Published in final edited form as:

Pediatr Infect Dis J. 2018 December ; 37(12): 1279–1281. doi:10.1097/INF.0000000000002142.

Mobile, Population-Wide, Hybrid HIV Testing Strategy Increases Number of Children Tested in Rural Kenya and Uganda

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Abstract

Efficient ways to identify children with HIV in the context of universal test-and-treat policies are needed. We evaluated a hybrid testing strategy combining mobile community and home-based HIV testing in 87,700 children across 32 rural communities in 2 East African countries. This approach resulted in 81% testing coverage of at-risk children and doubled the number of children diagnosed with HIV.

Keywords

children; testing; mobile; coverage

Introduction

Despite global expansion of testing and treatment programs, children in eastern and southern Africa accounted for 9.7%(77,000/790,000) of the new HIV infections and 14%(58,000/420,000) of AIDS-related deaths in the region in 2016.(1) Early infant diagnosis (EID) programs represent the primary method of achieving early HIV diagnosis of at-risk children but large portions of children are often lost to follow up after the first test.(2) Additional methods to diagnose children with HIV are needed to enable immediate treatment and prevent mortality.

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Conflict of Interest Statement

EDC reports grants from NIH, during the conduct of the study. DVH reports grants from National Institutes of Health, non-financial support from Gilead Sciences, during the conduct of the study; grants from National Institutes of Health, grants from Gates Foundation, outside the submitted work.

The Sustainable East Africa Research in Community Health trial (SEARCH:NCT01864603) achieved HIV-testing coverage of 89% for adults (≥15years old)(3) and 86% for adolescents (10–14 years old)(4) in 32 communities of rural Uganda and Kenya during the trial's baseline year, by incorporating HIV-testing into a hybrid out-of-facility testing strategy of multi-disease mobile community health campaigns followed by home-based HIV testing of campaign non-attendees. We conducted a sub-analysis within the SEARCH study to evaluate the effectiveness of the hybrid-testing program in achieving population-level HIV-testing coverage among children, ages 2–9 years, and examined predictors of children not testing.

Methods

Between April 2013, and June 2014, the SEARCH trial enumerated and collected demographic information on residents of 32 rural communities each comprising approximately 10,000 individuals in western Kenya and eastern and southwestern Uganda (3). Following the census, staff implemented 2-week multi-disease community health campaigns (CHCs) in partnership with the local health authorities in each community. Rapid finger-prick blood-based HIV antibody test kits, and serial rapid HIV antibody testing algorithms following local guidelines were used to test all children ≥ 18 months old for HIV infection, with Determine HIV-1/2 Rapid Test followed by Unigold for confirmation. In addition to HIV testing, CHCs offered deworming, malaria screening, and Vitamin A supplementation. Following CHC completion, children who were considered "at-risk" for HIV infection, defined as having a mother with positive or unknown HIV serostatus, and did not attend the CHCs (identified using census data), were physically tracked for home-based HIV testing (HBT). A mother's serostatus could be unknown because the mother was deceased, moved away, declined testing, or was unable to be linked to the child based on relationship information obtained at enumeration.

We included stable resident (reported living in study community for ≥6 months in the year prior) children aged 2 through 9 years. We evaluated testing coverage of all enumerated children, and coverage of the at-risk subgroup. We additionally examined predictors for non-testing among at-risk children using generalized estimating equations (GEE) modeling with an exchangeable working correlation structure, including region as a fixed effect and clustering on household. We also report the yield of positive HIV tests by this hybrid approach and the proportion of infected children reporting no prior testing.

Results

Among 92,030 children 2–9 years of age enumerated via census in the 32 SEARCH communities, 87,700 (95%) were stable residents. Maternal serostatus was negative for 66% (57,655/87,700) of children, positive for 8% (7,055/87,700), and unknown in 26% (22,990/87,700); 34%(30,045/87,700) of children were thus considered at-risk. Among children with unknown maternal status (n=22,990), reasons identified were; insufficient information to link children to mothers (70%, n=16,186); mother not tested at CHC or HBT (11%, n=2,535); mother declined testing (10%, n=2,208); mother deceased (8%, n=1,897); or testing assay error (1%, n=164).

