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## Outcome of HIV Testing Among Family Members of Index Cases Across 36 Facilities in Abidjan, Côte d'Ivoire

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### Abstract

In Côte d'Ivoire, the Family Approach to Counseling and Testing (FACT) program began in 2015 and provides facility-based HIV testing to the sexual partners, children and other household family members of HIV-positive index cases. We evaluated whether the FACT program is an effective approach to HIV case finding. We reviewed 1762 index patient charts to evaluate outcomes of the FACT program, held across 36 facilities in Abidjan. Index cases enumerated a total of 644 partners, 2301 children and 508 other family members including parents and siblings. Among the partners tested for HIV, the positivity rate was 21%; for children the positivity rate was 5% and for all other family members the positivity rate was 11%. Offering HIV testing services to the family members of HIV positive index cases is an effective approach to case finding in Côte d'Ivoire. Particularly, offering HIV testing to the partners of positive women index cases can be key to identifying previously undiagnosed men and linking them to treatment.

### Keywords

HIV; HIV testing; Index contact testing; Contact tracing; Partner notification

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**Conflict of interest** The authors declare that they have no conflicts of interest.

**Ethical Review** The FACT activity was carried out according to national policies and procedures on human subject protections, upheld by Côte d'Ivoire's National Ethics and Research Committee (CNER) under the Ministry of Health and Public Hygiene. The analysis was approved by the Human Research Protection Coordinator of the Center for Global Health, Centers for Disease Control and Prevention (CDC).

## Introduction

Côte d'Ivoire has a population of 22.6 million and Abidjan, the economic capital of Côte d'Ivoire, has a population of 4.7 million. Adult HIV prevalence in the country is estimated at 2.8%, the highest among countries in the West Africa region [1]. UNAIDS estimates suggest that 500,000 adults and children are living with HIV in Côte d'Ivoire, of which 225,839 are receiving ART [1]. Since 2004, Côte d'Ivoire offers its population free healthcare for the management of HIV infection including HIV testing, consultations, ARV treatment and laboratory tests. A recent population-based HIV impact assessment (PHIA) survey in Côte d'Ivoire suggests that 37% of adults (15–64) are aware of their positive HIV status, highlighting substantial gaps towards achieving HIV epidemic control [2]. Given resource constraints, targeted HIV case identification strategies are needed to reach the remaining individuals with undiagnosed HIV infection.

This study evaluates the outcomes of the Family Approach to Counseling and Testing (FACT) program in Côte d'Ivoire. The FACT program, which began in 2015, provides facility-based HIV testing to the main partner, children and other household family member of HIV-positive index cases. Family-centered HIV care models have been implemented and evaluated, mainly in the context of treatment for children living with HIV [3]. Also, family-centered prevention models have been evaluated and tend to focus on assessing outcomes for mothers and children in family planning clinics and maternal health clinics [4–6].

The WHO's guidelines on HIV partner services, also known as index contact testing or partner notification, were issued in 2016 [7], subsequent to the start of the FACT program. HIV partner services consist in offering voluntary HIV testing services to sexual and/or drug injecting partners of people with HIV. Several studies have demonstrated the effectiveness of HIV index contact testing for identifying new cases of HIV among adults, with positivity rates ranging from 35 to 62% [8–12]. Studies also show new case identification rates among children of HIV positive index cases ranging from 4 to 18% [13–16]. Index contact testing may be a relatively cost-effective approach to HIV case finding, particularly among those who would not otherwise access health care services. Economic studies of HIV index contact testing in resource constrained settings suggest that such interventions are cost-effective [17, 18]. To gauge the effectiveness of the FACT program, we examined the number of family members enumerated, tested, and linked to care and treatment initiation through the program across 36 sites, in Abidjan, between June 2015 and December 2016. We also evaluated the association between the characteristics of the index case and the family member testing positive.

