

Acceptance of HIV Testing for Children Ages 18 Months to 13 Years Identified Through Voluntary, Home-Based HIV Counseling and Testing in Western Kenya

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Background: Home-based voluntary counseling and testing (HCT) presents a novel approach to early diagnosis. We sought to describe uptake of pediatric HIV testing, associated factors, and HIV prevalence among children offered HCT in Kenya.

Methods: The USAID-Academic Model Providing Access to Healthcare Partnership conducted HCT in western Kenya in 2008. Children 18 months to 13 years were offered HCT if their mother was known to be dead, her living status was unknown, mother was HIV infected, or of unknown HIV status. This retrospective analysis describes the cohort of children encountered and tested.

Results: HCT was offered to 2289 children and accepted for 1294 (57%). Children were more likely to be tested if more information was available about a suspected or confirmed maternal HIV infection [for HIV-infected living mothers odds ratio (OR) = 3.20, 95% confidence interval (CI): 1.64 to 6.23], if parents were not in household (OR = 1.50, 95% CI: 1.40 to 1.63), if they were grandchildren of head of household (OR = 4.02, 95% CI: 3.06 to 5.28), or if their father was

not in household (OR = 1.41, 95% CI: 1.24 to 1.56). Of the eligible children tested, 60 (4.6%) were HIV infected.

Conclusions: HCT provides an opportunity to identify HIV among high-risk children; however, acceptance of HCT for children was limited. Further investigation is needed to identify and overcome barriers to testing uptake.

Key Words: barriers to testing, HIV, home-based testing, pediatrics
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INTRODUCTION

To initiate timely HIV treatment and ensure widespread prevention of further infections, a person must first know his or her HIV status.¹ Early diagnosis and treatment is particularly important within pediatrics since HIV-infected children face very high mortality rates in the first few years of life. Without treatment, approximately 50% of HIV-infected children die before the age of 2, with mortality rates as high as 75% by 5 years of age.^{2,3} In regions such as sub-Saharan Africa, where a high incidence of infection is coupled with limited resources, the early diagnosis of HIV-infected children is critical for optimal therapy and effective public health planning.⁴

Despite the critical importance of testing at-risk children for HIV, acceptance of pediatric testing among caregivers and children in sub-Saharan Africa has not yet been well studied. In a study of free inpatient HIV testing in Uganda, testing was offered to all adults and children who were admitted to participating units in the hospitals and who had not had previous HIV testing.⁵ The overall uptake for testing was 98%, but this statistic was not broken down by age and does not specify children's testing uptake. The prevalence of HIV was 28% in the 39,037 patients who had never been tested before and 9% in those who had previously tested negative.⁵ Of the 10,439 family members offered testing, 9720 (93%) accepted and 20% were HIV infected.⁵ Outpatient testing programs may differ from inpatient testing programs in both the uptake of testing and prevalence of HIV. In an evaluation of a program offering HIV counseling and testing for outpatients seen at a rural hospital in Tanzania, children constituted 6.6% of the 4353 individuals tested.⁶ One thousand sixty-nine (24.6%) of

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those tested were HIV infected, and 83 of these (7.8%) were children.⁶ In a study of an outpatient program in Malawi offering HIV testing with acute malnutrition care, 92% of the children presenting for nutrition services also were tested for HIV, and HIV prevalence was 3%.⁷ In the inpatient setting of the same program, 97% of caregivers accepted HIV testing for children admitted with malnutrition, and HIV prevalence was 21.6%.⁸ The uptake of testing in settings where patients also receive other forms of care or service may differ significantly from the uptake of testing in the general community.

