

1 **Findings from home-based HIV testing and facilitated linkage after scale up of test**
2 **and treat in rural South Africa: young people still missing**

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30 **Abstract**

31 **Objectives:** to estimate linkage to HIV care and ART initiation after the introduction of
32 home-based HIV counselling and testing (HBHCT) and telephone-facilitated support for
33 linkage in rural South Africa.

34 **Methods:** Population-based prospective cohort study in KwaZulu Natal. All residents aged
35 ≥ 15 years (y) were eligible for HBHCT. Those who tested positive and were not in care were
36 referred for ART at one of 11 public-sector clinics. Individuals who did not attend the clinic
37 within 2 weeks were sent an SMS reminder; those who had not attended after a further 2
38 weeks were telephoned by a nurse counsellor, to discuss concerns and encourage linkage.
39 Kaplan-Meier methods were used to estimate the proportion of newly-diagnosed individuals
40 linking to care and initiating ART.

41 **Results:** Among 38,827 individuals visited, 26% accepted HBHCT. Uptake was higher in
42 women than men (30% vs 20%), but similar in people aged < 30 y and ≥ 30 y (28% vs 26%).
43 784 (8%) tested HIV positive, of whom 427 (54%) were newly diagnosed. Within 6 months,
44 31% of women and 18% of men < 30 y had linked to care, and 29% and 16%, respectively,
45 had started ART. Among those ≥ 30 y, 41% of women and 38% of men had linked to care
46 within 6 months, and 41% and 35% had started ART.

47 **Conclusions:** Despite facilitated linkage, timely linkage to care and ART initiation after
48 HBHCT was very low, particularly among young men. Innovations are needed to provide
49 effective HIV care and prevention interventions to young people, and thus maximise the
50 benefits of universal test-and-treat.

51 **Introduction**

52 Universal test-and-treat (UTT) has the potential to improve the health of HIV-positive
53 individuals and reduce HIV transmission. The effectiveness of UTT relies on high uptake of
54 HIV testing and timely initiation of antiretroviral treatment (ART) among those testing
55 positive. South Africa has the largest HIV treatment programme globally and rolled out UTT
56 in September 2016. However, a 2017 national survey estimated that only 40% of HIV-
57 positive young people aged 15-25 years were on ART, and viral suppression was lowest
58 among young men, suggesting that reaching young people with UTT should be prioritised[1].

59 Home-based HIV counselling and testing (HBHCT) facilitates early HIV diagnosis and could
60 promote prompt linkage to care[2]. However, the ANRS-12249 Treatment-as-Prevention
61 (TasP) trial in KwaZulu-Natal, South Africa showed that only 30% of those newly diagnosed
62 through HBHCT linked to care within 6 months, and linkage was lower in young people[3].
63 Lower rates of linkage to HIV care have been reported among young people elsewhere in
64 sub-Saharan Africa (SSA)[4,5]. These findings suggest that rolling out UTT without
65 interventions to link young people to treatment will not realise the full individual and
66 population-level benefits of UTT.

67 In 2017, we introduced a programme combining HBHCT and enhanced telephone-facilitated
68 support for linkage to care within a demographic surveillance area (DSA) in rural KwaZulu-
69 Natal. We report on uptake of testing and linkage to care in the first year of the programme.

70 **Methods**

71 **Setting**

72 This study was conducted in the Africa Health Research Institute (AHRI) DSA in rural
73 uMkhanyakude District, KwaZulu-Natal[6]. Triannual household-based surveys are used to

74 collect demographic data from approximately 150,000 people in an 845 km² area.
75 Additionally, all residents aged ≥ 15 years are invited to participate in an annual individual-
76 level survey, which includes collection of dried blood spots (DBS) for anonymised HIV
77 testing. HIV prevalence in the 2017 survey was 30% (unpublished data) and HIV incidence,
78 although declining, remains extraordinarily high[7,8].