## Methods

### Setting

The FACT program provides facility-based HIV testing to the family members of index patients and enables linkage to care and treatment for those newly identified cases. The FACT program has been implemented throughout 96 primary health care facilities supported by the Ariel Glaser Foundation in Côte d'Ivoire. The process begins during clinical consultations and psychosocial support meetings, where trained HIV counselors and health

care providers sensitize HIV-infected adult patients, and the parents or guardians of HIV infected children, about the importance of getting their family members tested for HIV. Following oral consent, an HIV counselor conducts an enumeration interview with the index case, or for minors, with their parents or guardians. During this interview, a family tree within the index client's chart, is used to record all household family members, their gender, age, HIV status, ART status for those who are HIV-positive, and relationship to the index case. For each family member enumerated, whose HIV status is reported as negative or unknown, index clients are asked to refer and/or accompany their family members to the health care facility for HIV testing. Family members presenting at HIV testing points within the health care facilities are tested by HIV counselors, according to Côte d'Ivoire's National HIV testing guidelines [19]. During HIV post-test counselling, family members who test HIV-positive are linked to HIV treatment services and offered support for voluntary disclosure of their HIV status to their sex partners. HIV counselors also update the family member's HIV status record in the family tree within the index patient's chart accordingly. At the index cases' subsequent clinical consultation, routinely within one to three months, providers review the family tree and, as needed, encourage the index patient to refer additional family members for testing until all their family members of negative or unknown HIV status are tested.

### Data Collection

We selected 36 HIV care and treatment sites, from a total of 96, as a convenience sample located in and around Abidjan. Between May and June 2017, we conducted a retrospective chart review of all 1762 HIV-positive index patients across those 36 sites who had participated in the FACT program. Seventy-four community counselors and 17 social workers abstracted data routinely collected from June 2015 to December 2016, including socio-demographic variables such as age, nationality, religion, education, and marital status of the index patient, as well as clinical factors such as length of knowledge of HIV status, HIV type and length of time on antiretroviral therapy (ART). Information on family members was also abstracted from the index charts and was limited to: relationship to the index case, sex, age group (under 15 or 15 and older), and, HIV test, linkage and treatment outcomes, following FACT.

### Data Analysis

Descriptive statistics were generated for the index cases, stratified by gender, using complex survey procedures to account for clustering by facility where data were collected [20], and included information on demographics, clinical care, and number of family members referred. We classified family members into three main types according to their relationship to the index case: partner, biological child, and other family member. The "others" type of family member included: father, mother, sibling, cousin, niece or nephew, and unspecified. Eleven HIV-positive index cases under 15 years of age were reported to have enumerated children of their own; data were verified and it was confirmed that these represented siblings of the minor index case and thus data were recoded as such.<sup>1</sup>

We estimated the number of persons having been referred, tested, testing positive, linked to care and, initiated on ART, by type of family member and by relationship to the index case.

The positivity rate or yield of HIV testing was calculated as the percentage of HIV positive tests among all HIV family members tested in the FACT program.

To determine the risk factors associated with referring an HIV-positive versus HIV-negative family member, we created three distinct univariable and, subsequently, multivariable models examining relationships between index cases and referring HIV-positive partners, children, and “others”. Logistic regression was used for the multivariable model to identify only those variables related to HIV positivity; those significant at the 0.1 level remained in the model. Where needed, variables with high degrees of missing data were removed, and data with sparse distributions were collapsed to allow for better fitting model construction. The following variables regarding the index case were considered for inclusion into the model: age, sex, nationality, education level, marital status, years on ART (if at all), and length of knowledge of HIV status.

All data cleaning and analysis was performed using SAS version 9.4 (SAS Institute Inc., Cary, NC).

This activity was carried out according to national policies and procedures on human subject protections, upheld by Côte d’Ivoire’s National Ethics and Research Committee (CNER) under MSHP.

## Results

### Number of Family Members Enumerated, Tested, and Linked to Care and Treatment Initiation

Patient charts of 1762 HIV-positive index cases from 36 facilities were reviewed, of which 80% were men. Demographic and clinical characteristics of the index cases are presented in Table 1 and account for facility clusters. The mean age of index cases was 37. Over three-quarters of index cases were of Ivoirian nationality (78%), approximately one-third (37%) had no formal education, and the majority were married or in a relationship (66%). Nearly all index cases were on ART (96%) and the mean time on ART was 40 months.

Overall, 39% of index cases referred one partner, while 2% referred two; more than half (58%) of all participants did not refer any partners (Table 2). Adult men referred fewer partners (36% referred one partner and 2% referred more than one), than adult women (64% referred one partner and 4% referred more than one). Among adult index cases 68% of women and 83% of men referred one or more children. Most index cases (82%) did not refer other family members; however, at least one other family member was reported for all but two index cases less than 15 years.