Community-based or population-based HIV testing may allow identification of HIV-infected children before they exhibit signs or symptoms of illness, enabling earlier treatment and more effective prevention. One such approach is Home-Based Voluntary Counseling and Testing (HCT).⁹ The Academic Model Providing Access to Healthcare (AMPATH) is a large clinical care system that has enrolled over 113,000 HIV-infected adult and pediatric patients in western Kenya.¹⁰ In 2007, AMPATH initiated HCT in western Kenya.¹¹ AMPATH implemented a form of HCT that includes the administration of a rapid, in-home HIV test for adults and children above 18 months, immediate disposition of the test results, posttest counseling and appropriate referral—all during 1 visit to a household.¹² In this article, we report the acceptance rates, associated characteristics, and results of HIV testing for at-risk children 18 months to 12 years of age within a program of HCT implemented in the Turbo Division in western Kenya.

METHODS

Study Design

This retrospective study used data collected through the HCT initiative of the AMPATH clinical care system in western Kenya. The study was approved by the Institutional Research and Ethics Committee of the Moi University School of Medicine (Eldoret, Kenya) and the Institutional Review Board of the Indiana University School of Medicine (Indianapolis, IN).

Setting

AMPATH began in 2001 as a partnership between Moi University School of Medicine, Moi Teaching and Referral Hospital (Eldoret, Kenya), and the Indiana University School of Medicine (Indiana).^{12,13} AMPATH currently provides comprehensive HIV care, including free antiretroviral therapy, for over 101,000 HIV-infected and HIV-exposed adult and pediatric patients in 23 clinics and 23 clinic satellites throughout western Kenya.¹² AMPATH actively provides care for more than 14,800 children under the age of 14 years (as of May 15, 2010).

AMPATH piloted implementation of HCT in the Kosirai Division of the Nandi North District of the Rift Valley Province in 2007, and then rolled HCT out into the Turbo Division of the Uasin Gishu District of the Rift Valley Province in 2008. This division is considered representative of the ethnic groups and socioeconomic strata of many rural divisions in western Kenya and is the site of an AMPATH clinic caring for 5340 patients, including 989 children. Time constraints resulted in the implementation of 2 separate phases

of HCT in the Turbo Division, the first occurring June to December 2008, and the second in January to June 2009. We examined data collected in the first phase of the Turbo rollout, the first broad implementation of HCT in Kenya.

HCT Door-to-Door Program of Testing

AMPATH sought to establish a strong partnership with the target division to effectively implement population-wide HCT in Turbo.¹¹ AMPATH conducted community focus group discussions and worked with community leaders to prepare for visits. Mobilization teams, comprised of respected community members, disseminated information about HIV, AMPATH's services, and the HCT program during visits to every household in their respective villages. They also requested permission for trained counselors to subsequently visit the home and offer counseling and testing for HIV.

All consenting adult household members (those 13 years and older) were eligible for testing. Children less than 13 years of age were deemed eligible for testing if they met 1 or more of the following criteria: mother known to be dead; mother's living status not known; mother HIV infected; or mother's HIV status unknown. The mother's HIV status was determined through HCT testing or prior documentation of a positive HIV test. Parents/guardians could also choose to have children who did not meet the eligibility criteria tested. For children older than 18 months, HIV testing used parallel tests, the Determine HIV-1/2 rapid assay (Abbott Laboratories, Abbott Park, IL) and SD Bioline HIV-1/2 3.0 rapid assay (Standard Diagnostics Inc., Kyonggi-do, South Korea). If the results were discordant, a tie-breaking test was done using the UniGold HIV test (Trinity Biotech, Dublin, Ireland) rapid assay. Posttest counseling was provided for everyone, and all children with positive test results were referred to AMPATH. Children younger than 18 months require DNA polymerase chain reaction (PCR) testing for HIV because they may have circulating maternal antibodies in their blood, for which a rapid test was not available. Thus, the parents or guardians of eligible children younger than 18 months received counseling and were referred to the AMPATH Turbo clinic for the children to have DNA PCR testing for HIV. Because testing for children younger than 18 months was not conducted within the immediate context of HCT, they were excluded from the analyses. The parents and guardians of both HIV-infected and HIV-uninfected children were counseled on risk-lowering behaviors, such as using condoms and repeated testing.

