HTC Campaign in Households Reached the Majority of Women but Only 50% of Men in Botswana Community

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ABSTRACT

The identification of populations at high risk of HIV infection, or unaware of their HIV status, is a critical component of clinical trials and public health interventions.
A baseline and two follow-up enhanced HTC campaigns targeted 16–64-year-old (y.o.) residents in the northeastern sector of Mochudi, a southern African community with 3,650 households. Following community mobilization and engagement, individuals were approached during HH visits and were offered consenting, HIV testing, counseling, data collection and blood sampling.

A total of 6,238 age-eligible residents in the northeastern sector of Mochudi were tested for HIV-1 status in HH, and 1,240 of them were found to be HIV positive. Comparison with the UN estimates revealed that 88.4% of females and 49.5% of males aged 16–64 were reached by the HH-based HTC in Mochudi. The proportion of missing men peaked at 59%-63% in the age group 25–44 y.o.

A total of 5,605 ART-naive residents with available gender and age data reported the history of their previous HIV testing, if any. Of those, 3,869 individuals reported the results of their previous HIV test (69.0%; 95% CI 67.8% to 70.2%), including 509 (13.2%; 95% CI 12.1% to 14.3%) who tested HIV-positive, and 1,379 (35.6%; 95% CI 34.1% to 37.2%) men. A total of 1,736 (31.0%; 95% CI 29.8% to 32.2%) individuals reported that they had never been tested previously, including 189 (10.9%; 95% CI 9.5% to 12.5%) who tested HIV-positive, and 753 (43.4%; 95% CI 41.0% to 45.8%) men.

The household-based HTC campaign in Mochudi, Botswana, missed about half of men, and about 12% of women. To bring missing individuals to care and reduce HIV incidence, the identified age-specific groups should be targeted by alternative non-standard strategies of HIV testing and counseling in communities.

METHODS

Study Subjects. The Mochudi study is the NIH-funded project An HIV Prevention Program for Mochudi, Botswana (R01 AI083036; PI: M. Essex). Major characteristics of the study cohort were presented previously.[1] Estimates of HIV-1 incidence and prevalence among 16–64-year-old residents over time were the major goals of an enhanced HTC campaign in the northeastern sector (NES) of Mochudi. All data presented in the study refer to the NES of Mochudi.

The study focused on HIV-1 testing and counseling of community residents in households. Community mobilization and engagement, and procedures of consenting, HIV testing, counseling, collection of data and sampling were the same at baseline and at two follow-up enhanced HTC campaigns during May 2010–August 2013. During the household visit, eligible residents were asked to complete an individual questionnaire with socio-demographic and HIV-related information including ART status and patterns of sexual behavior, and to donate a blood sample for rapid HIV test and viral genotyping (if HIV positive).

The capillary blood samples were collected as dry blood spots (DBS) in households. HIV testing was performed in households using National HIV Testing guidelines and two rapid tests in parallel, Determine HIV-1/2 Rapid Test (Abbott Diagnostic Division, Belgium/Luxemburg) and Uni-gold™ HIV rapid test (Trinity Biotech, Wicklow, Ireland), as approved by the Botswana government. Only concordant results in two tests were considered valid. If results were discordant, subject was invited to a clinic and blood specimen was collected by phlebotomy and transported to a reference laboratory. The confirmatory HIV testing was performed using EIA (Murex HIV 1.2.0 test – Murex Biotech Ltd, Dartford, Kent, England; or Vironostika Uniform II plus O EIA – BioMerieux Inc, Durham, NC) and/or Western blot (Genetic Systems HIV-1 Western Blot – Bio-Rad Laboratories, Redmond, WA). The results of EIA and/or Western Blot superseded the discordant or indeterminate results obtained in the field.

ART-naïve HIV-infected individuals were invited to a clinic to determine their eligibility for initiation of ARV treatment; a clinic visit included collection of venous blood by phlebotomy for CD4 and HIV-1 RNA testing. The HIV-1 RNA load was quantified in DBS or in plasma (if venous blood was collected in the clinic) by Roche Amplirep/Amplicor v.1.5 or Abbott m2000sp/Abbott m2000rt. Individuals reported to be on ART received treatment through the National ART program and initiated ART based on Botswana national guidelines (treatment of all adults with CD4≤350 cells/μL or WHO Stage III/IV). Individuals on ART were not invited to a clinic in this study. Seroconverters were identified based on paired HIV-negative and HIV-positive tests during the follow-up enhanced HTC campaigns.

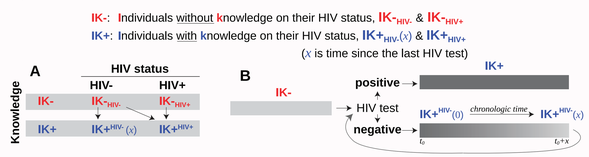
RESULTS

IK-

We use persons' knowledge of their own HIV status to define individuals with unknown HIV status as **IK-**, or "**I**ndividuals without **K**nowledge of their HIV status" = "never tested." Similarly, we term individuals who know their HIV status as **IK+**, or "Individuals with Knowledge of their HIV status" = "previously tested." Of note, knowledge of HIV status should not be confused with HIV infection status. Both **IK-** and **IK+** could be either HIV-negative or HIV-positive (Fig. 1A), and the transition from HIV-negative to HIV-positive status is irreversible.