Of the 644 partners referred, 483 (75%) were tested and 103 (21%) tested positive. Of those, 92 (89%) registered for HIV care, and 91 (99%) initiated ART (Fig. 1). Of the 2301 children referred for testing, 2047 (89%) were tested, and 98 (5%) tested positive. Among the 508

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<sup>1</sup>This data misclassification error may have been caused by confusion during the enumeration interviews where the parent or guardian of the minor index cases enumerated their other children. Further, data showed that all but one of these minor index cases were 11 years old or younger.

other family members referred, 396 (78%) were tested, 44 (11%) tested positive, of which 35 (80%) registered for HIV care, and 30 (86%) initiated ART.

### **Association Between the Characteristics of the Index Case and the Family Member Testing Positive**

Logistic regression showed risk factors related to HIV-positivity among those referred, based on characteristics of the index case (Table 3). Women had a 46.9 times greater likelihood of referring an HIV-positive partner than men (95% CI 16.3–134.8,  $p < 0.0001$ ). Index cases with primary education or less were more likely to refer a positive partner, and index cases who were of other African nationality were more likely to refer an HIV-positive child. Variables not significant at the 0.1 level are not presented.

Among the other family members referred, mothers had the highest HIV positivity rate at 41%, followed by fathers at 36%, and they comprised 20% of the total number of “others”; aunts or uncles had the highest testing percentage at 89% ( $n = 23/26$ ) (Table 4). Cousins, nieces, nephews, aunt and uncles of the index case jointly comprised 28% of the total tested and contributed two positives to the overall 44 who tested positive.

## **Discussion**

This study demonstrates that the FACT program for HIV testing in Côte d’Ivoire is a feasible and effective approach to case finding, particularly among partners of HIV index cases.

Studies of partner testing reported HIV testing uptake rates ranging from 2 to 65% [11, 12, 21]. The FACT data show that 75% of sexual partners, 89% of children, and 78% of “others” came to the facility testing (Fig. 1). The higher uptake rate obtained through the FACT program may result from the family-focused approach, where trained social workers and HIV counselors assist a family in the management of HIV and offer benefits to the family as a whole.

Strikingly, women index cases were 47 times more likely ( $p < 0.0001$ ) than men index cases to refer a positive partner, perhaps owing to the near universal coverage of Côte d’Ivoire’s Prevention of Mother to Child Transmission (PMTCT) program, which started in 2004, and where women are routinely screened for HIV in antenatal clinics. HIV positive women ought to be prioritized for partner enumeration interviews to increase HIV case identification among men, for whom the gap in knowledge of HIV positivity is highest at 76% [22].

A majority of index cases were men ( $n = 1326$ ; 81%), maybe because, as heads of household, they felt more comfortable consenting to participate in the FACT program. A majority of these men (62%) did not refer a sexual partner, and among the 302 women index cases, 32% did not refer a sexual partner. Given the high rates of new diagnoses among partners, maximizing the number of index cases who refer one or more partners is key to increasing case identification. Further research may inform this gender difference.

From 2015 to 2018, the average positivity rate of PEPFAR-supported HIV testing, among those less than 15 years age in Côte d’Ivoire, was 0.7% [2], by contrast, children of index

cases tested through the FACT program had a 5% positivity rate. Median life expectancy for children with perinatally-acquired HIV is 2 years, without ART [23], and in Côte d'Ivoire, an estimated 38,000 children living with HIV are unaware of their status [1], thereby reinforcing the need to test the children of index cases and getting those HIV-positive children on life-saving treatment. In their 2019 brief, the WHO strengthened their recommendation for HIV partner services, with emphasis on the importance of extending HIV partner services to offer HIV testing for untested children of HIV positive clients [24].

From 2015 to 2018, PEPFAR-supported facility-based testing programs reported nearly 6 million HIV tests and with a 3% positivity rate [2]. The FACT program showed HIV positivity rates of 21% and 11%, among the partners and other family member of index cases. Relative to provider-initiated facility-based testing, the FACT approach requires additional resources to conduct the enumeration interview with the index case, and follow-up on the HIV testing status of their family members. While we did not collect any cost data, these additional resources are unlikely to outweigh the incremental HIV case finding benefit of the FACT program. And, economic evaluations of HIV index testing strategies in resource constrained setting indicates that these approaches are cost-effective [17, 18].