Data Collection and Measures

Personnel conducting HCT carried Palm T|X Personal digital assistant (PDA) devices (Palm Inc, Sunnyvale, CA) that were used to enter information into data-collection forms programed with Pendragon Forms Software (DDH Software, Inc, Wellington, FL). Data collected included individual demographic and household information and HIV testing results. Data were transferred to a Microsoft Access database (Microsoft Corp, Redman, Washington, DC) by synchronizing the PDAs to a dedicated server.

Data Analysis

We described the demographic and household characteristics of the cohort of children approached in Phase One of Turbo HCT, focusing on acceptance of HIV testing and HIV prevalence. We performed multivariable logistic regression to assess the association between odds of accepting HIV testing for children and mother risk category, controlling for gender, age, whether both parents were in the household, child's relationship to head of home, father's HIV status, father's living status, whether the child had been completely immunized (by immunization card or by caregiver report), and whether the child had a previous HIV test. Mother risk was defined as an ordered categorical variable (0 = Mother HIV uninfected and alive; 1 = Mother HIV unknown and alive, 2 = Mother HIV uninfected or HIV unknown and living status unknown; 3 = Mother HIV uninfected or HIV unknown and dead; 4 = Mother HIV infected and alive; and 5 = Mother HIV infected and dead or living status unknown). We assessed whether a higher mother risk category was statistically significantly associated with an increased odds of accepting HIV testing by including the ordered categorical variable mother risk category as a continuous variable (test of trend). Stratified analyses were done to determine whether socio-demographic characteristics were differentially associated with the odds of accepting testing by mother risk category. We tested the statistical significance of interactions using likelihood ratio tests. All models calculated 95 percent confidence intervals (CIs) based on robust variance estimates. All statistical analyses were performed using Stata MP 10.1 for Windows (Stata Corp, College Station, TX).

RESULTS

The HCT effort in the Turbo Division identified a total of 57,466 household residents. Of these, 15,513 were children aged less than 13 years, and 12,862 were between the ages of 18 months and 13 years. 49.2% were female, and 88.6% had their parents in the household. Of these 12,862 children, HCT was indicated for 2289 children (Fig. 1).

Of the 2289 children for whom testing was indicated, HIV testing was accepted for 1294 children (57%) (Fig. 1). Among all children for whom testing was indicated, higher percentages of children in the tested group did not have parents living with them; were grandchildren of the head of household (compared with being children of the head of household, other relatives of the head of household, or nonbiological relations to the head of household); had a father who had died, had living status was unknown, or was HIV-infected; and had their immunization unknown (Table 1). Higher percentages of children ages 5–12 years had HIV testing than did children who were less than 5 years of age. In multivariate logistic regression, eligible children were less likely to be tested for HIV if their mother was alive and had an unknown HIV status (OR = 0.34, 95% CI: 0.18 to 0.66), if they lived with both parents (OR = 0.50, 95% CI: 0.40 to 0.63), or if they had previously been tested for HIV (OR = 0.30, 95% CI: 0.19 to 0.46). Children were more likely to be tested if more information was available about a suspected or confirmed maternal HIV infection (for HIV infected, living mothers,

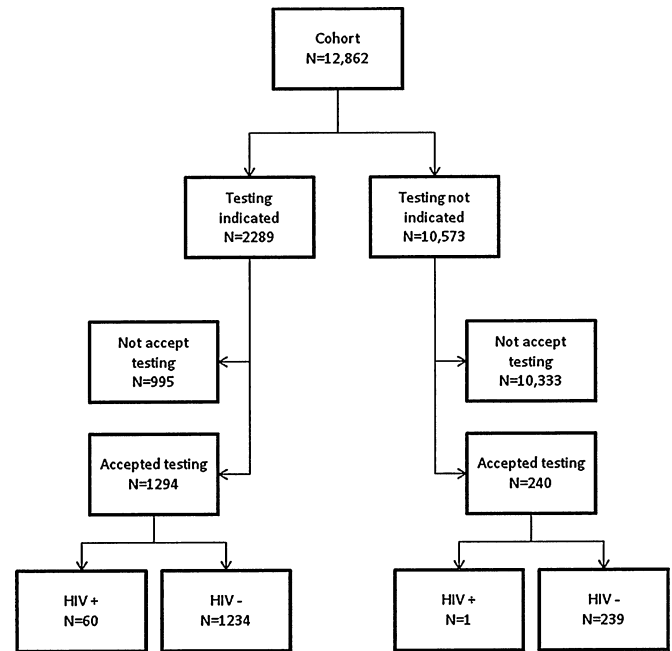


FIGURE 1. Acceptance of pediatric HIV testing through HCT in Turbo, Kenya.