Residents of a community not previously tested for HIV status are considered to be **IK-**. As community residents, **IK-** are likely to be integrated in relationships with other community residents, which is critical in the context of HIV transmission. **IK-** status is temporal, lasting only until the individual has been tested. All HIV-infected individuals had **IK-** status at some point before they were tested for HIV, or maintain their **IK-** status if they still have not been tested. HIV testing during HTC immediately changes an individual's knowledge status from **IK-** to **IK+** (Fig. 1B; t_0 is the time of HIV test). If the HIV test is positive, the person transitions to an irreversible HIV-positive status, $IK+^{HIV+}$. However, if an HIV test is negative, the person's **IK+** status is temporal, $IK+^{HIV-}(0)$, and as time goes by, the person's status changes to $IK+^{HIV-}(x)$, where x indicates time since the last HIV test. The next HIV test of the $IK+^{HIV-}(x)$ individual changes his/her status to either $IK+^{HIV+}$ or $IK+^{HIV-}(0)$ (Fig. 1B).

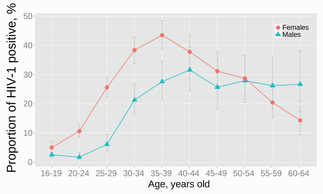
Figure 1. HIV status and knowledge about HIV status



Residents aged 16 to 64 years old were tested for HIV status in households during the enhanced HTC campaigns in the NES of Mochudi. Based on the Botswana Census 2011 data,[2] the estimated total population in the NES of Mochudi was 15,000. Of those, an estimated 8,700 residents were aged 16 to 64 years old. By the end of the study (August 2013), the results of HIV testing and accompanying age and gender information was available for 6,238 (71.7%; 95% CI 70.7% to 72.6%) age-eligible residents. The estimated proportion of HIV-positive individuals was 19.9% (95% CI 18.9% to 20.9%) with a substantial gender gap, 13.4% (95% CI 12.0% to 14.8%) among men and 23.7% (95% CI 22.4% to 25.1%) among women.

	Number	
Total population in NES Mochudi (est.)	15,000	
Ages 16 to 64 years old (est.)	8,700	
Approached, reached, consented, and tested	6,238	HIV-positive (n=1,240)
Reported history of their previous HIV testing, if any	6,134	HIV-positive (n=1,227) On ART (n=529)
ART-naive residents	5,605	HIV-positive (n=698)
Tested **IK-** individuals	1,736	HIV-positive (n=189)
IK+ individuals	3,869	HIV-positive (n=509)

Figure 2. Proportion of HIV-positive individuals in Mochudi by age and gender

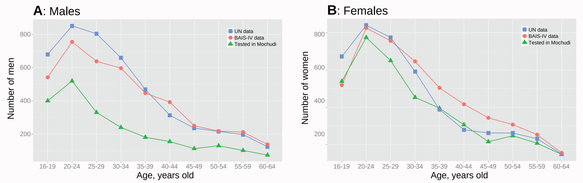


HIV-1 infection was spread unevenly across age groups and showed earlier rise in women (Figure 2). The proportion of HIV-positive men remained under 10% within young males until their late twenties, then gradually rose to 21%, 28%, and 32% in the age groups 30–34, 35–39, and 40–44 years old, respectively, and plateaued at the level of mid-20% in older males until 64 years old. Males peaked at 31.6% (95% CI 24.5% to 39.6%) at ages 40–44 years old. A sharp increase in the estimated HIV-1 prevalence occurred among young females about a decade earlier than in males. A gradual increase in the proportion of HIV-positive females was observed up to their late thirties, and was followed by gradual decrease to 14.3% in the age group 60–64 years old. Females peaked at 43.5% (95% CI 38.6% to 48.6%) at ages 35–39 years old.

RESULTS

To learn about the missing population not reached by the household-based HTC campaign, we estimated the gender and age structure for *not-tested* **IK-** individuals in the NES of Mochudi. We used two reference sources to estimate the demographic structure of the NES community, the United Nations DoEaSA, Population Division data (UN data)[3] and the Botswana AIDS Impact Survey IV (BAIS-IV data).[4] Both reference sources had similar estimates on the age/gender structure of the Botswana population. However, while the UN-based data showed approximately even numbers of men and women within each age group, the BAIS-IV-based estimates were skewed toward higher numbers of women within most age groups. A breakdown of the total estimated population of 15,000 in the NES of Mochudi by gender and age groups was performed based on the distributions in the UN and BAIS-IV data. The estimated UN-based (blue curves) and BAIS-IV-based (red curves) projections for males (Fig. 3A) and females (Fig. 3B) were compared with the number of individuals reached by the enhanced HTC campaigns in the NES of Mochudi (green curves).
The proportion of missed men among estimated total men was estimated at 50.5% (95% CI 49.0% to 52.0%) based on comparison with the UN data, and 46.3% (95% CI 44.8% to 47.8%) based on comparison with the BAIS-IV data. However the proportion of missed women among estimated total women was substantially smaller, 11.6% (95% CI 10.6% to 12.5%) as compared with the UN data, and 16.7% (95% CI 15.7% to 17.8%) as compared with the BAIS-IV data.