79 **HIV counselling and testing**

80 To maximise the benefits of UTT, AHRI rolled out HBHCT in January 2017, offering rapid
81 point of care tests for all residents aged ≥ 15 years during the annual survey. Individuals
82 opting out of the survey are still eligible for HBHCT. Individuals are asked if they have ever
83 tested for HIV previously; those who report a previous positive test are asked if they are on
84 ART and, if so, discouraged from testing again.

85 A finger-prick blood sample is tested using two parallel HIV rapid tests: Abon™ HIV 1/2/O
86 Tri-Line (Abon Biopharm, China) and Advanced Quality™ Rapid Anti-HIV(1&2) (InTec,
87 China). Participants who test positive and are not on ART are referred for care at one of the
88 11 Department of Health (DoH) primary health care clinics in the DSA; they are given an
89 appointment and asked for consent for facilitated linkage. Consenting individuals who do not
90 attend the clinic within 2 weeks are sent an SMS reminder with a message of their choice.
91 Individuals who have not attended within a further 2 weeks are contacted by telephone by an
92 AHRI nurse, to discuss concerns and encourage them to attend the clinic.

93 **Clinic attendance**

94 Attendance at the 11 DoH clinics in the DSA is captured by an AHRI research assistant
95 stationed at each clinic, using the AHRI ClinicLink system. All individuals visiting a clinic
96 are asked for consent to record the date and reason for their visit, and are linked to their

97 surveillance identification number at the time of the visit. If an individual who tested HIV-
98 positive through HBHCT attends the clinic for any reason and has not yet linked to care, the
99 ClinicLink system notifies the AHRI nurse stationed at the clinic.

100 AHRI has a memorandum of agreement with the DoH to receive data transfers from an HIV
101 care electronic patient records system (TIER.net) used in government clinics. The TIER.net
102 database includes ART dispensing records for all individuals on ART. AHRI receives
103 TIER.net data from 17 clinics in the district, including those in the DSA. Individuals in
104 TIER.net who are members of the DSA are retrospectively linked with their surveillance
105 identification number, using deterministic record linkage algorithms.

106 **Statistical methods**

107 Data were collected electronically using REDCap tools[9], and analysed using Stata14
108 (College Station, USA). Uptake of HBHCT was assessed among individuals who were
109 eligible to participate (aged ≥ 15 years and resident in the DSA in 2017) and did not report
110 being on ART. Linkage to care was examined among individuals who were newly diagnosed
111 through HBHCT between January–December 2017, and used ClinicLink data from
112 1st January 2017 through 30th May 2018. Individuals were considered newly diagnosed if: 1)
113 at the time of the HBHCT visit, they did not report having previously tested HIV-positive; 2)
114 they had no record in ClinicLink of having attended a clinic for ART before the HBHCT
115 visit; 3) they had no record of ART in the TIER.net database before the HBHCT visit. The
116 proportion linking to HIV care was estimated using Kaplan Meier methods, and compared
117 between groups using log rank tests. Person-time was calculated from the date of HBHCT
118 (taken as the date of HIV diagnosis) until the earliest of date of attending a clinic for HIV
119 referral, out-migration from the DSA, or death. Individuals who had not attended a clinic,
120 and were not known to have died or out-migrated, were administratively censored on 30th

121 May 2018. Individuals were considered to have linked to care if they attended the clinic and
122 reported HIV referral as the reason. ART initiation was ascertained using data from both
123 ClinicLink and TIER.net. As a sensitivity analysis, linkage was defined as attending the clinic
124 for any reason, to account for the possibility that some individuals may not have reported
125 their true reason for attendance.

126 **Ethics**

127 Ethical approval for the demographic surveillance, ClinicLink, and linkage to government
128 ART records (TIER.net) was granted by the Biomedical Research Ethics Committee of the
129 University of KwaZulu-Natal, South Africa. Individuals provided separate written informed
130 consent for HBHCT, facilitated linkage, and recording visits in ClinicLink.