OR = 3.20, 95% CI: 1.64 to 6.23) or if they were not the child of the head of household. For example, grandchildren of the head of household were more likely to receive HIV testing (OR = 4.02, 95% CI: 3.06 to 5.28). Children were more likely to get tested if both of their parents were absent from the household (OR = 1.50, 95% CI: 1.40 to 1.63) or if their father was not in the household (OR = 1.41, 95% CI: 1.24 to 1.56). Gender; father's HIV status; being related to the head of the household as a sibling, househelp, or "other" relationship; child's age; child's immunization status; having a mother whose living status and HIV status are unknown; and having a dead mother with unknown or negative HIV status were not significantly associated with uptake of testing in the multivariable logistic regression.

Of the 1294 children for whom testing was indicated and whose parents/guardians accepted testing, 60 (4.6%) of the children were HIV infected (Table 2). Positive HIV tests in children were more common among the children with mothers known to be HIV infected; 9% of the children with HIV-infected living mothers tested positive and 13% of those with HIV-infected, deceased or unknown living status mothers tested positive (Table 2).

As previously described, the mother's risk factors defined whether or not testing was indicated for children. Parental/guardian acceptance of testing varied with the mother's specific risk factors within the general indication for testing (Table 3). The odds of accepting testing for a child was increased with higher values of the mother risk variable, with $P < 0.001$ for the test of trend. This remained significant even when excluding those children whose mothers were alive and known to be HIV uninfected and adjusting for the other variables ($P < 0.01$). Children whose mothers were alive but

TABLE 1. Characteristics of Children Identified Through HCT

	Testing Not Indicated		Testing Indicated			
	Mother Alive, HIV Negative		Testing Indicated, Not Tested		Testing Indicated, Tested	
	n = 10,573		n = 995		n = 1294	
	n	%	n	%	n	%
Gender						
Female	5232	49.5	462	46.4	637	49.2
Male	5341	50.5	533	53.6	657	40.8
Age (yrs)						
1	1073	10.1	76	7.6	68	5.2
2	1707	16.1	128	12.9	113	8.7
3	1428	13.5	135	13.6	141	10.9
4	1245	11.8	99	9.9	125	9.7
5	988	9.3	99	9.9	127	9.8
6	809	7.7	74	7.4	107	8.3
7	679	6.4	64	6.4	102	7.9
8	726	6.9	90	9.0	119	9.2
9	518	4.9	58	5.8	94	7.3
10	543	5.1	71	7.1	117	9.0
11	395	3.7	43	4.3	89	6.9
12	462	4.4	58	5.8	92	7.1
Parents in household						
No	608	5.8	273	27.4	586	45.3
Yes	9,965	94.2	719	72.3	708	54.7
Missing	0	0.0	3	0.3	—	—
Household status						
1	9687	91.6	621	62.4	608	47.0
2	605	5.7	287	28.8	529	40.9
3	134	1.3	25	2.5	17	1.3
4	22	0.2	15	1.5	46	3.6
5	40	0.4	27	2.7	60	4.6
6	3	0.0	5	0.5	7	0.5
8	4	0.0	0	0.0	0	0.0
9	13	0.1	6	0.6	15	1.1
Missing	65	0.6	9	0.9	12	0.9
Father HIV status						
No	5220	49.4	214	21.5	218	16.8
Yes	95	0.9	73	7.3	171	13.2
Unknown	5258	49.7	708	71.2	905	69.9
Father died						
No	9996	94.5	796	80.0	941	72.7
Yes	317	3.0	86	8.6	178	13.8
Unknown	260	2.5	113	11.4	175	13.5
Child immunized						
No	91	0.9	6	0.6	16	1.2
Yes	5360	50.7	419	42.1	413	31.9
Unknown	5122	48.4	570	57.2	865	66.8

had unknown HIV status (n = 1283) were more likely to be tested if they were older, if they did not have parents in the household, if they were not the children of the head of the household, or if their fathers were dead or living status was unknown (Table 3). If their fathers were known to be HIV uninfected, then these children were less likely to be tested.