Figure 3. HTC in NES Mochudi: tested vs. estimated by UN and BAIS-IV.



The proportions of missed/not-tested **IK-** among all individuals were estimated within each age group (Fig. 4) by comparison with the UN (Figs. 4A and 4C) and BAIS-IV (Figs. 4B and 4D) data. Based on the UN data, the proportion of missed men among total estimated men was about 40% in young males, peaked at 59–63% in the age groups 25–29, 30–34, and 35–39, and fluctuated between 40% and 52% in older males (Fig. 4A). The BAIS-IV comparison produced similar proportions of missed men, peaking at 59–60% in the age groups 30–34, 35–39, and 40–44 (Fig. 4B). The estimated proportion of missed women among the total number of women was substantially smaller, remaining at low levels in both UN-based (Fig. 4C) and BAIS-IV-based (Fig. 4D) comparisons. Thus, while about 50% of men from 16 to 64 years old were not reached in households, an even higher proportion (about 60%) of men within the age groups 25 to 44 years old were not reached by the household-based HTC. In contrast, the household-based HTC campaigns seem to be an efficient tool for reaching and testing women in Botswana.

Figure 4. Estimated proportions of not-tested **IK-** individuals in NES Mochudi



During household-based HTC in the NES of Mochudi, participants were asked about their history of HIV testing. A total of 5,605 ART-naive residents with available gender and age data reported the history of their previous HIV testing, if any. Of those, 3,869 individuals reported the results of their previous HIV test (69.0%; 95% CI 67.8% to 70.2%), including 509 (13.2%; 95% CI 12.1% to 14.3%) who tested HIV-positive, and 1,379 (35.6%; 95% CI 34.1% to 37.2%) men. A total of 1,736 (31.0%; 95% CI 29.8% to 32.2%) individuals reported that they had never been tested previously, including 189 (10.9%; 95% CI 9.5% to 12.5%) who tested HIV-positive, and 753 (43.4%; 95% CI 41.0% to 45.8%) men.

HIV-1 infection was spread unevenly across age groups in both **IK-** and **IK+** (Figure 5). The proportion of HIV-positive men seemed to be higher in **IK-** than in **IK+** among middle-aged men and women from 30 to 49 years old, but the difference within the age groups did not reach statistical significance.

RESULTS

Figure 5. Proportions HIV-positive among ART-naive **IK-** and **IK+** individuals

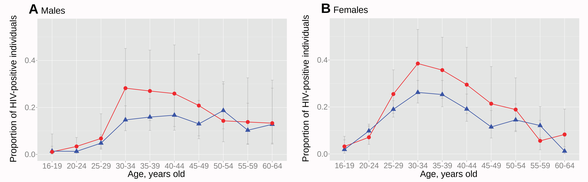
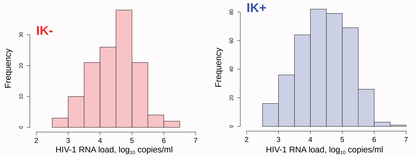


Figure 6. Distribution of HIV-1 RNA among ART-naive **IK-** (never tested) and **IK+** (previously tested) individuals



[10]Data on detectable (>400 copies/ml) HIV-1 RNA load were available for 125 IK- and 376 IK+ ART-naïve individuals. No difference was found between levels of detectable HIV-1 RNA load (median (IQR) 4.54 (3.96 to 4.93) $\log_{10}$ copies/ml for **IK-** and 4.46 (3.87 to 5.05) $\log_{10}$ copies/ml for **IK+**). Distribution of HIV-1 RNA load was also similar between groups of ART-naïve **IK-** and **IK+** individuals (Fig. 6).

CONCLUSIONS

- The proportion of HIV-positive individuals in the NES of Mochudi, Botswana, was high (19.9%). A gender gap was evident in the lower proportion of HIV-positive men, 13.4%, and higher proportion of HIV-positive women, 23.7%. Males peaked at 31.6% at ages 40–44, while females peaked at 43.5% at ages 35–39 years old.
- The household-based HTC campaign in the NES of Mochudi missed about half of men (between 46.3% and 50.5%), but a relatively small fraction of women (between 11.6% and 16.7%). Missed men peaked at 59–63% in the age groups 25 to 44, while the proportion of missed women was low throughout the age groups. The identified age-specific group of missing men necessitates alternative non-standard strategies of HIV testing and counseling in communities. Household-based HTC campaigns seem to be an efficient tool for reaching women in Botswana.
- The proportions of HIV-positive individuals within age groups seemed to be higher among middle-aged **IK-** (never tested) than among **IK+** (tested previously), but the difference within age groups did not reach statistical significance.
- The distribution of HIV-1 RNA did not differ between **IK-** and **IK+** individuals.

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