Among the “others” family members, a focus on testing the parents of index cases is warranted given their high positivity rate, 41% for mothers and 36% for fathers, particularly mothers of index cases under the age of 15 of whom 11 out of 12 tested positive. Focusing the FACT approach on immediate family members, rather than extended ones (e.g. aunts, uncles, and cousins) may free up resources to scale-up the approach.

A majority (76%) of index cases referred at least one child, however, most (57%) index cases over the age of 15 did not enumerate any sexual partners (Table 2). Given that the highest yield of testing was observed among partners of index cases, increasing the number of sexual partners named is key to increasing new HIV case identification. Improving the interview skills of counselors, offering support for HIV disclosure and offering masked couples testing and/or enabling a provider to contact the partner to refer them for testing may help reduce barriers faced by the index case in terms of naming and referring their sexual partners for HIV testing.

Subsequent to our study period, the FACT program expanded its services to offer several referral approaches to index contact testing including assisted approaches where the provider is engaged in referring the contacts for testing, and, an analysis of those program outcomes categorized by referral approach is available [25].

Our analysis has several limitations. First, data were abstracted from index patient charts and variables relating to family members were limited. More information about family members may increase our ability to establish association between characteristic of the family member and testing result. Also, characteristics of HIV counselors (e.g., gender, age, experience with HIV/AIDS) were not captured and may influence index patients' decision to refer their family members. The amount of time between the enumeration interview and testing of the family member was not known. Such data would allow to improve follow-up and contact tracing. Third, marital status was missing in nearly 10% of all index cases



overall, and was therefore excluded from the multivariable model. Lastly, 158 (9%) of index cases were removed due to illogical progression of events from referral to testing, to ART initiation. The majority of these errors are likely unbiased data abstraction errors and therefore their removal is unlikely to alter the significance of our findings.

## Conclusion

The FACT program is undoubtedly a valuable addition to HIV testing efforts in Côte d'Ivoire. Scale-up of HIV testing among the family contacts of index cases is warranted to maximize HIV case finding and curtail the epidemic.

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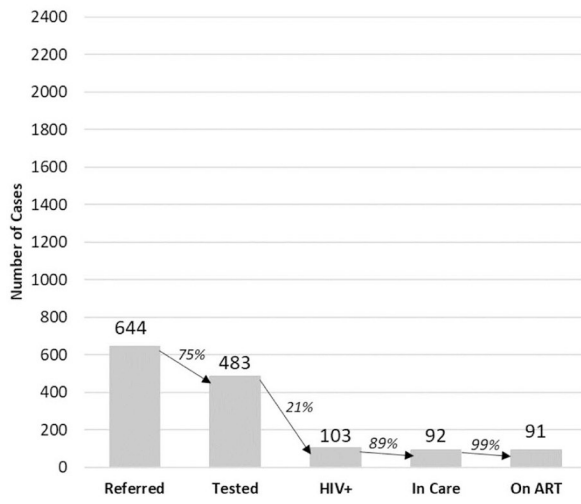
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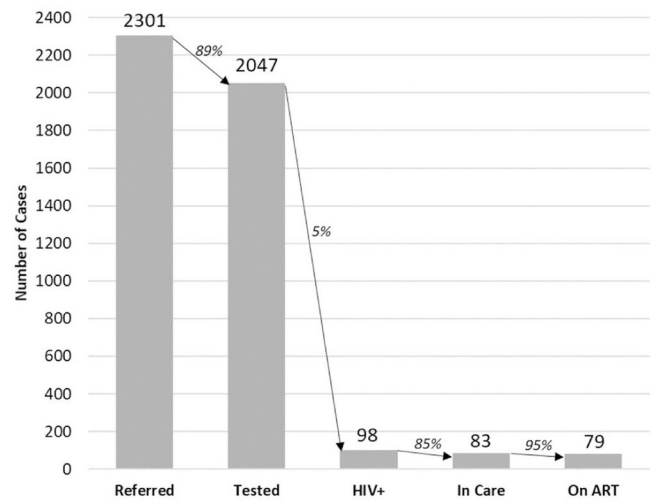
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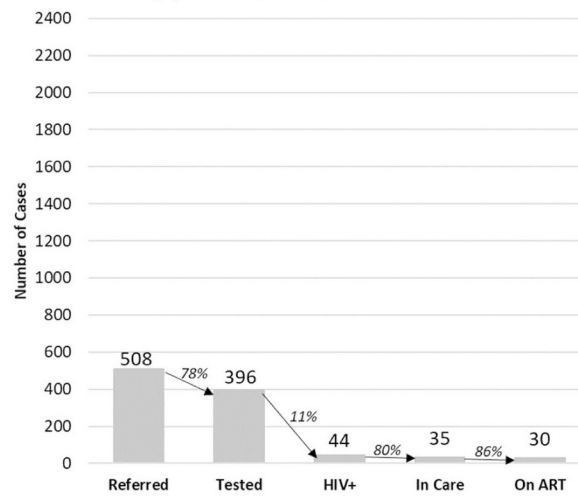
**(a) Partners**