TABLE 2. HIV Test Results Among Children Tested in HCT

Group based on Mother Risk	HIV Negative		HIV Positive	
	N	% of Group	N	% of Group
Mother: HIV unknown and alive	579	99.1	5	0.9
Mother: HIV uninfected or unknown and living status unknown	52	100.0	0	0.0
Mother: HIV uninfected or unknown and dead	132	95.7	6	4.3
Mother: HIV infected and alive	424	91.0	42	9.0
Mother: HIV infected and dead or unknown	47	87.0	7	13.0
Total among those tested	1234	95.8	60	4.7

Children who had deceased mothers or for whom the mother's living status was unknown and the mother's HIV status was negative or unknown (n = 299) were more likely to be tested if they were older; if they did not have parents in the household; if they were not the children of the head of household; if their father's HIV status was unknown; if their father had died or had an unknown living status; or if the child's immunization status was unknown.

Among children whose mothers were alive and HIV infected (n = 635), there were no prominent differences in demographics between those who were tested and those who were not, except that those not tested had more often had a previous HIV test and were less likely to have known immunization status (Table 3). The groups were similar in regard to gender; age; the presence of parents in the household; relationship to the head of household; and father's HIV and living status. Among children whose mothers were dead or of unknown living status but known to be HIV infected (n = 72), older children, children whose parents were not in the household, those who were not the children of the head of the household, children whose fathers had died, and children with unknown immunization status were tested more often.

In 10,573 cases, HCT testing was not indicated for the children because the child's mother was both alive and HIV uninfected. Children for whom testing was not indicated differed from the children for whom testing was indicated in other ways besides having a living, HIV-uninfected mother (Table 1). These children were also younger, more likely to have a mother or a father in the household, and more likely to be children of the head of the household. They more often had living HIV-uninfected fathers and were described as fully immunized. Thirty-two children for whom testing was not indicated had had a prior HIV test (0.2%). Caregivers opted to have testing for 239 children for whom testing was not indicated; 1 was found to be HIV infected.

DISCUSSION

HCT provides a unique opportunity to identify HIV infection early in the disease course, enabling the provision of early treatment and enhancing possibilities for prevention of