Among the 87,700 stable-resident children, 76% (66,421) were tested for HIV during the CHC and 7% (5,820) were tested by HBT, achieving total population testing coverage of 82% (72,241/87,700).

Among the at-risk subset of children, HIV testing coverage was 81% (24,414/30,045) across the three regions (Table 1). Of these, 84% (20,580/24,414) were tested at CHC and 16% (3,834/24,414) at HBT. The reasons for 5,631 at-risk children not being tested were: 31% (n=1,761) attended CHC but declined HIV testing; 25% (n=1,401) tracked but not found for HBT; 22% (n=1,271) tracked for HBT but declined participation; and, 21%(n=1,198) tracked for HBT but not tested for undocumented reasons. Among at-risk children, significant risk factors for not testing were residence in Kenya [aOR 3.69(95%CI:3.32–4.10)] compared to Southwest Uganda; ages 8–9 [aOR 1.09(95%CI:1.01–1.017)] compared to 2–3 years; having a household head with primary [aOR 1.12(95%CI:0.99–1.26)] or secondary and above education [aOR 1.76(95%CI:1.54–2.03)] compared to no education.

A total of 817 of the 72,241(1.1%) children tested through this hybrid-testing strategy were identified as HIV-infected. The yield of testing differed by region, with 2.6% (585/22,267) testing positive in Kenya compared to 0.4% (102/27,876) in East Uganda and 0.6%(130/22,098) in Southwest Uganda (Table 1). The median CD4 count among children with HIV was 1009 cells/mm^3 (IQR 676,1378). Most children with HIV, 59% (483/817), were linked to mothers who tested positive for HIV, but 33% (273/817) had unknown maternal HIV status and 7% (61/817) were reported to be children of women who had tested negative. Among children of deceased mothers, the testing yield was 5% (92/1897); 34% (92/237) of children with unknown maternal status had deceased mothers. Among children who tested positive for HIV, 45% (367/817) had parents/guardians who reported the child had no prior positive HIV test.

Discussion

The SEARCH community-based hybrid-mobile testing model achieved high population-level coverage of 82% among all children aged 2 through 9 years, including 81% of at-risk children, during the baseline year of the trial. These high rates of population testing coverage among children were feasible by integrating pediatric HIV testing into large scale CHC testing, combined with targeted home-based testing of at-risk children based on maternal HIV status for CHC non-attendees. While the overall yield was only 1.1% among 72,241 tests, significant efficiency was gained by integration into the larger campaign that also provided other health services to adults and children, including hypertension, diabetes and cervical cancer screening, male circumcision, child immunization and Vitamin A supplementation.

Current EID programs have had limited success in testing at-risk children. An evaluation of 24 Ugandan health facilities in 2012 showed that less than 26% of HIV-exposed infants completed the EID testing algorithm (2). EID programs in Kenya have shown improvement over time, with a decline in losses to follow up, from 15% in 2011 to 8% in 2013(5), however this means many children not being tested after their exposure to transmission from breastfeeding. New recommendations to test at birth and expanded availability of rapid turn-

around nucleic acid testing assays may increase the efficacy of EID programs. However, even without any loss to follow-up, EID programs suffer an inherent limitation in reaching all HIV-exposed infants. By relying on testing of women in prenatal care or labor clinics, EID programs systematically miss infants of women who fail to engage in antenatal care, deliver at home, or transmit infection during lactation following intra- or post-partum seroconversion.