**(b) Children**



**(c) Other family members**



**Fig. 1.** Number of partners, children and other family members referred, tested, testing positive, linked to care and on ART

Table 1

Demographic and clinical characteristics of the index cases, stratified by sex

	Overall (N = 1762) n (%), 95% CI or mean (95% CI)	Men (N = 1401) n (%), 95% CI or mean (95% CI)	Women (N = 355) n (%), 95% CI or mean (95% CI)
Age at study (years)			
< 15	95 (6%, 0–13)	48 (4%, 0–8)	47 (14%, 0–32)
15–18	27 (2%, 0–4)	19 (1%, 0–3)	8 (2%, 0–6)
19–29	212 (12%, 10–15)	205 (15%, 12–18)	7 (2%, 0–3)
30–39	717 (42%, 36–47)	657 (48%, 43–52)	60 (17%, 11–24)
40+	674 (39%, 33–46)	445 (32%, 27–37)	227 (65%, 47–83)
Mean age	37 (33–39)	36 (34–37)	40 (32–48)
Nationality			
Ivoirian	1354 (78%, 75–83)	1091 (79%, 75–82)	263 (74%, 68–81)
Sub-Saharan African	389 (22%, 19–26)	298 (21%, 18–25)	91 (26%, 19–32)
Non-African	1 (0%, 0–0)	1 (0%, 0–0)	0 (0%, 0–0)
Education			
No formal education	647 (37%, 29–45)	563 (40%, 32–49)	84 (24%, 18–29.8)
Primary	495 (28%, 24.0–32)	409 (29%, 25–33)	86 (24%, 16–32.4)
Secondary	420 (24%, 19–29)	295 (21%, 16–27)	125 (35%, 30–40.9)
Higher education	143 (8%, 4–12)	95 (7%, 3–10)	48 (14%, 6–21)
Missing or unknown	57 (3%, 2–5)	39 (3%, 1–5)	12 (3%, 1–6)
Marital status			
Single	354 (20%, 17–23)	316 (23%, 19–26)	38 (11%, 6–15)
Divorced	12 (1%, 0–1)	12 (1%, 0–1)	0 (0%, 0–0)
Married, live as a couple	1159 (66%, 59–73)	900 (64%, 59–69)	258 (73%, 54–91)
Widow	89 (5%, 3–7)	85 (6%, 4–8)	4 (1%, 0–2)
Missing or unknown	148 (8%, 0–18)	88 (6%, 1–12)	55 (16%, 0–37)
HIV status known (years)			
< 1	221 (13%, 9–16)	167 (12%, 9–16)	54 (16%, 10–21)
1–2	472 (27%, 23–32)	361 (26%, 21–31)	111 (32%, 24–40)
3–4	378 (22%, 19–25)	300 (22%, 18–25)	76 (22%, 17–27)
5–7	357 (21%, 18–24)	300 (22%, 19–25)	57 (16%, 12–20)