TABLE 3. Acceptance of Pediatric HIV Testing Based on Mother’s Risk Factors

	Mother: HIV Unknown and Alive (1)				Mother: HIV Infected or Unknown and Living Status Unknown or Dead (2 + 3)			
	Not tested		Tested		Not Tested		Tested	
	n = 699		n = 584		n = 109		n = 190	
	n	%	n	%	n	%	n	%
Child’s gender								
Female	321	45.9	295	50.5	45	41.3	91	47.9
Male	378	54.1	289	49.5	64	58.7	99	52.1
Child’s age								
18 months to <24 months	58	8.3	23	3.9	3	2.8	7	3.7
2 years to 2 years 11 months	96	13.7	48	8.2	14	12.8	16	8.4
3 years to 3 years 11 months	105	15.0	53	9.1	14	12.8	18	9.5
4 years to 4 years 11 months	70	10.0	50	8.6	10	9.2	18	9.5
5 years to 5 years 11 months	63	9.0	54	9.2	9	8.3	16	8.4
6 years to 6 years 11 months	55	7.9	56	9.6	9	8.3	16	8.4
7 years to 7 years 11 months	35	5.0	51	8.7	9	8.3	10	5.3
8 years to 8 years 11 months	62	8.9	54	9.2	13	11.9	17	8.9
9 years to 9 years 11 months	38	5.4	45	7.7	7	6.4	14	7.4
10 years to 10 years 11 months	47	6.7	57	9.8	9	8.3	22	11.6
11 years to 11 years 11 months	32	4.6	49	8.4	6	5.5	15	7.9
12 years to 12 years 11 months	38	5.4	44	7.5	6	5.5	21	11.1
Both parents in household								
No	197	28.2	321	55.0	41	37.6	145	76.3
Yes	502	71.8	263	45.0	65	59.6	45	23.7
Missing	0	0.0			3	2.8		
Child’s relationship to head of house								
Child	397	56.8	139	23.8	62	56.9	42	22.1
Grandchild	235	33.6	384	65.8	29	26.6	89	46.8
Sibling	18	2.6	10	1.7	6	5.5	3	1.6
Foster or Stepchild	12	1.7	11	1.9	3	2.8	28	14.7
Niece, Nephew, Cou	21	3.0	31	5.3	5	4.6	14	7.4
Househelp	4	0.6	4	0.7	1	0.9	1	0.5
Self	0	0.0	0	0.0	0	0.0	0	0.0
Other	4	0.6	0	0.0	2	1.8	12	6.3
Missing	8	1.1	5	0.9	1	0.9	1	0.5
Father HIV status								
No	146	20.9	93	15.9	41	37.6	35	18.4
Yes	8	1.1	11	1.9	4	3.7	7	3.7
Unknown	545	78.0	480	82.2	64	58.7	148	77.9
Father died								
No	577	82.5	452	77.4	79	72.5	94	49.5
Yes	41	5.9	48	8.2	9	8.3	35	18.4
Unknown	81	11.6	83	14.2	21	19.3	61	32.1
Child immunized								
No	3	0.4	4	0.7	1	0.9	6	3.2
Yes	314	44.9	165	28.3	39	35.8	43	22.6
Unknown	382	54.6	415	71.0	69	63.3	141	74.2
Previous HIV test								
No	695	99.4	581	99.5	105	96.3	185	97.4
Yes	4	0.6	3	0.5	4	3.7	5	2.6
HIV results								
Negative			579	99.1			184	96.8
Positive			5	0.9			6	3.2

TABLE 3. (continued) Acceptance of Pediatric HIV Testing Based on Mother's Risk Factors

	Mother: HIV Infected and Alive (4)				Mother: HIV Infected and Living Status Unknown or Dead (5)			
	Not Tested		Tested		Not Tested		Tested	
	n = 169		n = 466		n = 18		n = 54	
	n	%	n	%	n	%	n	%
Child's gender								
Female	86	50.9	226	48.5	10	55.6	25	46.3
Male	83	49.1	240	51.5	6	44.4	29	53.7
Child's age								
18 months to <24 months	15	8.9	36	7.7	0	0.0	2	3.7
2 years to 2 years 11 months	17	10.1	48	10.3	1	5.6	1	1.9
3 years to 3 years 11 months	15	8.9	70	15.0	1	5.6	0	0.0
4 years to 4 years 11 months	17	10.1	52	11.2	2	11.1	5	9.3
5 years to 5 years 11 months	26	15.4	54	11.6	1	5.6	3	5.6
6 years to 6 years 11 months	8	4.7	33	7.1	2	11.1	2	3.7
7 years to 7 years 11 months	18	10.7	36	7.7	2	11.1	5	9.3
8 years to 8 years 11 months	11	6.5	38	8.2	4	22.2	10	18.5
9 years to 9 years 11 months	13	7.7	33	7.1	0	0.0	2	3.7
10 years to 10 years 11 months	13	7.7	29	6.2	2	11.1	9	16.7
11 years to 11 years 11 months	4	2.4	17	3.6	1	5.6	8	14.8
12 years to 12 years 11 months	12	7.1	20	4.3	2	11.1	7	13.0
Both parents in household								
No	25	14.8	75	16.1	10	55.6	45	83.3
Yes	144	85.2	391	83.9	8	44.4	9	16.7
Missing	0	0.0			0	0.0		0.0
Child's relationship to head of house								
Child	154	91.1	421	90.3	8	44.4	6	11.1
Grandchild	14	8.3	31	6.7	9	50.0	25	46.3
Sibling	1	0.6	3	0.6	0	0.0	1	1.9
Foster or Stepchild	0	0.0	1	0.2	0	0.0	6	11.1
Niece, Nephew, Cou	0	0.0	4	0.9	1	5.6	11	20.4
Househelp	0	0.0	1	0.2	0	0.0	1	1.9
Self	0	0.0	0	0.0	0	0.0	0	0.0
Other	0	0.0	2	0.4	0	0.0	1	1.9
Missing	0	0.0	3	0.6	0	0.0	3	5.6
Father HIV status								
No	24	14.2	88	18.9	3	16.7	2	3.7
Yes	52	30.8	121	26.0	9	50.0	32	59.3
Unknown	93	55.0	257	55.2	6	33.3	20	37.0
Father died								
No	130	76.9	382	82.0	10	55.6	12	22.2
Yes	30	17.8	62	13.3	6	33.3	33	61.1
Unknown	9	5.3	22	4.7	2	11.1	9	16.7
Child immunized								
No	2	1.2	6	1.3	0	0.0	0	0.0
Yes	62	36.7	198	42.5	4	22.2	7	13.0
Unknown	105	62.1	262	56.2	14	77.8	47	87.0
Previous HIV test								
No	131	77.5	425	91.2	9	50.0	45	83.3
Yes	38	22.5	41	8.8	9	50.0	9	16.7
HIV results								
Negative			424	91.0			47	87.0
Positive			42	9.0			7	13.0

