/22482)	6.0% (121/2011)	5.1% (2502/49470)
Age group: 0–4 years	N/A (0/0)	23.2% (270/1162)	11.8% (33/280)	4.0% (7/174)
Age group: 5–14 years	35.0% (7/20)	18.0% (174/966)	2.4% (26/1085)	2.0% (29/1418)
Age group: 15–24 years	7.2% (192/2651)	16.9% (972/5755)	2.4% (8/327)	2.5% (397/15761)
Age group: 25–34 years	20.6% (742/3598)	34.7% (2451/7054)	25.9% (21/81)	7.1% (985/13835)
Age group: 35–44 years	29.9% (633/2116)	36.4% (1481/4072)	30.0% (21/70)	8.4% (724/8623)
Age group: >45 years	21.8% (260/1194)	21.9% (760/3474)	7.2% (12/167)	3.7% (360/9659)
Sex: female	23.3% (1086/4656)	27.8% (3911/14044)	6.2% (65/1042)	6.1% (1526/25187)
Sex: male	15.2% (748/4923)	26.0% (2197/8439)	5.8% (56/968)	4.0% (976/24283)
First-time tester	24.3% (1511/6227)	31.5% (5807/18428)	5.3% (101/1916)	5.3% (2350/44523)
Repeat tester	9.7% (328/3377)	10.5% (481/4568)	21.1% (20/95)	3.1% (152/4947)
Tested as couple	18.4% (218/1188)	32.4% (236/728)	27.5% (41/149)	4.0% (430/10671)
Tested as individual	19.3% (1616/8391)	27.0% (5872/21755)	4.3% (80/1861)	5.3% (2072/38799)
Immune status (% of HIV-infected clients, *N*/Denominator[b])				
CD4 cell count <200 cells/μl	48.1% (6976/14512)	47.2% (510/1081)	44.6% (871/1953)	30.7% (244/796)
CD4 cell count <50 cells/μl	19.6% (2848/14512)	24.1% (260/1081)	12.2% (238/1953)	5.7% (45/796)
Couples HCT (% of all couples, *N*/Denominator[a])				
Concordant negative	76.6% (908/1186)	55.4% (399/720)	30.2% (42/139)	94.2% (9903/10517)
Concordant positive	13.7% (162/1186)	21.8% (157/720)	28.1% (39/139)	2.3% (240/10517)
Discordant (female positive)	4.4% (52/1186)	8.1% (58/720)	12.2% (17/139)	1.2% (129/10517)
Discordant (male positive)	5.4% (64/1186)	14.7% (106/720)	29.5% (41/139)	2.3% (245/10517)
Discordant (of all HCT clients)	1.2% (116/9604)	0.7% (164/23238)	3.1% (58/1864)	0.8% (374/49470)

HCT, HIV counseling and testing.
[a]Due to occasional missing data, denominators may not match exactly in all parts of the table.
[b]Data on CD4 cell count distribution collected from a separate sample of HCT clients for each strategy.

Table 3. Cost-effectiveness comparisons.

	Stand-alone HCT	Hospital-based HCT	Household-member HCT	Door-to-door HCT
Average cost-effectiveness ratios for different outcomes[a]				
Cost per HCT client[b]	$19.26	$11.68	$13.85	$8.29
Cost per new HCT client	$29.70	$14.73	$14.54	$9.21
Cost per HIV-positive individual identified	$100.59	$43.10	$231.65	$163.93

HCT, HIV counseling and testing.
[a]Costs reported as 2007 US Dollars.
[b]Excludes clients not completing all HCT components.

and household-member HCT showed substantially higher rates of HIV discordance (Table 2), related to the high HIV prevalence in these populations, for example, hospitalized patients, or household members of people with HIV. The percentage of all clients who were part of a discordant couple ranged from 0.7% for hospital-based HCT to 3.1% for household-member HCT. It is notable that for all strategies, the infected partner was male in the majority of discordant couples.

Cost-effectiveness results

Cost-effectiveness ratios were estimated for the crude cost per client and the costs for reaching key target groups (Table 3). Each of the three nontraditional strategies compared favorably with stand-alone HCT in terms of the crude cost per client, and door-to-door HCT was the least expensive strategy per client tested. Door-to-door HCT also appeared to be the most cost-effective in terms of reaching new clients, whereas hospital-based HCT appeared superior in terms of identifying HIV-infected clients.