131 **Results**

132 Overall, 41,815 of 51,380 (81%) eligible individuals were contacted for the 2017 survey
133 (Supplementary Figure S1). Among those contacted, 2988 (7%) reported being on ART and
134 so were excluded from analysis of HBHCT uptake. 4265 (28%) individuals <30 years and
135 5992 (26%) ≥ 30 years consented to HBHCT (Table 1). Women were more likely to accept
136 HBHCT than men (30% vs 20%, $p < 0.001$). In both men and women, HBHCT uptake was
137 lowest among those aged 25-44 years, and highest among those ≥ 50 years. HBHCT uptake
138 was also lower among people who were married, who had higher levels of education, who
139 lived in urban areas and who were employed. Over 95% of those accepting HBHCT
140 consented to facilitated linkage, with no evidence of a difference by age or sex.

141 Among those accepting HBHCT, 784 (8%) tested HIV-positive, of whom 357 (46%) had
142 been previously diagnosed (88 self-report, 269 with ART records). Overall, 427 (4%) were
143 newly diagnosed (209 aged <30 years and 218 aged ≥ 30 years), and included in the analysis

144 of linkage to care. Among women <30 years, an estimated 11%, 21% and 31% had linked to
145 care within 1, 3 and 6 months, respectively (Figure 1). Linkage was slower in men of the
146 same age, with 8%, 16% and 18% linking to care in the same time frame. Within 6 months,
147 29% of women and 16% of men <30 years had started ART. Linkage among individuals ≥ 30
148 years was higher, with 18%, 34% and 41% of women and 14%, 31%, and 38% of men
149 linking to care within 1, 3 and 6 months, respectively. By 6 months, 41% of women and
150 35% of men ≥ 30 years had started ART. There was some evidence of a difference in linkage
151 at 6 months between the four age/sex groups ($p=0.08$). Overall, 34% and 48% of individuals
152 had linked to care within 6 and 12 months, respectively.

153 In the sensitivity analysis, 44% of all individuals (44% of women and 20% of men <30 years,
154 and 50% of women and 46% of men ≥ 30 years) had attended a clinic for any reason within 6
155 months, and 59% had attended within 12 months (Supplementary Figure S2).

156 SMS reminders were successfully transmitted in over 90% of cases, and 82% of individuals
157 received a phone call. Only 4% of calls turned out to be to an incorrect number; 65% of calls
158 were answered, and the others went over to voicemail (26%) or were not answered (5%).

159 **Discussion**

160 We found that, even with a programme to facilitate linkage, including SMS reminders and
161 nurse-led telephone calls for those not linked within a month, less than a third of newly
162 diagnosed young adults <30 years in this hyper-endemic HIV setting had linked to care
163 within 6 months. Linkage was particularly low in young men, with only 16% starting ART
164 within 6 months. Our results suggest that HBHCT, early SMS reminders and telephone
165 support for linkage are not sufficient to eliminate barriers to timely ART initiation among
166 young adults, particularly young men, in this population.

167 Our estimates of linkage to care are lower than those reported by several trials evaluating
168 UTT interventions in SSA, although they also report lower linkage among younger
169 adults[5,10]. In Year 2 of the HPTN-071 PopART trial in South Africa, 50% of women and
170 42% of men initiated ART within 6 months[10]. However, the TasP trial, conducted in the
171 same area as our study, found similar low rates of linkage within 6 months, with lowest
172 linkage in young people, particularly young men, and in those who had never been on
173 ART[3]. Our estimates of linkage are also comparable to South Africa national estimates[11].

174 Barriers to linkage are multifactorial and include individual and health-systems factors such
175 as stigma, fear of disclosure, distance, and cost of travel to clinic[12,13]. We observed poor
176 linkage despite interventions to link those who did not attend a clinic within 2 weeks and
177 having dedicated AHRI nurses in each clinic to overcome some of the facility-level barriers.
178 This raises concern as to whether primary care clinics in their current format are able to
179 attract young people, particularly men, to early HIV treatment, and whether alternative modes
180 of care are required.