Efficient ways to test children beyond infancy and breastfeeding will be required for countries attempting to achieve the UNAIDS goal of identifying 90% of HIV-infected children (6). Targeted testing of ill children is one approach; up to 29% of children being treated for malnutrition and 22% of children with TB also have HIV infection.(7) A major limitation of these approaches is that they identify children only after disease has progressed; the high median CD4 count of children diagnosed with HIV suggests that some may have been early in disease progression, though some may also have already been on therapy (data not collected). Our results also underscore the limitations of testing approaches that only target children of known seropositive women: 40% of the infected children in our study had not been identified to be children of infected women, and 7% had been reported to be children of seronegative women. This demonstrates that patient/parent reported information cannot be considered perfectly accurate; testing programs aiming to reach 100% of at-risk children are likely going to need to include multiple approaches, including targeting children through family/adult HIV treatment clinics.

It is important to examine why our hybrid-testing approach failed to reach 19% of at-risk children. The parents/guardians of half of at-risk children were contacted by the hybrid-testing program, but declined to participate. Stigma is a likely barrier to testing uptake, as parents must consider not only the potential impact on the child, but also on themselves since disclosure of a child's status communicates information about the mother's status; parents/guardians might also have declined under the false presumption that infants with HIV don't survive beyond the first years of life. The poorer coverage in Kenya might have been due to higher stigma or different health-seeking behavior between the Kenyan and Ugandan communities(8) or testing fatigue from Kenyan communities where high HIV prevalence has prompted frequent testing campaigns. Low rates of acceptance of HBT of children have been reported in western Kenya, with one study reporting testing uptake of only 57% of families approached (9). Additional community sensitization and health education, as well as addition of other health services (such as immunization) into CHCs might help alleviate stigma and improve care engagement (8). Skepticism about the utility of free health services among household heads with greater education may have been responsible for the lower testing rates as compared to those who had no education.

Our study has limitations. The proportion of HIV-diagnoses reported as "new" may have been falsely elevated due to social desirability. Secondly, a significant proportion of children were not linked to mothers, limiting our ability to analyze maternal-level predictors for testing. However, our approach should still have correctly identified infected children because all children with unknown maternal status were considered "at-risk" and targeted for testing.

Conclusion

A mobile, hybrid, community-based HIV testing strategy for at-risk children, resulted in high HIV testing coverage for at-risk children in rural east Africa communities. Similar approaches, integrating pediatric HIV screening into mobile population-level health campaigns, could serve as efficient tools for identifying children living with HIV as countries seek to implement universal testing and treatment.

Acknowledgments

Support: This research was supported by Division of AIDS, NIAID of the National Institutes of Health under award numbers U01AI099959 and 5UM1AI068636, and in part by the President's Emergency Plan for AIDS Relief, Bill and Melinda Gates Foundation, and Gilead Sciences.

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Table 1.
Testing coverage and yield of at-risk children in SEARCH communities

Region	Total Children	Community Health Campaign Testing		Targeted Home-based Testing		Total Testing Coverage	Children with HIV	Yield
	n	n	%	n	%	%	n	%
Children considered at-risk								
Southwest Uganda								
Mother HIV+	1,115	855	77%	209	19%	95%	67	6.0%
Mother HIV unk	6,157	4,487	73%	1,009	16%	89%	56	0.9%
Eastern Uganda								
Mother HIV+	816	701	86%	77	9%	95%	53	6.5%
Mother HIV unk	7,816	5,794	74%	1,014	13%	87%	33	0.4%
Kenya								
Mother HIV+	5,124	3,585	70%	799	16%	86%	363	7.1%
Mother HIV unk	9,017	5,158	57%	726	8%	65%	184	2.0%
Total	**30,045**	20,580	68%	3,834	13%	81%	756	2.5%
Children with reportedly seronegative mothers								
Southwest Uganda	18,023	14,543	81%	995	6%	86%	7	0.04%
Eastern Uganda	22,613	19,471	86%	819	4%	90%	16	0.07%
Kenya	17,019	11,827	69%	172	1%	71%	38	0.22%
Total	**57,655**	**45,841**	80%	**1986**	**3%**	**83%**	61	0.11%