	Overall (N = 1762) n (%), 95% CI or mean (95% CI)	Men (N = 1401) n (%), 95% CI or mean (95% CI)	Women (N = 355) n (%), 95% CI or mean (95% CI)
8–10	223 (13%, 10–16)	186 (13%, 10–17)	34 (10%, 5–15)
> 10	86 (5%, 1–9)	70 (5%, 1–9)	16 (5%, 1–8)
Mean length of knowledge of HIV status	4 (3–5)	4 (4–5)	4 (3–4)
HIV type			
HIV-1	1666 (97%, 96–98)	1332 (97%, 96–98)	329 (95%, 92–98)
HIV-2	59 (3%, 2–4)	41 (3%, 2–4)	18 (5%, 2–8)
Unknown	2 (0%, 0–0)	2 (0%, 0–0)	0 (0%, 0–0)
ART use			
Yes	1667 (96%, 95–98)	1322 (96%, 94–98)	340 (97%, 95–99)
No	65 (4%, 2–5)	55 (4%, 2–5)	10 (3%, 1–5)
Mean length on ART (among those on ART, in months)	40 (34–45)	40 (34–45)	39 (31–48)
ART use time categories			
Never	65 (4%, 2–6)	55 (4%, 2–6)	10 (3%, 1–5)
<1 year	338 (20%, 17–23)	274 (20%, 17–24)	64 (19%, 14–23)
1 to <2 years	387 (23%, 20–26)	300 (22%, 19–25)	87 (25%, 20–30)
2 to <5 years	528 (31%, 27–35)	420 (31%, 27–35)	106 (31%, 24–37)
5+ years	388 (23%, 16–29)	308 (23%, 16–30)	77 (22%, 13–32)

Due to missing values, the numbers presented in table may not add up to the denominator presented

**Table 2**

Percentage of index cases referring family members, stratified by sex and age

	Overall (N = 1762) % (95% CI)	Men, 15 years and older (N = 1326) % (95% CI)	Women, 15 years and older (N = 302) % (95% CI)	Children < 15 years (N = 95) % (95% CI)
Number of partners referred				
0	58% (50–67)	62% (55–70)	32% (23–40)	98% (94–100)
1	39% (31–48)	36% (28–44)	64% (54–75)	2% (0–7)
> 1	2% (0–4)	2% (0–4)	4% (0–10)	0% (0–0)
Number of children referred <sup>a</sup>				
0	24% (15–33)	17% (11–23)	32% (24–40)	100% (100–100)
1–2	61% (53–68)	69% (63–74)	45% (39–51)	0% (0–0)
3–4	14% (11–16)	13% (10–16)	20% (16–24)	0% (0–0)
> 4	2% (1–3)	2% (1–3)	3% (1–6)	0% (0–0)
Number of other family referred				
0	82% (73–90)	87% (83–91)	82% (75–89)	2% (0–4)
1–2	16% (7–24)	11% (8–14)	16% (9–22)	83% (67–100)
3–4	2% (1–3)	2% (1–2)	1% (0–3)	8% (0–18)
> 4	1% (0–2)	1% (0–1)	1% (0–3)	6% (0–13)

<sup>a</sup> 11 children under 15 that had referred children of their own were recoded to “other” family to represent the reality that this was an index case’s mother or father referring to his or her other children and therefore the brother or sister of the index case

**Table 3**  
 Characteristics of index case related to referring HIV-positive versus HIV-negative family members

Type of family member	Variable	Level	Total with HIV status	Number HIV positive	% by category (CL) or mean (CL)	Adjusted odds ratio (95% CI)	p-value
Partner	Length of knowledge of HIV status (in years)	Women	714	97	4 (3–5)	<i>1.1 (1.0–1.2)</i>	<i>0.0088</i>
		Men	213	89	90 (82–98)	<i>46.9 (16.3–134.8)</i>	< 0.0001
	Sex of index case	None or primary	514	10	10 (2–18)	1	
		Secondary or more	427	58	59 (45–72)	<i>1.8 (1.1–2.9)</i>	0.0155
Other Family	Education level of index case	None or primary	281	41	41 (28–55)	1	
		Secondary or more	207	33	85 (71–99)	<i>2.7 (0.9–7.5)</i>	0.0639
Children	Length of knowledge of HIV status (in years)	Other African	1318	94	4 (4–5)	0.9 (0.9–1.0)	0.0618
		Ivoirian	302	34	33 (24–43)	<i>1.9 (1.2–3.0)</i>	<i>0.0112</i>
	Nationality of index case		1024	68	67 (57–76)	1	

All values in *italics* indicate significance at the alpha = 0.05 level

Number of “other” family members referred, tested and testing positive, by relationship to the index case

**Table 4**

	Number referred	Number tested	% tested	Number tested positive	% tested positive
Mother	52	42	81	17	41
Father	48	42	88	15	36
Other unspecified family	122	85	70	5	6
Brother or sister	146	114	78	5	4
Cousins	36	30	83	1	3
Niece or nephew	78	60	77	1	2
Aunt or uncle	26	23	89	0	0
Total	508	396	78	44	11