181 We also found low HBHCT uptake, and the proportion of individuals testing HIV-positive
182 through HBHCT was low compared with prevalence estimates from anonymous HIV
183 serosurveys in the same population. Also of note was the large proportion testing positive
184 who already knew their status, and were already in care. This suggests that many HIV-
185 positive people who are potentially unaware of their status might not accept HBHCT. Other
186 interventions, such as HIV self-testing, multi-disease screening, work-based or mobile-clinic
187 based testing may be needed to overcome barriers to testing.

188 Limitations include that our primary definition of linkage was based on clinic attendance for
189 a self-reported reason of HIV referral or ART, or a record in TIER.net. This may have
190 underestimated linkage if people are unwilling to report their true reason for attendance. A

191 sensitivity analysis assuming that all who attended the clinic for any reason had linked to care
192 yielded somewhat higher estimates, although linkage was still very low among young men.
193 We did not collect data from clinics outside the DSA, however TIER.net contains ART
194 records for all 17 government clinics in or near the area.

195 In summary, despite facilitated linkage, timely ART initiation after HBHCT was very low
196 among young men. Home-based HIV testing and telephone-supported linkage to care may be
197 insufficient to obtain the desired impact of UTT on improving health outcomes among HIV-
198 positive people or reducing HIV transmission. Innovations are needed to provide effective
199 HIV care and prevention interventions to young people, particularly young men, and thus
200 maximise the individual and population benefits of a UTT approach.

201

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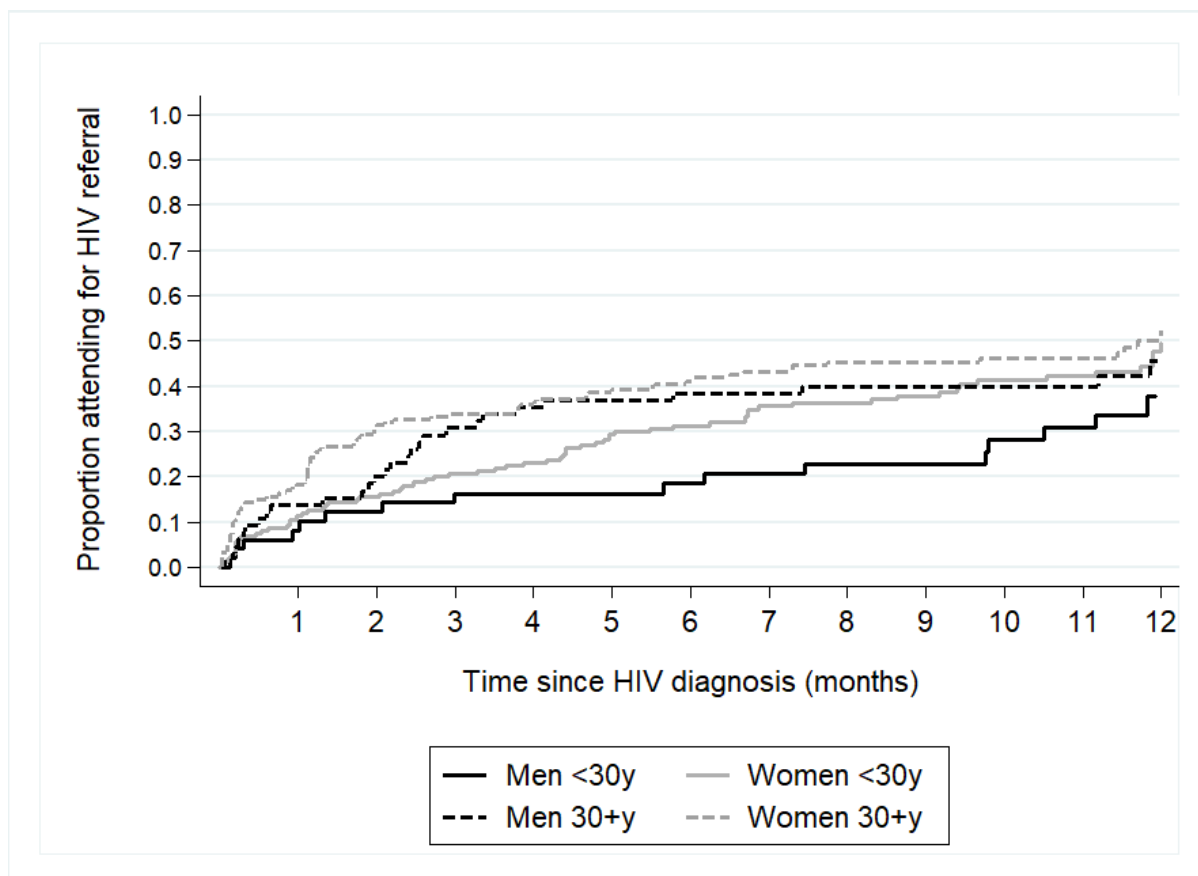
Table 1. Uptake of home-based HIV counselling and testing (HBHCT) among individuals who were contacted