transmission. Implementation of HCT in the Turbo Division of western Kenya used the mother's risk factors, specifically HIV status and living status, to identify children at high risk for HIV infection. In contrast to the testing of adults in this program, where 95% of adults accepted testing,¹¹ caregivers refused HIV testing for almost half of these high-risk children, underscoring the need to improve home-based pediatric HIV testing. Children with HIV-infected mothers, children who did not have parents in the household, and those who were not the children of the head of household were more likely to get HIV tests. Given the rates of HIV among those who were tested, there may be many HIV-infected children who remain undiagnosed if no community-based testing is available or if these testing options are refused.

The findings underscored that maternal HIV and living status are key indicators of a child's HIV risk, both in terms of caregivers' willingness to have the child tested and in terms of HIV prevalence. As the mother's risk factors increased, so did the likelihood of testing and of HIV infection. The children of mothers known to have HIV infection and/or known to be dead were most likely to be tested, and children with mothers known to be HIV infected were more likely to be HIV infected as well. Many children with HIV-infected mothers did remain untested, and these children had minimal differences in demographic characteristics from those with HIV-infected mothers who were tested. Thus, it is possible that HIV diagnoses were missed among the children for whom testing was refused. If all children who were considered high risk for HIV had been tested and if they had had an equal risk of HIV infection as the other children who were tested, 46 (2%) more pediatric HIV cases may have been identified.

This study found that almost half of caregivers did not consent to have high-risk children tested for HIV in HCT. The acceptance of testing varied with the child's position in the household, in particular with their relationship to the head of household and whether or not their fathers were alive or HIV infected. Children who did not have both parents in the household and who were not the children of the head of the household were more likely to get tested. This suggests that orphaned children living with extended family may be more likely to be tested for HIV than children still living with their biological parents. This could reflect that the caregivers of these children are less concerned about the stigma associated with HIV testing or the child's HIV status. Biological caregivers also may not consent to testing because of feelings of guilt over potentially being the source of the child's infection. Children with an HIV-infected or deceased father may have been tested more often because they were seen as being at greater risk for HIV given their father's potential or known HIV status or the possibility that the father may have died from HIV. There was also a trend for older children to be more likely to get tested. Parents may be more apt to test older children for multiple reasons: older children manifesting more illnesses or signs of infection with age, concerns about increasing risk of transmitting infection as sexual debut draws closer, or feeling that an older child is better able to handle the diagnosis psychologically and emotionally. This would be in line with previous research, where caregivers refused testing for children because of fear that they were not psychologically

ready or because the children were still healthy.⁷ With increased antenatal HIV testing, it is also possible that younger children and their mothers were more likely to have received antenatal counseling and testing previously. Having previous testing was a reason for not accepting another HIV test described for both adults and children in the study of inpatient HIV testing in Uganda.¹⁴