Discussion

The nontraditional HCT strategies we evaluated are increasingly being implemented to expand access to HIV diagnosis and prevention, care, and treatment services. Other studies have investigated the cost-effectiveness of stand-alone HCT in developing countries, but this study directly compared four different HCT strategies that a national HIV program might consider. Our results revealed clear differences between the four HCT strategies in terms of the populations served, the crude cost per client, and the relative cost-effectiveness in reaching key target groups.

Both home-based strategies were comparatively inexpensive and effective at reaching population groups with low rates of prior testing and appear to be the best strategies for addressing the first of three HIV control priorities identified earlier – expanding knowledge of HIV status in previously untested clients. In contrast, hospital-based HCT appears most effective at addressing other priorities. Hospital-based HCT identified a greater percentage of HIV-infected clients compared with other strategies, had a lower cost per HIV-infected client identified, and a high proportion had CD4 cell counts less than 50 cells/μl, and for these reasons may be the most efficient strategy for identifying HIV-infected individuals in immediate need of antiretroviral therapy. Although these individuals would be immediately eligible for treatment, research has shown poorer outcomes for individuals initiated on treatment with such advanced immunosupression. HIV-infected individuals would ideally be identified for treatment at an earlier stage of the disease, an apparent advantage of the home-based strategies. Providing HCT to HIV-positive individuals is also important for HIV prevention, and so hospital-based HCT appears a reasonable strategy for advancing both treatment and prevention goals. Stand-alone HCT also identified many infected individuals, and despite its higher cost per client was a more cost-effective strategy for identifying infected individuals than the two home-based strategies.

Household-member HCT reached many young clients aged 5–14 years with low HIV prevalence, increasing the cost per infected individual identified. In secondary analyses, we examined the potential benefits of modifying this strategy to target higher prevalence age groups (0–4-year olds and ≥20-year olds), and found that this modified household-member HCT strategy might achieve substantially improved cost-effectiveness results ($103 per HIV-positive individual identified) and provide couples counseling to many HIV-discordant couples (9% of all clients).

Couples counseling is a high-priority intervention and has strong preventive effects when received by HIV-discordant couples [14–17]. In a nationally representative survey in Uganda, 40% of all HIV-infected married persons had an HIV-negative spouse [28] and research suggests that a substantial proportion of all new infections occur within cohabiting couples [29,30]. In our analysis, the HCT strategies showed varying success at enrolling couples, and in all cases less than 50% of clients who were married or part of a cohabiting couple actually undertook testing with their partner. For all strategies, discordant couples represented less than 4% of all clients. Greater HIV-prevention effects might be possible if HCT projects are able to increase participation in couples HCT.

As this was an individual-level analysis, it does not take into account any potential population benefits of

bringing HCT to scale, such as reducing stigma, mobilizing communities to respond to the epidemic, or community-wide reductions in HIV transmission. In addition, although this study focused on the programatic costs of HCT, it is likely that increasing HCT coverage would reduce future HIV treatment costs by averting new HIV infections. This may not have been true during the early years of the epidemic response (when treatment costs were determined by the limited availability of treatment slots), but becomes increasingly plausible as HIV treatment services are scaled-up.

This study highlights the need for ongoing empirical research as HCT services expand and diversify. In particular, research is needed to clarify the durability of HCT behavior change in resource-poor settings and to confirm the behavioral impact of HCT as implemented through provider-initiated and home-based strategies. Although there have been a number of studies investigating the effects of client-initiated HCT provided through stand-alone sites, it is not clear how these effects translate to provider-initiated HCT, in which services are provided in a variety of settings to clients who are not self-selected in the same way as client-initiated HCT.

The present research was conducted in Uganda, but many features of this setting – high HIV prevalence, widespread risky sexual behavior, and limited access to HCT and HIV care and treatment services – are common to many sub-Saharan African settings. In a generalized epidemic such as this, interventions need to be expanded beyond traditional risk groups and service provision strategies to achieve population-level impact. The results suggest that in addition to stand-alone HCT, expanding new hospital-based and home-based strategies may have the cost-effective 'scalability' needed to substantially increase access. Together these strategies provide new tools for countries aiming to meet the UNAIDS/WHO call for universal access to HCT by 2010 [31].

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