	Contacted and eligible (col %) ¹	Accepted HBHCT (row %)
	38,827	10,257
Age group (years)		P<0.001
<30	15,509 (39.9%)	4265 (27.5%)
30-39	6591 (17.0%)	1164 (17.7%)
40-49	4849 (12.5%)	896 (18.5%)
≥50	11,878 (30.6%)	3932 (33.1%)
Sex		P<0.001
Male	15,042 (38.7%)	3009 (20.0%)
Female	23,785 (61.3%)	7248 (30.5%)
Education		P<0.001
None	7413 (26.6%)	2325 (31.4%)
Primary/incomplete secondary	8327 (29.9%)	2511 (30.2%)
Complete secondary/above	12,126 (43.5%)	2111 (17.4%)
<i>Missing</i>	<i>10,961</i>	<i>3310</i>
Marital status		P<0.001
Single	8234 (23.4%)	2171 (26.4%)
Married/informal union	22,997 (65.3%)	5734 (24.9%)
Sep/divorced/widowed	4013 (11.4%)	1380 (34.4%)
<i>Missing</i>	<i>3583</i>	<i>972</i>
Employed?		P<0.001
No	17,203 (71.5%)	4924 (28.6%)
Yes	6846 (28.5%)	867 (12.7%)
<i>Missing</i>	<i>11,625</i>	<i>4466</i>
Residence location		P<0.001
Urban	2002 (7.6 %)	339 (16.9%)
Peri-urban	8968 (33.9%)	2242 (25.0%)
Rural	15469 (58.5%)	3886 (25.1%)
<i>Missing</i>	<i>12,388</i>	<i>3790</i>
SES tertile		P=0.36

Low	9213 (33.7%)	2327 (25.3%)
Middle	9398 (34.3%)	2358 (25.1%)
High	8756 (32.0%)	2135 (24.4%)
<i>Missing</i>	<i>11,460</i>	<i>3437</i>
Distance to nearest clinic (quartiles)		P<0.001
0- <1.5 km	9344 (25.0%)	2201 (23.6%)
1.5-2.5 km	9388 (25.1%)	2352 (25.1%)
>2.5-3.9 km	9321 (24.9%)	2460 (26.4%)
>3.9 km	9318 (24.9%)	2792 (30.0%)
<i>Missing</i>	<i>1456</i>	<i>452</i>

¹Excludes 2988 individuals who reported being on ART and were therefore discouraged from testing again. ²P-value from Chi-squared test (excluding individuals with missing values).

Figure 1. Time from HIV diagnosis until attending the clinic for referral to HIV care among 427 individuals who had not been previously diagnosed as HIV-positive



Supplementary Figure S2. Time from HIV diagnosis until attending the clinic for any reason, among 427 individuals who had not been previously diagnosed as HIV-positive