Fear of stigma and discrimination in the community also may have played a role in the refusal of testing. Because testing was only offered to high-risk children, and not to every child in every household, parents and caregivers may have been afraid that accepting testing for the children would signal to their neighbors that the household had some risk factor for HIV. In this setting, parents often avoid informing children about their HIV diagnosis or keep HIV medicines hidden because they are afraid that the child will tell others.¹⁵ Similarly, fear that the child would report that they were tested could have influenced parents' willingness to accept the testing. Alternatively, individual, family, or community factors, not measured by this program, may have influenced testing. For example, the acceptance of testing for children may be related to perception of access to care or to varying experiences of clinical disease in the mother or child.

These outcomes underscore the need to further investigate caregivers' reasons for refusing pediatric testing so that we do not miss important opportunities to detect HIV within high-risk pediatric populations. More open-ended or qualitative techniques may be needed to illuminate the impact of social stigma; beliefs about pediatric HIV acquisition, treatment, or prognosis; issues about consenting for children's testing; concerns about the emotional impact of testing positive; or logistic challenges to pediatric testing and care access. Better understanding caregiver rationales for refusing or accepting testing will help identify interventions to increase pediatric testing uptake and ultimately improve treatment and prevention.

There are several potential limitations to our study. One limitation is that children were considered eligible or not eligible for testing based on the characteristics of their mother. A child's own risk factors or their health status were neither taken into account nor was the testing aimed universally for all child household members as it was for adult household members. Whether or not a child was sick or other characteristics about the child may have offered appropriate criteria for offering testing that also may have influenced caretakers' decisions. Nonetheless, the maternal characteristics clearly did play an important role in determining at risk children. Another limitation is that we were unable to offer testing for the youngest children, those younger than 18 months, who are also the most in need of early treatment if HIV infected. These children could not be tested within their homes because of the need for a nonrapid, DNA PCR test to distinguish maternal antibodies from child antibodies. Prevalence of HIV among these children and follow-up of testing uptake with the need for a specialized referral would be interesting outcomes, but are not data captured in the scope of this investigation. Another limitation is that some households in the target community, and some individuals within the households, were missed during the "Turbo Phase One" testing and approached and possibly tested during "Phase Two". Nonetheless, there was no indication of any selection bias in who was recruited in each phase. Moreover, Phase One data still reflect a large community

sample, with more than 57,000 household residents counseled and offered testing. Another potential limitation is that our analyses were limited to quantitative data collected during brief household visits. Although additional individual or household characteristics may have been of interest, we could only examine the data recorded. A final limitation of this study is that it occurred in a specific geographical and cultural area, which may not be generalizable to other regions. However, as other resource-limited settings move to scale-up HIV testing for larger populations and using community-based approaches, these results underscore the importance of considering how uptake of pediatric testing can be maximized for this vulnerable population.

In conclusion, home-based counseling and testing offers an important method for identifying the HIV-infected children early in their disease course. Maximizing the uptake of pediatric HIV testing for this vulnerable population will ensure optimal therapy and effective public health interventions to prevent transmission. Although we were able to test almost 1300 children and to identify 60 new pediatric HIV cases through HCT in a single community, HIV testing was not accepted for almost half of the high-risk children to whom testing was offered. In addition to the mother's HIV status and living status, whether or not the children had parents in the household and their relationship to the head of the household seemed to play an important role in whether their caregivers accepted HIV testing for the children. When parents or guardians refuse to test even high-risk children for HIV, urgent attention needs to be paid to identifying the caregivers' barriers to pediatric testing and overcoming these barriers.

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